

## **Scholarly Research Review**

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External reviewers' editorial analysis consists of the evaluation reports of the conference session chairs and participants in addition to online internal and external reviewers' reports. Based on completion of the scholarly research review process, those manuscripts meeting the publication standards are published 10 days after the event date.

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# The Accuracy of an In-House Developed Computer-Assisted Surgery Protocol for Mandibular Micro-Vascular Reconstruction

Christophe Spaas, Lies Pottel, Joke De Ceulaer, Johan Abeloos, Philippe Lamoral, Tom De Backer, Calix De Clercq

**Abstract**—We aimed to evaluate the accuracy of an in-house developed low-cost computer-assisted surgery (CAS) protocol for osseous free flap mandibular reconstruction. All patients who underwent primary or secondary mandibular reconstruction with a free (solely or composite) osseous flap, either a fibula free flap or iliac crest free flap, between January 2014 and December 2017 were evaluated. The low-cost protocol consisted out of a virtual surgical planning, a prebend custom reconstruction plate and an individualized free flap positioning guide. The accuracy of the protocol was evaluated through comparison of the postoperative outcome with the 3D virtual planning, based on measurement of the following parameters: intercondylar distance, mandibular angle (axial and sagittal), inner angular distance, anterior-posterior distance, length of the fibular/iliac crest segments and osteotomy angles. A statistical analysis of the obtained values was done. Virtual 3D surgical planning and cutting guide design were performed with Proplan CMF® software (Materialise, Leuven, Belgium) and IPS Gate® (KLS Martin, Tuttlingen, Germany). Segmentation of the DICOM data as well as outcome analysis were done with BrainLab iPlan® Software (Brainlab AG, Feldkirchen, Germany). A cost analysis of the protocol was done. Twenty-two patients (11 fibula /11 iliac crest) were included and analyzed. Based on voxel-based registration on the cranial base, 3D virtual planning landmark parameters did not significantly differ from those measured on the actual treatment outcome (p-values >0.05). A cost evaluation of the in-house developed CAS protocol revealed a 1750 euro cost reduction in comparison with a standard CAS protocol with a patient-specific reconstruction plate. Our results indicate that an accurate transfer of the planning with our in-house developed low-cost CAS protocol is feasible at a significant lower cost.

**Keywords**—CAD/CAM, computer-assisted surgery, low-cost, mandibular reconstruction

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# Simulation of Colombian Exchange Rate to Cover the Exchange Risk Using Financial Options Like Hedge Strategy

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**Abstract**—Imperfections in the capital market are used to argue the relevance of the corporate risk management function. With corporate hedge, the value of the company is increased by reducing the volatility of the expected cash flow and making it possible to face a lower bankruptcy costs and financial difficulties, without sacrificing tax advantages for debt financing. With the propose to avoid exchange rate troubles over cash flows of Colombian exporting firms, this dissertation uses financial options, over exchange rate between Peso and Dollar, for realizing a financial hedge. In this study a strategy of hedge is designed for an exporting company in Colombia with the objective of preventing fluctuations because, if the exchange rate down, the number of Colombian pesos that obtains the company by exports, is less than agreed. The exchange rate of Colombia is measured by the TRM (Representative Market Rate), representing the number of Colombian pesos for an American dollar. First, the TMR is modelled through the Geometric Brownian Motion, with this, the project price is simulated using Montecarlo simulations and finding the mean of TRM for three, six and twelve months. For financial hedging, currency options were used. The 6-month projection was covered with financial options on European-type currency with a strike price of \$ 2,780.47 for each month, this value corresponds to the last value of the historical TRM. In the compensation of the options in each month, the price paid for the premium, calculated with the Black-Scholes method for currency options, was considered. Finally, with the modeling of prices and the Monte Carlo simulation, the effect of the exchange hedging with options on the exporting company was determined, this by means of the unit price estimate to which the dollars in the scenario without coverage were changed and scenario with coverage. After using the scenarios: is determinate that the TRM will have a bull trend and the exporting firm will be affected positively because they will get more pesos for each dollar. The results show that the financial options manage to reduce the exchange risk. The expected value with coverage is approximate to the expected value without coverage, but the 5% percentile with coverage is greater than without coverage. The foregoing indicates that in the worst scenarios the exporting companies will obtain better prices for the sale of the currencies if they cover.

**Keywords**—Currency hedging, Geometric Brownian Motion, Options, Strategy hedge.

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# Valuation of Wind Farms in Colombia through Real Options

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**Keywords**—Energy price, Flexibility wind farm, Real options Analysis, Uncertainty.

**Abstract**—In uncertain environments, managerial flexibility in projects has significant economic value. Methods were developed that recognize the monetary value of the options incorporated in the investment opportunities, among the methods the one of real options stands out or also called ROA (Real Options Analysis). The ROA is an adaptation of the financial option method applied to the valuation of physical or real assets, evaluates the implicit value of managerial flexibility in investment projects, so the real options theory is an extension of option pricing theory. Managerial flexibility refers to the fact that investment plans are modified or deferred in response to the arrival of new information or until uncertainty is resolved. Thus, the project management takes advantage of new opportunities mitigating and preventing losses. In Colombia, Wind energy represents 0.14% of total installed capacity of power generation. This data reflects the lack of diversification of energy sources. The main reason for the low representation of wind energy is due to the costs of this technology, which are higher than those of conventional technologies, despite the abundant wind in some areas. Thus, assess wind farms in Colombia by methodologies that quantify the uncertainty of the sector is appropriate to determine economic viability of these projects. The main objective of this study is to evaluate a non-conventional renewable energy project in Colombia through ROA and traditional methodologies. Cash flow discount methods such as Net Present Value-NPV and Internal Rate of Return -IRR are used in the valuation of a wind farm in Colombia, then, the flexibility of postponing the investment is considered, postponing the investment until favorable conditions are obtained and the project generates economic benefits, that is, until economic viability is achieved.

This study is realized with a wind power generation project located in the La Guajira, that it has an installed capacity of 100 Megawatts (MW). The cash flow projection is for 15 years, approximate life time of the wind turbines and time granted by the Colombian government of exempt income for this type of projects. The US Department of Energy, through the EIA (U.S. Energy Information Administration), provides data for the projection of cash flow.

Through the application of real options, project management can analyze market conditions. to obtaining more complete and realistic information, allows to avoid losses and get greater profits of the project during the five years of evaluation. Traditional methods of project evaluation, such as VPN and IRR, do not allow an investor to define the optimal time to invest or to estimate the real value of the project uncertainty. In this case, the study is not profitable because it has a negative VPN, which shows that an analysis based on the traditional NPV is not enough. However, with the ROA considers the flexibility in the management during the life of the project and thereby, the decision to invest in the wind farm, under this method, is postponed to obtain more information in order to reduce the uncertainty of it.

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# Microscaled Plasma-Actuator Flow Measurements by MEMS-Based Thermal Conductivity Sensors for Aerodynamics Applications

Dominik Berndt, Matthias Lindner, Rupert Schreiner

**Abstract**—Micro-plasma discharges in the range of low and atmospheric pressure are a promising approach for the realization of stable glow discharges. Arranged in the geometric shape of a miniaturized DBD actuator with electrode tips of a few microns, plasma generation causes ionic wind behind the exposed electrode resulting in a gas flow due to conservation of momentum. Thus, interesting basic approaches in aerodynamics and fluid mechanics applications are provided. We present a new measurement method for micro DBD-plasma actuator flow using MEMS-based thermal conductivity gas-sensors. Conventional sensors like Pitot-tubes have the disadvantages that an accurate measurement of the plasma-induced flow is too vague and is influencing the measurement itself, as well as only one component of flow direction can be detected. Our sensor utilizes the fact, that the thermal conductivity of a gas is pressure dependent. A heated metal stripe line with a width of a few micrometer located on a membrane suspended over an etched trench of a few hundred micrometer loses heat to an on-rushing gas flow, and thus acting as a kind of MEMS-based surface hot film. On the one hand, applying a constant current to the metal film, the electrical resistance of the wire decreases when the sensor is located in the DBD-induced gas flow. This can be proofed by a 4-point measurement of the voltage experienced at the heated filament and can also be adapted to an external heater with sensitive filaments up- and downstream the gas flow what allows statements about flow velocity and direction as well as volume stream. The sensor voltage is plotted over the time showing sequences of plasma operation with different high voltages. The array-like arrangement of those MEMS-based sensors in a rather small area allows a very fine resolution of the local flow characteristics, what gives a closer look to the fluctuations occurring during the plasma operation. On the other hand the gas species dependency of the effect could be used in the regions without plasma operation to give an impression how the gas composition has changed during the plasma generation, in order to give an indication of e.g. the hazardous ozone concentration caused by the plasma operation in a closed environment. For further investigations the sensor will be placed together with a DBD-plasma actuator in a laminar stream. The measurement of the plasma-induced volume stream could then be used to influence the generation of instabilities leading to turbulent flow.

**Keywords**—Plasma actuators, sensors for aerospace, surface hotfilms, thermal conductivity sensors.

# Effect of Fuel Type on Design Parameters and Atomization Process for Pressure Swirl Atomizer and Dual Orifice Atomizer for High Bypass Turbofan Engine

Mohamed K. Khalil, Mohamed S. Ragab

**Abstract**—Atomizers are used in many engineering applications including diesel engines, petrol engines and spray combustion in furnaces as well as gas turbine engines. These atomizers are used to increase the specific surface area of the fuel, which achieve a high rate of fuel mixing and evaporation. In all combustion systems reduction in mean drop size is a challenge which has many advantages since it leads to rapid and easier ignition, higher volumetric heat release rate, wider burning range and lower exhaust concentrations of the pollutant emissions. Pressure atomizers have a different configuration for design such as swirl atomizer (simplex), dual orifice, spill return, plain orifice, duplex and fan spray. Simplex pressure atomizers are the most common type of all. Among all types of atomizers, pressure swirl types resemble a special category since they differ in quality of atomization, the reliability of operation, simplicity of construction and low expenditure of energy. But, the disadvantages of these atomizers are that they require very high injection pressure and have low discharge coefficient owing to the fact that the air core covers the majority of the atomizer orifice. To overcome these problems, dual orifice atomizer was designed. This paper proposes a detailed mathematical model design procedure for both pressure swirl atomizer (Simplex) and dual orifice atomizer, examines the effects of varying fuel type and makes a clear comparison between the two types. Using five types of fuel (JP-5, JA1, JP-4, Diesel and Bio-Diesel) as a case study, reveal the effect of changing fuel type and its properties on atomizers design and spray characteristics. Which effect on combustion process parameters; Sauter Mean Diameter (SMD), spray cone angle and sheet thickness with varying the discharge coefficient from 0.27 to 0.35 during takeoff for high bypass turbofan engines. The spray atomizer performance of the pressure swirl fuel injector was compared to the dual orifice fuel injector at the same differential pressure and discharge coefficient using Excel. The results are analyzed and handled to form the final reliability results for fuel injectors in high bypass turbofan engines. The results show that the Sauter Mean Diameter (SMD) in dual orifice atomizer is larger than Sauter Mean Diameter (SMD) in pressure swirl atomizer, the film thickness ( $h$ ) in dual orifice atomizer is less than the film thickness ( $h$ ) in pressure swirl atomizer. The Spray Cone Angle ( $\alpha$ ) in pressure swirl atomizer is larger than Spray Cone Angle ( $\alpha$ ) in dual orifice atomizer.

**Keywords**—Gas turbine engines, Atomization process, Sauter Mean Diameter, JP-5.

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# Lymphadenectomy for Oral Squamous Carcinoma, a Retrospective Study of the Incidence of Skips Metastases

Ahmed Abdelrahman, Nikola Dimitrovpetrov, Daya Gahir

**Abstract**—The risk of lymph node metastasis in patients with oral cavity squamous cell carcinoma considered the most significant prognostic factor. The superiority of the surgical treatment of metastatic lymph node is established in level Ib evidence for patients with oral squamous cell carcinoma. However, there is still controversy on the extent of the neck dissection in the treatment of these patients. Selective neck dissection (SND) allows accurate staging and treatment of occult disease by removing of subclinical metastases. However, it comes with its own aesthetic and functional risks and complications. Current guidelines suggested that SOHND should be offered to oral cavity SCC with N0 neck. Few studies described the possibility of skip lesions in level IV, and recommend including level IV. No consensus exists to define the extent of the neck dissection A retrospective analysis of 88 cases with oral squamous carcinoma treated surgically with tumor resection plus lymphadenectomy. All patients underwent extended selective neck dissection level I to IV. Patients' characteristics, tumors characteristics and number/location of lymph nodes involved pathologically were evaluated in order to identify risk factors associated with skip metastases to level IV. Neck metastases were evident in 45% of the patients. 4.5% developed skip metastases to level IV. 9% develop metastases to level IV as part of other nodal metastases. The incidence of skip metastases is not negligible and might have significant prognostic values. The need for level I evidence might resolve the current debates about the extent of the selective neck dissection in oral squamous carcinoma.

**Keywords**—skip metastases, Oral carcinoma, Lymphadenectomy, SOHND

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# Application of Number Theory in Collaborative Technology

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**Abstract**—Collaborative technology has become ubiquitous in today's world. This due to the fact that communication and collaborative applications demand several ephemeral and volatile messaging groups which generally cause maintenance overhead. A mechanism is being proposed which enables dynamic orchestration of volatile and short lived messaging groups with minimal overhead. A mechanism is being proposed to enable dynamic orchestration of such groups with minimal overhead. CRUD operations - (creation, read, update and delete) on short lived messaging groups pose a big administration and maintenance overhead. A number theory based algorithm encompasses semi-prime and logarithmic property which optimises CRUD operations on messaging subsets. A unique prime number is assigned to the individual elements of a parent group (groups destined to be non-volatile and long lived). Dynamic selection of subsets of members of parent group result in formation of non-zero group token (product of individual prime numbers of selected elements - logarithm is used for mathematical convenience). Members of the parent group whose prime number divide the non-zero group token with no remainder will be actual recipient even though the message is destined to the parent group. The mechanism outlined above enables constant  $O(1)$  complexity (selective multicast) as opposed to  $O(N)$  (individual unicast) and avoids CRUD on short lived messaging groups This methodology realizes dynamic orchestration of messaging subsets and accomplishes selective multicast.

**Keywords**—collaborative technology, CRUD, dynamic orchestration, Number Theory

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# Modeling and Fuzzy Control of an Automated System

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**Abstract**—Introduction: Because of the mutations affecting the various activities of an automated system (operation, maintenance, supervision and management of stock, quality control...), the study and application of modern techniques of analysis and control are essential activities that require a change in the logical framework and to provide tools to help in the decision-making process.

**Methods:** The requirements of the future of the automated system change in terms of complexity, efficiency, and flexibility. The growing complexity of automated systems led to a high investment costs in modern plants consisting of factors related to the manufacturing time. In fact we present an application of System Modeling Language and fuzzy control in order to study an automated system. To achieve high productivity and maximize the efficiency of an automatic system, we need to adapt these systems to accurate models, in addition, performance are increasing, which leads to a strong demand of flexibility of future systems automated.

**Results:** After proposition in the first step of the methodology of analysis and control of an automated system in order to help in the decision-making process, we choose a case study. In a second step, we will introduce this methodology of research for modeling and control of the automated system. In the third step, we present the validation of the model of analysis and control on the case study. Then, the models of modeling and control of the automated system are validated.

**Conclusion:** The development of the automated systems led to a development in the theory of the control. The effective functioning of these systems depends on these algorithms of automatic control appropriate. Control systems can be found in many traditional and new technologies. In the present work, we consider the fuzzy logic control as a control tool aimed to show the effectiveness of such a type of order for these types of systems.

**Keywords**—Automated system, SysML, Fuzzy Logic, decision making.

# Self-Organizing Clustering Algorithm Recommendation and Complexity Analysis in Wireless Sensor Networks

Naim Karasekreter, Ugur Fidan, Fatih Basciftci

**Abstract**—Devices with a sensor unit, transceiver unit, and a battery on it are called wireless sensor nodes (SN). Sensing nodes with limited energy and transmission distance attempt to transmit the received data to the Base Station (BS). For that reason, a large number of SNs are needed if the area to be detected is large. SNs with limited energies should use their energies balanced to be durable. The equipment that consumes the most energy in the SNs is the transceiver, but the output power of this equipment is directly proportional to the transmission distance and can be programmed. For this reason, the idea that SNs perceive the SNs to be transmitted over another sensor node instead of directly transmitting the data to the BS itself has caused the creation of Wireless Sensor Network (WSN) structures. One of the important topics in the WSN related literature is clustering algorithms. The basic principle in clustering algorithms is based on the fact that the nodes in the network are choosing a cluster head and sending the data to it in its cluster, so that they can use the resources efficiently. Clustering algorithms in the literature are divided into BS-oriented and self-organized structures. In this study, a new self-organizing clustering algorithm is proposed for WSN and the computational complexity is analyzed. The simulation of the proposed algorithm was performed in Matlab. The clustering success of the algorithm is demonstrated by the calculation of the coverage areas of clusters.

**Keywords**—wireless sensor network, clustering algorithm, self-organized clustering, cluster head selection

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# Low Temperature Boron Carbide Synthesis and Characterization Studies by Sol-Gel Method

Ahmet Helvaci

**Abstract**—Boron carbide is a high-tech material that has been studied extensively due to its good chemical stability, high hardness and properties such as melting point, low density and neutron absorption capacity. Boron carbide (B<sub>4</sub>C) can be obtained by different methods such as elemental boron and carbon's direct synthesis, Carbothermal Reduction, Chemical Vapor Deposition (CVD) and Sol-gel. Among these methods, the sol-gel method is the foreground because of the lower temperature and the cheapness. In this study, possibilities of low temperature boron carbide production by sol-gel method were investigated and characterization was realized. Two different starting materials, polyvinyl alcohol (PVA) and citric acid were used for this purpose. The solutions prepared from these materials were gelled by mixing with a solution of boric acid. The obtained gels were dried at 105°C and pyrolyzed for 3 hours at different temperatures (700, 800 and 900°C) in nitrogen gas atmosphere. Production by microwave assisted method was also investigated. For this, the dried gels were calcined again in nitrogen gas atmosphere in microwave oven at 450, 550 and 650 watt power levels and varying heating times (5, 10 and 15 minutes). B<sub>4</sub>C was obtained in these studies. In characterization studies; XRD diffractograms were taken to determine the crystal structure of the samples, and FT-IR analyzes were performed to obtain information about the bond structures. TGA-DSC analyzes of the samples were also made. The SEM images were also taken and the grain size and morphology of the samples were determined. At the same time, elemental analyzes with EDS were made.

**Keywords**—boron carbide, sol-gel, low temperature, microwave, characterization

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# Correlation between Clinical Findings, the Radiological and Final Histopathological Diagnosis in Maxillofacial Oncology Patients at Royal Stoke University Hospital: A Retrospective Audit

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**Abstract**—The art of providing an accurate diagnosis clinically is something that all doctors strive to achieve for the benefit of their patients. In cancer, it is imperative that we aim to achieve the best clinical diagnosis as possible through staging. Clinically, it can be challenging to ascertain the full staging as small lymph nodes may be missed and tumour size can often only be approximated by palpation. Subsequent to a clinical examination, radiological examination becomes prudent to gain further insight into the staging of the tumour. However, final staging can be only assessed from the histopathological diagnosis.

Several literature reviews have attempted to determine the efficacy of palpation for staging of a tumour. The accuracy in determining neck metastasis was found to be approximately 60 – 80%. As this is a relatively low accuracy, radiological findings become more significant towards the final diagnosis. Computed Tomography (CT) has been “used to determine neck metastasis since 1981” and accuracy of this has been reported as “68% to 92.30%”. Clearly, data is incredibly variable with regards to the accuracy of clinical and radiological findings, which has led to the formation of this audit in order to determine the efficacy within this department.

The aim of this audit was to determine whether clinical findings correlate with radiological and the final histopathological diagnosis.

Data were collected from 50 patients. This was the last 50 patients with any Head & Neck cancer from the date that the audit commenced. Basic demographics was first obtained, including name, age and hospital number. The clinical, radiological and histopathological findings were then obtained and data included into a spreadsheet. The data were collected using a range of applications, the majority of information being sourced from hospital IT system.

Based upon the literature, the accuracy for clinical staging we were aiming for was approximately 60 – 80% which was achieved with a 68% success rate in this audit. Whilst this is within range, there is clearly room for improvement. There may be several reasons as to why staging differed clinically to the histology. The target range for radiological staging was between 68 – 92.3%. Unfortunately, this target was not achieved with a success rate of only 63%. The documentation of staging was also quite low at 64%.

To summarise these findings, the following recommendations are proposed:

1. TNM staging should be mentioned in all clinic and radiological reports.
2. Highlight to administrative staff the importance of ensuring all clinic documentations are typed onto the system, in particular first presentation clinic appointments.
3. Increasing the awareness of the limitations of clinical examinations.
4. A proforma or guide which outlines that TNM staging has to be mentioned. Interestingly, all histology reports have set proforma which prevents documentation errors. Could this be applied to clinical setting?

**Keywords**—Head and neck oncology, clinical finding, radiology, histopathology.

# Women Trainees' Perception on Non-Formal Educational Workshops in Improving Their Socio-Economic Status in Algeria and Costa Rica

Bahia Braktia, S. Anna Marcela Montenegro, Imene Abdessemed

**Abstract**—Adult education is still considered a crucial area of education. In a developing framework, it is regarded as a practical approach for social inclusion and poverty reduction. They are also perceived as a way to serve adults who did not have the chance to education in their early ages by providing them knowledge, skills and values. Non-formal adult education and trainings are critical means in a society to break poverty and unemployment, and to decrease the social inequality. This paper investigates the perception of women trainees about a series of workshops in natural beauty products, held in Algeria and Costa Rica and organized by a non-profit educational organization, to improve their socio-economic status. This research seeks to explore ways of empowering women by assessing their needs and providing them with skills to start their own business. A questionnaire is administered before the workshops and focus groups are held at the end. A qualitative research method is employed to analyze the data. Preliminary results show that the trainees aspire to create their businesses with the objectives of poverty reduction and social inclusion. The findings also reveal the need for small business funding programs and entrepreneurial training programs.

**Keywords**—adult education, non-formal education, socio-economic status, women empowerment

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# A Digital Environment for Developing Mathematical Abilities in Children with Autism Spectrum Disorder

M. I. Santos, A. Breda, A. M. Almeida

**Abstract**—This paper describes the several phases for the design and development of the digital Learning Environment on Mathematics for Autistic children (LEMA). LEMA is a prototype of a digital mathematical learning environment which activities are dynamically adapted to the user's profile, towards the development of mathematical abilities of children aged 6–12 years diagnosed with autism spectrum disorders (ASD). This prototype has already been evaluated with end-users (both students and teacher's experts) and based on the analysis of the collected data readjustments were made, enabling the continuous improvement of the prototype, namely considering the integration of universal design for learning approaches, which are of most importance in ASD, due to its heterogeneity. The learning strategies incorporated in LEMA are also described.

**Keywords**—Autism spectrum disorder; digital technologies; inclusion; mathematical abilities; mathematical learning activities.

## I. INTRODUCTION

THE math achievement profile of children with Autism Spectrum Disorders (ASD) is highly variable [1]. Besides, as it is well known, these children exhibit a highly variable functional and cognitive profile. ASD are a neurodevelopmental disorder, characterized by persistent deficits in communication and social interaction abilities, combined with restricted and/or repetitive patterns of behaviour, interests or activities [2], one of the problems that causes greater challenge at the intervention level.

Some children with ASD have above average mathematical abilities, being some of them even considered mathematically gifted, showing particularly better abilities in numerical problem solving [3]–[5]. Beyond such sporadic cases, research on mathematics abilities of children with ASD indicates that these individuals have difficulties with mathematics, recognizing that this is an area of relatively spared or even enhanced performance in a large proportion of individuals with this spectrum disorders [5]–[8]. In accordance with the same authors, the most frequent difficulties in the acquisition and development of mathematical abilities in children with ASD arise in key areas, namely at the level of abstraction, reasoning and

problem solving due to difficulties with comprehension, memory, organization; indeed, most of these individuals do not have the necessary cognitive flexibility for higher level abstract reasoning, such as forming representations to organize and understanding complex information, limiting academic success in this area.

Research on academic abilities of individuals with ASD underlines the importance of mathematics interventions [9]. Yet the proposal of digital applications for children and youth with ASD continues to attract little attention, namely, regarding the development of mathematical reasoning, being the use of the digital technologies an area of great interest for individuals with this disorder and its use is certainly a facilitative strategy in the development of their mathematical abilities.

Technologies are very effective in the creation of innovative learning occasions to these students and to develop creative, personalized and constructive environments, where they can develop differentiated abilities [10]. These children often reply well to learning activities involving information presented visually. Digital environments present opportunities in this field as dynamic customizable visual displays are often used, allowing the development of individualized instruction that accommodates different difficulty levels according to a particular student's ability [11], [12].

In this context, a proposal of a digital Learning Environment on Mathematics for Autistic children (LEMA) was developed, under the scope of a research project conducive to a PhD in Multimedia in Education and supported by the Thematic Line Geometrix, located in the Department of Mathematics (<http://geometrix.web.ua.pt>), in a collaboration effort with DigiMedia Research Center, of the Department of Communication and Art (University of Aveiro, Portugal). LEMA is a digital mathematical learning environment which activities are dynamically adapted to the user's profile, towards the development of mathematical abilities of children aged 6–12 years diagnosed with ASD. LEMA has already been evaluated with end-users (both students and teacher's experts) and based on the analysis of the collected data readjustments were made, enabling the continuous improvement of the prototype, namely considering the integration of universal design for learning (UDL) approaches, which are of most importance in ASD, due to its heterogeneity.

This paper presents the several developmental phases for the integration of the mathematical learning strategies incorporated in LEMA for improving math achievement in children with ASD.

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## II. MATHEMATICS STRATEGIES FOR CHILDREN WITH AUTISM SPECTRUM DISORDERS

Mathematical difficulties in children with ASD focus in the “language of math” (words describing mathematical concepts), word problems (problems where the significant background information is presented as text rather than in mathematical notation), estimation, and prediction. This happens because many children with ASD have language weakness, which may lead to the fact that they will mostly have below average in math word problem solving [13]. The executive functioning (EF) deficits associated with ASD compromise the development of higher level thinking, reasoning, and problem-solving abilities. EF deficits include poor organizational skills, attention difficulties, motivational issues, work completion problems and difficulties with abstract concepts, inferences, and applied problems [14], [15]. In this sense, the complexity underlying mathematical activities can be problematic for children with ASD.

For children with ASD, strategies in mathematics instruction should be selected considering student's age, instruction needs, motivation and the need to use direct instruction. One of the strategies that has been used in math instruction for students with ASD is self-regulation. Instructional interventions for individuals with ASD using frequent feedback, explicit instruction and practice, giving robustness to the learning of mathematical concepts, are crucial to create structure and ensure that the child understands each step in solving a mathematical problem [16]. According to the study of Su, Lai and Rivera [17] students with high-functioning autism were able to increase their knowledge of mathematical concepts when exposed to systematic instruction and teaching the defining features of geometric shapes such as the lengths of sides, vertices-angles, or the number of vertices may build the foundational abilities needed to learn more complex geometry abilities [18].

Bae et al. [6] propose that instruction for students with ASD should integrate students' everyday life experiences into problem solving processes to help them understand the meanings of word-based questions, since the ultimate goal of mathematics instruction for these students is the learning of basic and functional abilities to solve their real-life problems. Another of the mathematical teaching strategies that should be used with children with ASD is the partition of mathematical problems, breaking them into simpler tasks, leading to a greater concentration by the children with ASD in the intrinsic details to the resolution of the problem [5].

According to the study by Banire, Jomhari and Ahmad [19] all ASD experts surveyed agree that the use of various styles of presentation of the learning content is an effective strategy for capturing the attention of children diagnosed with ASD because it further increases the attention of these children in learning. The experts also added that the animation of abstract concepts will further increase the attention span of these children during learning because of its high stimulating effects. Therefore, teaching mathematics to children with ASD can be very challenging when relying on traditional teaching methods and resources; however, with some creative thought, giving to emphasis on visual aids and personal interests, and the use of digital technologies [20], the teaching mathematics to children with

ASD can be very successful.

## III. METHODOLOGY

The methodological options of this proposal are framed by prototyping and development techniques combined with the analysis of a set of case studies with children with ASD and training sessions with teacher's experts, using the digital environment LEMA under development. Given its exploratory nature, this research follows a process of successive refinements and prototype developments, starting from a theoretical basis which will be enriched by a qualitative analysis of requirements resultant of the prototype exploration sessions that will be running over time, as proposed by Richey and Klein [21]. This approach requires that end users and other stakeholders are involved in all stages of the development process, providing their insights about the required features to the product and testing different design solutions. This is a delicate aspect of this project, as the target users are children with special needs. Hence, we took special care with regard to the ethical aspects of this work [12].

The pedagogical framework used to design LEMA's math activities followed the four principles of therapeutic and educational intervention of Cain and Seeman (2002), namely: (1) Repetitive exercises; (2) Personalized flow of learning activities; (3) Combination of visual, auditory, and kinesiology stimuli; and (4) Step-wise activities with frequent feedback and reinforcement [12].

## IV. RESULTS

### *Phase 1. Preliminary study*

In order to better understand the specificities and needs of children with ASD a two-step preliminary study was conducted. The first step included several interviews with different sets of actors. Our sample comprised four health professionals (two psychologists, one speech therapist and one biomedical expert), two special education autism teachers and one higher education student with ASD. Simultaneously, a survey was carried out on students with ASD attending the 1st and 2nd cycles of Portuguese basic education at an ASD reference school in the district of Aveiro, Portugal. Authorization requests were sent to the school involved and to the caregivers of the students selected for this study; we also requested access to students' Individual Educational Programs (IEP), which were carefully analyzed. The second step included exploratory sessions, including interactive math activities designed in accordance with the IEP of each student and using GeoGebra (a Dynamic Mathematics Software).

The interviews showed that the most obvious characteristics of children/young people with ASD involve difficulties in social interaction, communication, understanding and attention/concentration; predisposition to social isolation was also reported. When asked about the mathematical difficulties presented by the target population of the study, the respondents stated that these students have gaps involving abstract thinking, deductive reasoning, notions of time and space and calculation. The second step of this preliminary study showed that the seven participants diagnosed with ASD, all of them males aged between 8 and

12 years, 3 from the 1st Cycle and 4 from the 2nd Cycle of Basic Education, have little or no structured mathematical reasoning and a low level of spatial perception (2D–3D–2D). We also found that problem solving abilities involving high abstraction and justification processes (deductive reasoning) need to be worked on with these students, especially in the domain of Geometry and Measurement [23].

### *Phase 2: Specification and development of the LEMA prototype*

The process of conceptualization and specification of the prototype was structured from the data collected in the preliminary study carried. The triangulation of these data proved to be crucial and enabled providing clues to design the conceptual model of the prototype; it also helped to draw guidelines to identify the main features of the prototype [23].

LEMA's math learning activities were designed according to three main sources: (i) the literature review, namely the Britto and Pizzolato [24] Guidelines for Accessible Interfaces for people with Autism; (ii) the results of the preliminary study alongside with the functional profiles of the four students selected for this research [23]; (iii) the Mathematics and Curricular Goals for Portuguese Basic Education [25].

As it is well recognized, geometry is an ideal domain for reasoning and so geometry was the natural choice for the design of the activities [26]. Besides, this knowledge domain was identified as the one where students showed lower performance levels in the preliminary study [23]. In this context, our proposal to design LEMA activities focused on the following geometric topics: bi-dimensional geometric shapes, perimeters and areas of planar figures and planar isometries [27].

LEMA was designed and developed based on the requirements and recommendations brought up from the literature review and based on the principles of UDL. UDL has its roots in the architectural principles of universal design, which states that design of products, environments, programs and services should be usable by all people to the greatest extent possible, without the need for adaptation or specialized design. UDL is an approach to address the diversity of learner needs by suggesting flexible goals, methods, materials, and assessment processes that enable educators to meet varied needs. It is an approach whose aim is that all students have equal opportunities to learn [28].

The implementation of LEMA was assured by a multidisciplinary team (mathematicians, educators, developers and designers) which are currently affiliated to the Thematic Line Geometrix ([http:// geometrix.web.ua.pt](http://geometrix.web.ua.pt)) of the Centre for Research and Development in Mathematics and Applications, located in the Department of Mathematics, in a collaboration effort with DigiMedia Research Center, of the Department of Communication and Art (University of Aveiro, Portugal). In order to make the environment accessible via multiple platforms, LEMA is being developed as a web-based application according to HTML5 recent standards.

LEMA's first version incorporate 32 activities based on a set of functions allowing direct manipulation of visual items, such as (see Fig. 1): selection of items, data entry (number or text to justify the answer), link items, drag items, and click on items and watch animations. Beyond the simple and careful design of the layouts for each activity, we also incorporated feedback in order to allow reinforcement with visual and sound animations; some activities include tutorials feedback with animations explaining the concepts and the resolution of an example problem.

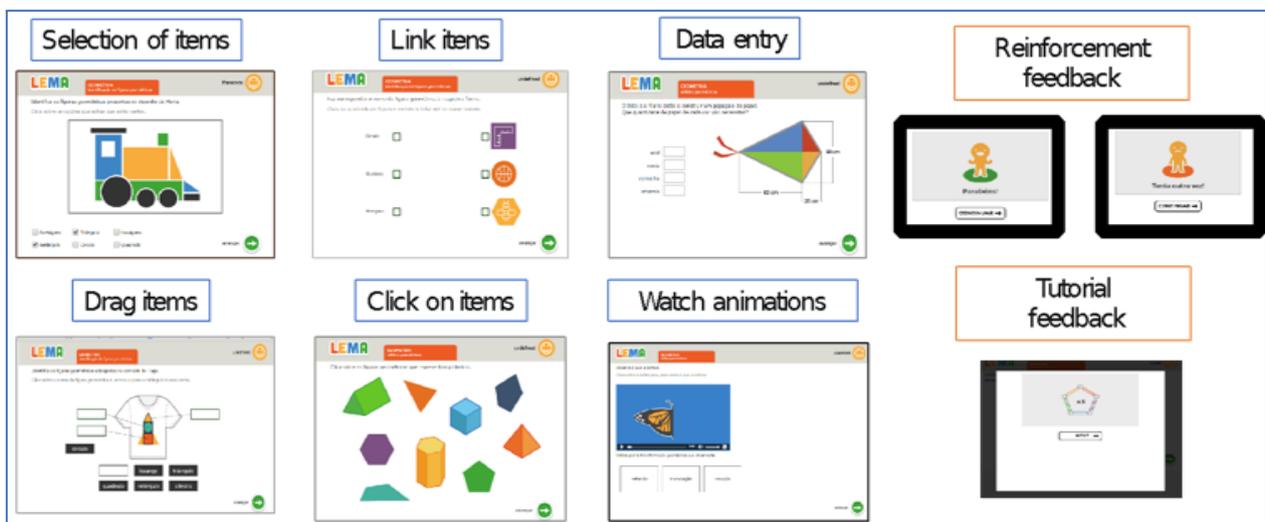


Fig. 1 LEMA's first version

This digital mathematical learning environment bids for each activity three attempts to solve it. Reinforcing feedback is provided for correct and incorrect answers. Tutorials feedback are also provided when the user gives a wrong answer on his/her second attempt to solve the proposed activity. When the user fails in his/her third attempt LEMA's system advances to the next activity.

### *Phase 3: Test and initial evaluation of the LEMA prototype*

A primary evaluation with end-users was already conducted focusing on "interaction", "execution of the activities" and "motivation". This primary evaluation was made through direct observations of different sessions with 4 students with ASD and enabled the collection of important

data that pinpointed the need to make some changes in the environment: (1) redesign the interface and the activities in order to better motivate the users; (2) partition of complex mathematical problems into simple tasks; (3) incorporate feedback tutorials with step-by-step clues; (4) more specific and appropriated reinforcing feedback should be incorporated; (5) restructure the instructions to support the human-computer-interaction; (2) include explanations of the mathematical concepts inherent to each mathematical task should be incorporated (6) adjust some activities to have a lower level of difficulty in view of the diversity of user profiles feature with this disorder; (7) include audio versions of the statements/instructions should be incorporated; (8) adjust the justification field; (9) incorporate more tasks to promote the development of orientation and spatial visualization abilities; and (10) change the type of interaction in some activities to make LEMA more interactive, considering the development of mathematical reasoning [29].

#### Phase 4: First readjustment of the LEMA prototype

The first readjustments on LEMA's interface (conducted in the context of the above mentioned primary evaluation results) are presented, namely considering the new dimension of gamification and the application of game-design elements and game principles in non-game contexts, as a form of enhancing the user's motivation [30], [31].

In order to communicate efficiently the math learning messages between LEMA and the children, a set of design characteristics was taken into account in the first readjustment, as described below (see Fig. 2).

- Good contrast between font and background. For example, in the identification of activities, the title has a small white contour, to fit in different color backgrounds;
- (Re)design of the activities in order to minimize screen complexity, with few items on the screen, clear interface with soft colors, without distractors or background images and use of buttons and icons, creating a visually appealing interface to stimulate mathematical thinking;
- Provide clear instructions and orientation about tasks to ease the user understanding of the content and content language, in order to stimulate, motivate and engage its users. For this reason, and aiming to promote an efficient communication between the system and the user, LEMA provides different types of feedback:
- **Visual feedback** - every selected items appears with an extra contour to provide visibility to the selected choice;
- **Sound feedback** - instruction may be listened, if required;
- **Informative feedback:** "hint" button, with helpful instructions including mathematical concepts and properties are available at the top of all activities' screens. Besides, at the end of two unsuccessfully attempts to complete an activity, LEMA forces the user to solve some problems in a step by step mode, providing a partition of the proposed problem into simpler tasks presenting clues through interactive videos. At the end of a third unsuccessfully attempt LEMA runs an interactive video showing a way of finding a solution to the proposed activity.

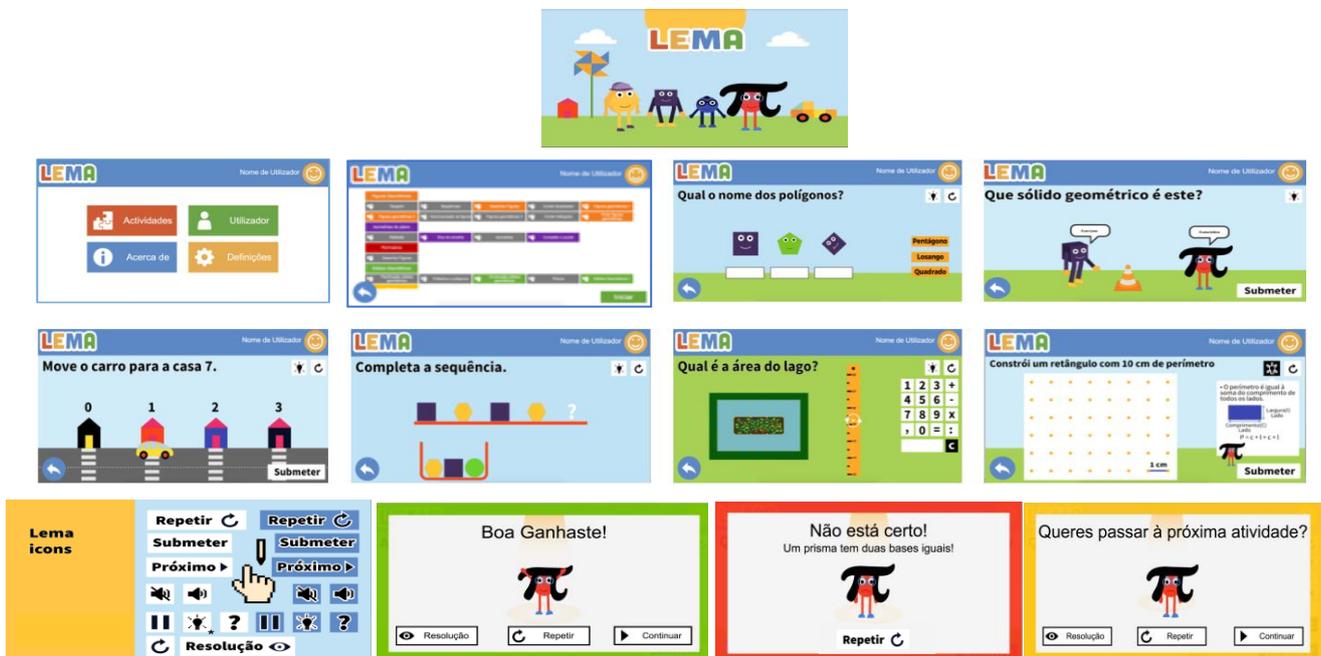


Fig. 2 LEMA's second version

#### Phase 5: Second readjustment of the LEMA prototype

A second readjustment on LEMA's functionalities was conducted based on training sessions with 23 teachers, having in mind the promotion, in general, of math abilities and, in particular, the development of mathematical reasoning.

In LEMA's third version, a set of others functionalities was developed aiming to enhance the user's motivation for mathematical learning, such as:

- Activities labelled by educational levels being each activity restructured into five levels of difficulty;
- Creation of two user profiles - student and teacher;

- Redesign of the activity menu making it more robust, intuitive and user-friendly (having in consideration the heterogeneity of children with PEA and the second principle of therapeutic intervention of Cain and Seeman [22].
- Integration of a teacher menu screen where teachers can select (personalize) the activities to be launched to a particular student, taking into account a specific functional profile and mathematical abilities (see Fig. 3).

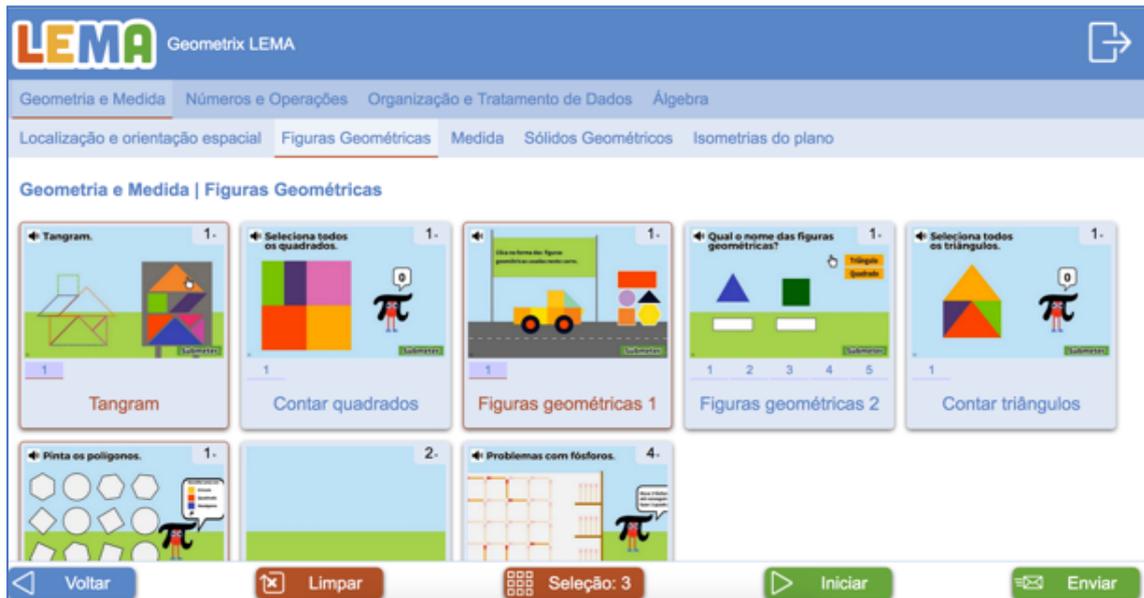


Fig. 3 Teacher's menu screen

- Integration of a step-by-step structuring model to the student's activity choice menu, where the student can select one of three options: 1) the activities sent by the user-teacher; 2) the activities already performed by the user-student, that is, the student can repeat activities that the user-teacher previously sent; and 3) choose the mathematical domain or domains to perform a new flow of activities generated randomly by the system and choose the number of activities to perform, between five and ten activities (see Fig. 4).



Fig. 4: Student-user's menu screen choice

- Integration of a progress bar for the activities that shows (1) the number of activities already executed and the student performance (successfully or failed), and of (2) the number of activities to be completed and the name of the ongoing activity (see Fig. 5).



Fig. 5 Progress bar

- Redesign of the reinforcement feedback: when an activity is successfully completed, an animation, with audio and differentiated "smile" according to the number of failed attempts to solve the activity is launched; the user has the possibility to check the solution of a specific activity, to repeat a new activity of the same level of difficulty, to raise the level of

difficulty or to advance to the next activity; in presence of an unsuccessfully activity (three failed attempts) the user may repeat the activity, descend the difficulty level or move to the next activity (see Fig. 6). LEMA enables users to repeat embedded activities whenever they are up to.

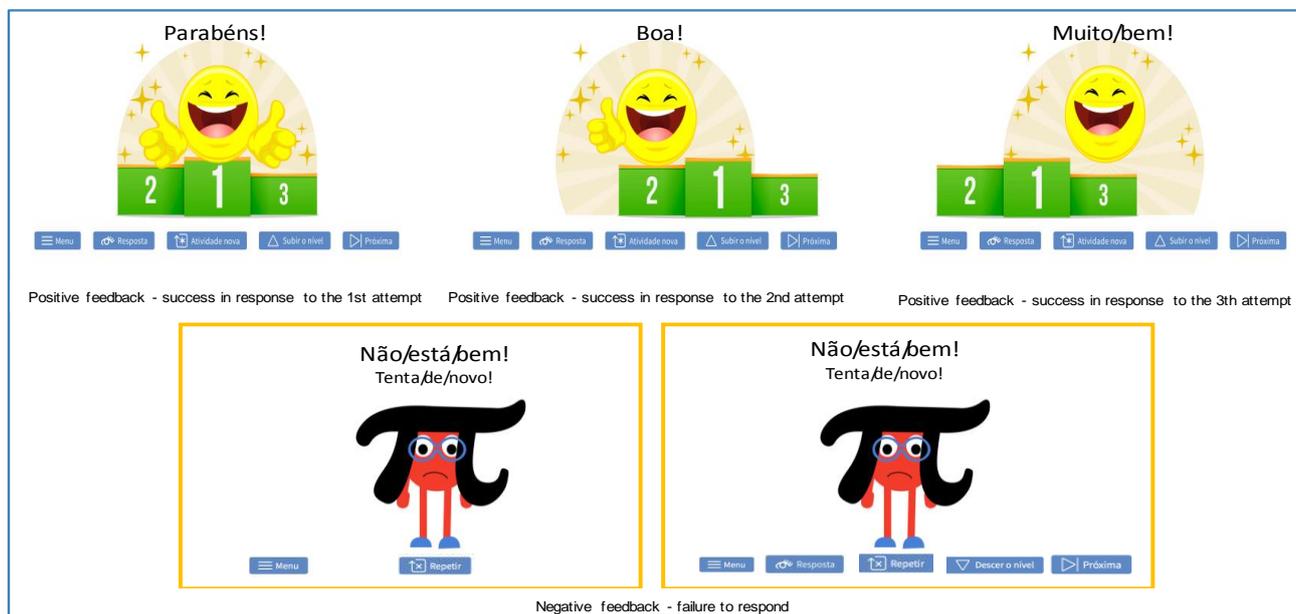


Fig. 6 Reinforcement feedback

- Integration of a performance record of each student visible for the user-teacher, so he/she can check the progress and difficulties of his/her students in the execution of the selected activities.

### V.CONCLUSION

LEMA was designed and developed according with principles of UDL in order to incorporate the flexible design of learning situations with customizable options, which allow all learners to progress at their own pace and respecting individual starting points, which are elements particularly important both for ASD learners and for a wider range of students. Despite LEMA's alignment with ASD, one should never forget how important is to observe the principles of UDL as these should be carefully considered in order to ensure learning equal opportunities for all.

In this moment, LEMA is in its third version and the learning strategies incorporated in LEMA are: (i) provide options to custom choice of math activities, according to user's profile; (ii) integrates simple interfaces with few elements, presenting only the features and content needed for the ongoing task; (iii) uses a simple visual and textual language; (iv) uses of different types of feedback (auditory, visual, positive/negative reinforcement, hints with helpful instructions including math concept definitions and solved math activities using split and easier tasks); (v) provides information in multiple representation, such as text, video, audio and image for better content and vocabulary understanding in order to stimulate, motivate and engage users to mathematical learning, also helping users to focus on content; (vi) avoids using elements that distract or

interfere with focus and attention; (vii) provides clear instructions and orientation about tasks to ease the user understanding of the content and the content language, in order to stimulate, motivate and engage the user; and (viii) uses buttons, familiarly icons and contrast between font and background.

Since these children may experience little sensory tolerance and may have an impaired motor skill, besides the user to have the possibility to interact with LEMA through the mouse (point and click with a single button), the user has the possibility to interact with LEMA through Kinect device (using simple gesture moves) [12].

It is our belief that LEMA will foster new possibilities and new educational approaches for the improvement of mathematical reasoning in students with ASD, preparing them to a more active, independent and inclusive life.

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### REFERENCES

[1] S. A. King, C. J. Lemons, and K. A. Davidson, "Math Interventions for Students With Autism Spectrum Disorder: A Best-Evidence Synthesis," *Except. Child.*, vol. 82, no. 4, pp. 443–462, Jul. 2016.  
 [2] American Psychiatric Association, *Diagnostic and Statistical Manual*

- of Mental Disorders*. American Psychiatric Association, 2013.
- [3] H. Chiang and Y. Lin, "Mathematical ability of students with Asperger syndrome and high-functioning autism: A review of literature," *Autism*, vol. 11, no. 6, pp. 547–56, Nov. 2007.
- [4] P. Howlin, S. Goode, J. Hutton, and M. Rutter, "Savant skills in autism: psychometric approaches and parental reports," *Philos. Trans. R. Soc. London Ser. B, Biol. Sci.*, vol. 364, no. 1522, pp. 1359–1367, 2009.
- [5] T. Iuculano, M. Rosenberg-Lee, K. Supekar, C. J. Lynch, A. Khouzam, J. Phillips, L. Q. Uddin, and V. Menon, "Brain organization underlying superior mathematical abilities in children with autism," *Biol. Psychiatry*, vol. 75, no. 3, pp. 223–30, Feb. 2014.
- [6] Y. S. Bae, H.-M. Chiang, and L. Hickson, "Mathematical Word Problem Solving Ability of Children with Autism Spectrum Disorder and their Typically Developing Peers," *J. Autism Dev. Disord.*, vol. 45, no. 7, pp. 2200–2208, Jul. 2015.
- [7] S. Fisch, R. Lesh, and E. Motoki, "Children's Mathematical Reasoning in Online Games: Can Data Mining Reveal Strategic Thinking?," *Child Dev.*, vol. 92, no. 1, pp. 1–12, 2011.
- [8] X. Wei, E. R. Christiano, J. W. Yu, M. Wagner, and D. Spiker, "Reading and math achievement profiles and longitudinal growth trajectories of children with an autism spectrum disorder," *Autism*, vol. 19, no. 2, pp. 200–210, Feb. 2015.
- [9] C. Gevarter, D. P. Bryant, B. Bryant, L. Watkins, C. Zamora, and N. Sammarco, "Mathematics Interventions for Individuals with Autism Spectrum Disorder: A Systematic Review," *Rev. J. Autism Dev. Disord.*, vol. 3, no. 3, pp. 224–238, 2016.
- [10] C. E. Burton, D. H. Anderson, M. A. Prater, and T. T. Dyches, "Video self-modeling on an iPad to teach functional math skills to adolescents with autism and intellectual disability," *Focus Autism Other Dev. Disabl.*, vol. 28, no. 2, pp. 67–77, 2013.
- [11] V. Knight, B. R. McKissick, and A. Saunders, "A review of technology-based interventions to teach academic skills to students with autism spectrum disorder," *J. Autism Dev. Disord.*, vol. 43, no. 11, pp. 2628–48, Nov. 2013.
- [12] A. Breda, E. Rocha, and M. I. Santos, "LEMA as a digital object manipulation learning environment," in *EDULEARN 2017*, 2017, pp. 2884–2888.
- [13] A. Darejeh and D. Singh, "A review on user interface design principles to increase software usability for users with less computer literacy," *J. Comput. Sci.*, vol. 9, no. 11, pp. 1443–1450, 2013.
- [14] F. Happé, R. Booth, R. Charlton, and C. Hughes, "Executive function deficits in autism spectrum disorders and attention-deficit/hyperactivity disorder: Examining profiles across domains and ages," *Brain Cogn.*, vol. 61, no. 1, pp. 25–39, 2006.
- [15] P. J. Whitby, "The Effects of Solve It! on the Mathematical Word Problem Solving Ability of Adolescents With Autism Spectrum Disorders," *Focus Autism Other Dev. Disabl.*, vol. 28, no. 2, pp. 78–88, 2012.
- [16] J. Donaldson and M. Koffler, "Mathematics Interventions for Students With High Functioning Autism/ Asperger's Syndrome," *Teach. Except. Child.*, vol. 42, no. 6, pp. 40–46, 2010.
- [17] H. Su, L. Lai, and H. Rivera, "Effective Mathematics Strategies for Pre-School Children with Autism," *Aust. Prim. Math. Classr.*, 2012.
- [18] M. R. Dixon, J. Belisle, C. R. Stanley, J. H. Daar, and L. A. Williams, "Derived Equivalence Relations of Geometry Skills in Students with Autism: an Application of the PEAK-E Curriculum," *Anal. Verbal Behav.*, vol. 32, no. 1, pp. 38–45, 2016.
- [19] B. Banire, N. Jomhari, and R. Ahmad, "Visual Hybrid Development Learning System (VHDL) Framework for Children with Autism," *J. Autism Dev. Disord.*, vol. 45, no. 10, pp. 3069–3084, 2015.
- [20] A. Sula, E. Spaho, K. Matsuo, L. Barolli, R. Miho, and F. Xhafa, "A Smart Environment and Heuristic Diagnostic Teaching Principle-Based System for Supporting Children with Autism during Learning," in *2014 28th International Conference on Advanced Information Networking and Applications Workshops*, 2014, pp. 31–36.
- [21] R. C. Richey and J. D. Klein, "Developmental research methods: Creating knowledge from instructional design and development practice," *J. Comput. High. Educ.*, vol. 16, no. 2, pp. 23–38, Mar. 2005.
- [22] D. Cain and J. Seeman, *Humanistic psychotherapies: Handbook of research and practice*. Washington: American Psychological Association, 2002.
- [23] M. I. Santos, A. Breda, and A. M. Almeida, "Brief Report: Preliminary Proposal of a Conceptual Model of a Digital Environment for Developing Mathematical Reasoning in Students with Autism Spectrum Disorders," *J. Autism Dev. Disord.*, vol. 45, no. 8, pp. 2633–2640, Aug. 2015.
- [24] T. C. P. Britto and E. B. Pizzolato, "Towards Web Accessibility Guidelines for People With Autism Spectrum Disorder," in *ACHI 2016: The Ninth International Conference on Advances in Computer-Human Interactions*, 2016, no. January, pp. 138–144.
- [25] A. Bivar, C. Grosso, F. Oliveira, and M. Timóteo, "Programa e Metas Curriculares. Matemática," 2013.
- [26] I. Abrantes, P., Serrazina, L. & Oliveira, A. *Matemática na Educação Básica*. Lisboa: ME/DEB, 1999.
- [27] M. I. Santos, A. Breda, and A. M. Almeida, "Design approach of mathematics learning activities in a digital environment for children with autism spectrum disorders," *Educ. Technol. Res. Dev.*, vol. 65, no. 5, pp. 1305–1323, Oct. 2017.
- [28] D. Rose, A. Meyer, N. Strangman, and G. Rappolt, *Teaching Every Student in the Digital Age: Universal Design for Learning*. Association for Supervision and Curriculum Development, Alexandria, VA., 2002.
- [29] M. I. Santos, A. Breda, and A. M. Almeida, "Learning Environment for Autism Spectrum Disorders," in *Proceedings of the 7th International Conference on Software Development and Technologies for Enhancing Accessibility and Fighting Info-exclusion - DSAI 2016*, 2016, pp. 162–169.
- [30] M. I. Santos, T. Ribeiro, A. Breda, and A. M. Almeida, "Redesigning LEMA: a web based classroom application to promote mathematical reasoning in autistic children," in *INTED2017 Proceedings*, 2017, pp. 8699–8706.
- [31] C. Yu-Kai, *Actionable Gamification: Beyond Points, Badges, and Leaderboards*, 2nd editio. Fremont: Octalysis Media, 2015.

# A Digital Game Fostering Spatial Abilities

P. Barros, A. Breda, E. Rocha, M. I. Santos

**Abstract**—As visual and spatial awareness develop, children apprehension of the concept of direction, (relative) distance and (relative) location materializes. Here we present the educational inclusive digital game ORIESPA, under development by the Thematic Line Geometrix, for children, aged between 6 and 10 years old, aiming the improvement of their visual and spatial awareness. Visual-spatial abilities are of crucial importance to succeed in many everyday life tasks. Unavoidable in the technological age we are living in, these abilities are very important, for instance, in mathematics. The game, set on a 2D/3D environment, focuses in tasks/challenges categorized on the following categories: (1) static orientation of the subject and object, requiring an understanding of the notions of up–down, left–right, front–back, higher–lower or nearer–farther; (2) interpretation of perspectives of three-dimensional objects, requiring the understanding of 2D and 3D representations of three-dimensional objects; and (3) orientation of the subject in real space, requiring the reading and interpreting of itineraries. In ORIESPA, simpler tasks are based on a quadrangular grid, where the front-back and left-right directions and the rotations of  $\pm 90^\circ$ ,  $\pm 180^\circ$  and  $\pm 270^\circ$  play the main requirements. The more complex ones are produced on a cubic grid adding the up and down movements. In the first levels, the game's mechanics regarding the reading and interpreting maps (from point A to point B) is based on map routes, following a given set of instructions. In higher levels, the player must produce a list of instructions taking the game character to the desired destination, avoiding obstacles. Being an inclusive game, the user has the possibility to interact through the mouse (point and click with a single button), the keyboard (small set of well-recognized keys) or a Kinect device (using simple gesture moves). The character control requires the action on buttons corresponding to movements in 2D and 3D environments. Buttons and instructions are complemented with text, sound and, soon, with sign language.

**Keywords**—Spatial orientation ability, digital game, inclusion, itinerary.

## I. INTRODUCTION

**N**OWADAYS, inclusive school basic principles – based upon humanistic beliefs concerned with human rights, equity and social justice – are unquestionable. Digital technologies can assist and transform the teaching and learning process of students with special education needs, providing them with a range of different opportunities and enabling the creation of constructive environments for the development of differentiated and meaningful activities. These tools can allow children to work autonomously on computers with minimal support, working at their own pace and skill level, increasing their learning rate as well as improving their attention span, social behavior, interactions with peers, responsiveness and performance, see for instance [1]. As stated in [2], there are evidences pointed out by several researchers, see for instance [3]-[6], that having a high level of spatial skills is positively related to the success

for students in the STEM (science, technology, engineering and mathematics) disciplines.

While the consensus about the importance of spatial ability is beyond question, the approach to improve this ability is yet unclear. However, what it is well known is that when applied to teaching contexts, that could be conveyed in the form of a digital game, the attention, motivation and engagement of the learner increases significantly. Besides, as pointed out in [7] digital game environments provide opportunities for a new type of cognitive learning experience. The facts, here presented, fully justify our intention in developing an inclusive digital game fostering spatial abilities.

## II. SPATIAL ABILITIES

The development of spatial abilities based on visualization is indispensable. Students usually explain their observation in words. However, as specified in [8], visual explanations are also of great significance, playing a crucial role in the development of the inference procedure.

Visual images of objects, in visualization activities, are performed according to specific processes. Namely, to visual processing (conversion of abstract information into visual images) and to the process of transformation of an already formed visual image in another, being that the interpretation of figurative information (the inverse of the visual processing) corresponds to the process of understanding and interpreting visual representations.

As argued by [9], the procedure to visualize and to orient an object, a subject or a space, does not only include the ability to "see" objects and spaces, but also the ability to reflect on them, on their possible representations, on the relationships between their parts, and to examine the effect caused by the action of a geometric transformation. Following this point of view, the authors have distinguished three large families of tasks promoting the development of space orientation and visualization, namely, (1) static orientation of subject and objects; (2) interpretation of three-dimensional object perspectives; and (3) guidance of the subject in real spaces.

Following a game-based approach, here we report the design of the inclusive digital game ORIESPA, a game for children aged between 6 to 10 years old, framed according to these three task families. ORIESPA is under development by GEOMETRIX, a research and development interdisciplinary- oriented thematic line of CIDMA (Center for Research and Development in Mathematics and Applications). Targeted at assorted target groups (running from primary to higher education level), GEOMETRIX is committed to the study, use and creation of digital environments, to promote knowledge and skills in mathematics, reflecting a transformation in the way they are grasped and applied.

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### III. ORIESPA GAME

#### A. Specific Learning Objectives

ORIESPA, an inclusive game focused on the acquisition and development of spatial visualization and spatial orientation skills, is embedded in a tridimensional context having in mind the three identified task families pointed to these goals.

#### B. Base Architecture and Game Dynamics

ORIESPA is being developed as a browser-based game, using current web technologies. The 3D scenes are supported by the widely used WebGL Javascript library: ThreeJS (<https://threejs.org>). Therefore, it runs on any current computer (desktop or laptop) and some mobile devices. Being a browser-based game, it can be available to a large number of children. All they need is a computer and an Internet connection.

Regarding the state-of-the-art on web games, the main contribute of ORIESPA is to show that current technologies can (and should) be used for educational games in a simple and effective manner, similar to any commercial web and/or mobile game. Regarding the philosophy and purpose of the proposed subgames (tasks), ORIESPA does not use any physics-based mechanics, but this can be easily introduced. There are many good and open source libraries for this. Whenever possible and effective, positional audio has been used.

ORIESPA was conceived for children to play alone (and even offline) whenever they feel up to, having a login feature: the user or tutor creates an account where all configurations and progress is saved (in a central database, if/when online). This gives tutors (teachers/parents/educators) a way to monitor each child's progress and, mainly, to access to repeated errors that may require a personal guidance. The monitoring process can be made remotely: the tutor may access to the student's account by logging into the central platform. Recall that all they need is a computer and an Internet connection.

The game ORIESPA is made of subgames (tasks with a specific learning objective), or scenarios, intended to train a specific skill. Each subgame is composed by a set of tasks with increasing levels of difficulty, being, most of them, built on the skill(s) developed on previous ones. Subgames and levels are locked *a priori*, being unlocked whenever the user solves the corresponding level game challenges. This strategy is a way of evolution and accomplishment being an incentive for training, learning, and overcoming obstacles, being enthusiastic to reach the next level and/or subgame. This procedure takes advantage on children's natural sense of curiosity and hunger for discovery.

By remotely accessing the child's account, tutors can unlock the access to any level or subgame to prevent the child from being stuck in a level and become demotivated to play.

A score system, depending on the subgame nature, is implemented. It may take in consideration the response time, the number of executed attempts and the use of help mechanisms provided in each level game. All levels share a common and well known "star system". Whenever played and at any level, the system provides the player with three stars. Every failed attempt costs the loss of a star. If no stars are available, the game is not over but the player returns to

the previous level. Hence, the player has the possibility of 3 failed attempts at each level and still be in play. The child can repeat any unlocked level at will and is encouraged (by the use of motivational dialogues) to achieve 3 stars (no failed attempts) at each game level.

When the child makes a failed attempt, Oriespa will show a slightly humorous animation: making mistakes a natural component of the learning process, not a drama. Children also relax with non-linear character behaviours, and experience shows that some errors are purposely made just to activate a character reaction and have some laughs. Note that a conscious error may imply the knowledge of the correct answer.

Scores are not shared among players: there is no "wall of fame". The focus is on self-progression, not competition.

ORIESPA is built upon the mainstream architecture for children games. Accordingly, ORIESPA provides:

- an introductory screen, presenting the game title, the protagonist character, the menu icons for common tasks such as game configuration, information, achieved scores, and game play;
- a main menu screen offering to the user information about all the subgames and levels, specifying if they are available to play (unlocked) or not, and, in the case of an unlocked level, the number of stars achieved is also shown. This gives to the player a notion of his/her progress and achievement being a focus of motivation to pursue the goal to finish each level with 3 stars (no errors);
- each subgame and corresponding levels are presented on a single page/screen, not overwhelming the child with visual information.

#### C. Interaction

Children with physical disabilities have limitations in terms of external stimuli: sensory processing and motor responses. These aspects lead to limitations in the acquisition of basic skills at every stage of their development. A reduced control of movement and muscle weakness makes it difficult to use a standard mouse. To overcome this difficulty, in ORIESPA, the user may perform all interactions through the keyboard (small set of well-recognized keys) or a Kinect device (by using simple gesture moves). Kinect technology has potential in training different skills in children with special education needs. In fact, Kinects may be used for rehabbing balance and motor skills, increasing autonomy and citizenship inside and outside school situations [10]. The character control requires the action (click, key press, hand gesture) on a button corresponding to movements in 2D and in 3D environments. Some interactions require that these actions be performed on game objects (for instance, boxes).

In the case of users with specific auditory deficiency, the main difficulties are focused on the perception of sound signals, location, and access to voice messages or to any kind of information in audio. To overcome this obstacle, sign language videos will be included to support students with hearing deficiency.

Nowadays children are very familiar with computers and standard input devices. In ORIESPA none was excluded. All menu and game actions are based on *point and click with a single button*. This generic *point and click* actions can be

performed with a mouse, a keyboard, or a Kinect. All interactions with ORIESPA can be made using exclusively one input device. With *point and click* as the main input mechanism, special care was taken on the design of menu items and game objects. They should be always visible, well recognized and distinguishable, and be big enough to facilitate selection by users with motor and/or visual impairment.

ORIESPA's input devices:

- Mouse - this is the main input device used to interact with ORIESPA. Only one button is required (left and right buttons can be used interchangeably throughout the user interface).
- Keyboard - although (written) text inputs are not used, keyboard interaction is also important. It is a common interface very familiar to all children. Users with some sort of motor impairment may find difficult to manipulate the mouse and/or point a target (due to trembling or inability to perform fine movements). Simplicity and clarity is an important factor. Accordingly, a small set of well-recognized keys are used. Namely,
  - «Arrow keys» are used to simulate the movement of a mouse (being the acceleration implemented and configured on the settings menu);
  - «Enter» and «Space bar» keys are used to perform a selection;
  - «Tab» key is used to navigate between targets as it is common in other computer applications;
  - «Esc» key is only used to pause/resume the game.
  - Kinect – this type of device is becoming less expensive and more available at local stores. Its functionality to assist, among others, interaction and socialization was one of the key motifs to be considered another input device of ORIESPA. In the game, the cursor follows the hand movement and the hand closing (making a fist) is interpreted as a click. No other body movements are required (for instance: left, right) which might require more free space in the room or make interaction difficult (if not impossible) for children on wheel chairs or with any other movement difficulty.

#### D. Feedback

When the cursor enters a target space (hovering), both visual and sound feedbacks are given. Menu icons and game objects produce one same sound when hovered and one other when clicked. Menu items share the same visual appearance (with an icon image providing good contrast) and gain a border when hovered, the border changes color when clicked.

When a menu item is hovered for more than 3 seconds, a label is shown, usually a white text on a black background or on other high contrast set-up, with the item's name followed by the action description: for example, "MENU: cancel the game and go back to main menu". These labels are used in conjunction with audio descriptions.

As the user gets familiar with menu items and dialogues, it may no longer feel the need of text labels and/or audio descriptions. The user may also feel this as intrusive. So, this behavior (seconds of delay and use of text labels and audio descriptions) may be configurable on the settings menu. It is worthwhile mention that it is possible to have both text and

sound, only text or sound, or none.

#### E. Subgames

All subgames were designed taking into account the orientations given in [11].

- All solved subgames and levels can be played whenever the player wants to, allowing the child to practice thoroughly the learnt abilities.
- All user's data (personal interface choices, performance, score, statistics, etc.) are stored in a central database allowing the user to face always the same environment, even if he connects to ORIESPA from different devices.
- Performance data are collected and made available to tutors, making possible the detection, among others, of repeated errors (an alert for personal guidance). The data also give a detailed notion of the time required for the execution of each task and the progression of the skills involved.
- All subgames are structured in a sequence of situations organized into increasing difficulty levels.
- All game messages are given in both text and audio (and soon in sign language).
- The game environment is simple and consistent: For any given context, all menu icons are visible and are big enough to facilitate hover and click actions; all menu icons and game objects produce the same sound when hovered and when clicked; visual cues are also included for hover and click actions; all icons and buttons have a text and/or image label in a high contrast with the background and when hovered for some time produce text and/or audio descriptions of their action.

#### Subgame 0 – Warm-up

ORIESPA begins with a warm-up subgame. Oriespa, the game protagonist, has 4 boxes on his front/back/left/right positions. The player is invited to explore the 3D scenario by clicking on the boxes. When a box is hovered, Oriespa explains the box location (text and audio information): "*That box is on my left.*", see Fig. 1. After clicking the 4 boxes the first level finishes. This subgame is made of 5 levels according to the player views of Oriespa. From his: 1) back, 2) front, 3) left, 4) right, and 5) viewpoint randomly chosen whenever a correct click is done (no two consecutive viewpoints are the same).

On level 5 a control panel with 4 buttons appears on the screen. The player/child is invited to explore them. Each button sets the view to a different position: view Oriespa from its back/front/left/right. The starting position is from the back, player and Oriespa share the same reference.



Fig. 1 - Subgame 0, Warm-up: Oriespa explaining the box location

This warm-up subgame works like a tutorial: introduces the game protagonist and the game behaviour; describes the way to interact with the subgames and explains to the player the four basic directions. The changing of the viewpoint puts in evidence that a scene may look different when viewed from different positions and that position references are dependent on the subject.

### Subgame 1 – Click on the boxes (left, right, front, back)

This subgame is built on the warm-up scenario: Oriespa chooses a random direction and tells the player (child): "Click on the box on my left.", see Fig. 2. When the box is clicked, Oriespa moves to the box location, picks the box and 4 other boxes appear, 1 in each one of the 4 main directions. This introduces movement to the game: when Oriespa moves towards a box the camera moves along; Oriespa may, also, rotate 90° or 180°, making the whole scene be seen from a different viewpoint. If the child clicks the wrong box, the warm-up behaviour is replicated (an explanation is shown) and a star is lost (consecutive errors on the same box do not cause the loss of a star so that the player can review the explanation).

The level finishes when 10 correct answers are given (the number can be redefined by the tutor). A progress bar is on the screen so that the child can actually see the end goal getting closer.

This scenario fits in the first family of tasks presented in [9]- *static orientation of subject and objects*. A degree of difficulty is added when Oriespa moves since the scene's perspective changes; reinforcing that references change according to the subject's position and orientation.



Fig. 2 - Oriespa receives an instruction and moves to the correct box. After clicked, the scene rotates and the perspective changes but the viewpoint, from Oriespa's back, is kept

### Subgame 2 – Which will be the box? (mental rotations)

This subgame, presented on the same scenario as subgame 1, trains a new skill: **mental rotation**. Again, Oriespa is surrounded by four boxes and he raises a question of this nature: "If I rotate 90 degrees to my right, which would be the box on my left?", see Fig. 3.



Fig. 3 - Subgame 2: A task requiring mental rotation

The child has to perform two operations: 1) perform the mental rotation of Oriespa; and 2) determine the correct box given the new (mental) Oriespa's orientation.

This scenario fits in the second family of tasks in [9] (*interpretation of three-dimensional object perspectives*) and is creating the foundations for the tasks fitting in the third family: *guidance of the subject in real spaces*.

### Subgame 3 – Closest and farther away (relative distance)

In this subgame Oriespa has only two boxes and the player is invited to click on the box which is closest to/further away from Oriespa; see Fig. 4. On level 1, the boxes are in line with Oriespa (the boxes and Oriespa form a straight line). On level 2 the boxes and Oriespa form a 90 degrees angle. From level 3 to level 5 a third box is added. On level 5, additionally, Oriespa's orientation changes whenever a correct answer is given.

This scenario fits in the first family of tasks presented in [9]- *static orientation of subject and objects*.



Fig. 4 Subgame 3: Oriespa is telling the child to click on the box that is farther away from him (on the right there is a control panel to change the viewpoint)

### Subgame 4 – Take Oriespa to the target box (movement)

In this subgame the child is introduced to a pair of control panels allowing the translation and rotation movement of Oriespa. Namely (1) the MOVE control panel, with a single button allowing Oriespa movement one step forward; and 2) the ROTATE control panel with a pair of buttons making Oriespa rotate 90 degrees to the left and to the right.

Oriespa has 4 boxes around him and the game gives instructions to the player, one at each time, to take Oriespa to

one of the boxes (randomly selected), see Fig 5. The player must act accordingly to the given instructions, using the MOVE and ROTATE control pannels' buttons.

In the levels 1 to 4, the viewpoint is respectively from Oriespa's back, front, left and right. On level 5 the viewpoint changes randomly whenever a correct answer (button click) is given.

This subgame fits in the third family of tasks presented in [9]- *guidance of the subject in real spaces*.

### Subgame 5 – Stairs and platforms (step up/down)

In this subgame a new pair of buttons are added to the MOVE control panel making Oriespa take one step up or down. The novelty is the notion of stepping up/down stairs or platforms bringing to the scene the three dimensions.

As in subgame 4, the player receives instructions, one at a time, to take Oriespa to one randomly selected box from the 4 available, see Fig. 6.

Due to the presence of obstacles (stairs and platforms) that might block the view of Oriespa and/or the target box, another control panel is present: the VIEW control panel with 4 buttons allowing the change of the Oriespa's viewpoint (back/ front/left/right). This control panel can be freely used, independently of the given instructions.

This subgame fits in the third family of tasks presented in [9]- *guidance of the subject in real spaces*.

### Subgame 6 – Take Oriespa to the target box

In this subgame there is only one instruction: "Take Oriespa to the box." see Fig. 7. The child can move and rotate Oriespa freely (and change the viewpoint). The subgame ends when Oriespa reaches the box

Two additional buttons are present on the ROTATE control panel to make Oriespa perform 180 degrees rotations.

Penalties (loss of a star) and explanations are given if Oriespa is instructed to: a) crash against a platform or a stair; b) fall from a platform or stair; and c) go outside the playing area.

Scores are given taken into account the number of translation and rotation movements made by Oriespa.

This subgame fits in the third family of tasks presented in [9]- *guidance of the subject in real spaces*.



Fig. 5 - Subgame 4: The player controls Oriespa's translation and rotation movements clicking on the control panels' buttons



Fig. 6 - Subgame 5: introduction of platforms and stairs and two new buttons on the MOVE control panel (step up/down)



Fig. 7 - Subgame 6: The player moves Oriespa (translations and rotations) and change the viewpoint at will

### Subgame 7 – The helicopter (above and below)

In this subgame Oriespa is on an helicopter. Above and below the helicopter are two boxes. Oriespa tells the player to "Click on the box BELOW me.", see Fig. 8.



Fig. 8 - Subgame 7: Oriespa is on an helicopter The player must click on the box located below him.

The mechanics are the same of subgames 1 and 2. With each correct answer, the helicopter rotates 90 or 180 degrees to show that the references above and below do not change with the subject's orientation.

This scenario fits in the first family of tasks presented in [9]- *static orientation of subject and objects*.

### Subgame 8 – Click on a box (mixed concepts and multiple correct answers)

In this subgame the child is presented to a scenario with varied concepts. Besides, multiple correct answers are

available.

Oriespa is in a scene with 3 platforms stacked vertically.

On level 1, Oriespa is on a platform in its center. There are 5 boxes on other platforms above and below the one where is Oriespa. Oriespa gives an instruction to the player, like this one: “Click on a box ABOVE me.”, see Fig 9. When a correct box is clicked it disappears and another instruction is given. Besides, Oriespa may rotate 90 or 180 degrees and/or move along the middle platform to show that, in this scenario, the references above and below do not change with the subject’s orientation and horizontal translational movement. The level ends when there are no more boxes to be clicked.



Fig. 9 - Subgame 8: mixing the concepts of above/below and left/right or front/back along with translational and rotational movements.

On level 2 Oriespa is also in the center of the middle platform. Now, 12 boxes are present (4 on each platform) and only on Oriespa’s left and right. Similar to level 1, the child is instructed to click on a box located on Oriespa’s left/right (or front/back, depending on Oriespa’s orientation). When a correct box is clicked Oriespa may rotate 90 or 180 degrees or even jump to another platform. This shows that the notions of left/right (front/back), in this scenario, do not change with the subject’s orientation and vertical movement.

On level 3 Oriespa is also in the center of the middle platform. There are 14 boxes present (5 above, 5 below and 4 in the middle platform). This time Oriespa gives an instruction containing two critical distinct information. Here is an example: “Click on a box that is both ABOVE me and to my LEFT.”. Again, multiple correct answers might be available.

On level 4, the difference to level 3 is that each time a correct box is clicked it disappears and Oriespa jumps to that empty spot. This movement changes some boxes’ relative position to Oriespa (and introduces a novelty to the game: Oriespa can jump).

This subgame fits in the first family of tasks presented in [9]- *static orientation of subject and objects*.

#### **Subgame 9 – How many boxes? (orthogonal perspectives)**

In this subgame Oriespa does not appear. On the grass there is a random placement of cubic boxes forming a three dimensional object (on a 3 x 6 grid). On the screen are also shown the three orthogonal views of the boxes composition (top, front and left/right side). The following question is raised “How many boxes are on the grass?”, see Fig 10.



Fig. 10 - Subgame 9: Composition of cubic boxes and their orthogonal views (projections).

By hovering a cubic box, its relevant faces are highlighted on each of the projections, to enhance the understanding of the three dimensional composition and its orthogonal views.

On the screen are also shown 3 to 5 possible answers and the player must choose (click) one of them. Clicking a wrong answer activates an explanation, the answer disappears and a star is lost. The subgame ends when the correct answer is given (clicked) or all stars are lost.

The subgame level limits the height (in number of cubic boxes) of the composition: level 1, “flat” composition; level 2, cubes composition with a maximum height of 2 cubes; etc...

This subgame fits in the second family of tasks presented in [9]- *interpretation of three-dimensional object perspectives*.

#### IV. FUTURE WORK

Further developments may include:

- Interaction with semaphores, zebras, elevators and escalators to promote the child’s autonomy in real life scenarios;
- Inclusion of a 2 dimensional representation of the scenario (i.e. a map) and the location of Oriespa to promote the child’s capability of relating a map with the three dimensional scene it represents and train the skills necessary to navigate in real life by means of a map;
- Inclusion of life-like situations: take Oriespa from its house to the bookstore, using the zebras and obeying to semaphores;
- Interaction with time-tables: take Oriespa to the bus station, consult the timetable and check when (hour) and where (bus lane) the next bus to a nearby city leaves the station.

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#### REFERENCES

- [1] J. Ribeiro, A. Almeida, and A. Moreira, “Enabling students with SEN through the use of Digital Learning Resources: Guidelines on how to

- select, develop and use DLR with SEN” *Education in a Technological World: Communicating Current and Emerging*, FORMATEX, Spain, 2011, pp. 180-189.
- [2] C. Carbonell-Carrera, S. H. Medler, “Spatial orientation skill improvement with geospatial applications: Report of a multi-year study”, *International Journal of Geo\_Information*, vol. 6, no. 9, pp.1-12, September 2017.
- [3] S. A. Sorby, “Educational research in developing 3-D spatial skills for engineering students”, *Int. J. Sci. Educ.*, vol. 3, pp. 459-480, 2009.
- [4] S. A. Sorby, “Developing 3-D spatial visualization skills”, *Eng. Des.Graph. J.*, vol.63, pp. 21-32, 2009.
- [5] L. S. Lieben, K. A. Kastens, A. E. Christensen, “Spatial foundations of science education: The illustrative case of instruction on introductory geological concepts”, *Cognit. Instr.*, vol. 29, pp. 45-87, 2011.
- [6] C. H. Lin, C. M. Chen, “Developing spatial visualization and mental rotation with a digital puzzle game at primary school level”, *Computers in Human Behavior*, vol. 7, pp. 23-30, 2016.
- [7] C. H. Lin, E. F. Z. Liu, “A comparison between drill-based and game-based typing software”, *Transaction on Edutainment III, Lecture Notes in Computer Sciene*, vol. 5940, pp. 48-58, 2009.
- [8] E. Bobek, B. Tversky “Creating visual explanations improves learning”, *Cognitive Research*, vol. 1, no.1, pp. 1–14, December 2016.
- [9] M. Gonzato, T. F. Blanco, and J. D. Godino, “Tareas para el desarrollo de habilidades de visualización y orientación espacial”, *Números, Revista de Didáctica de Las Matemáticas*, vol. 77, pp. 99–117, July 2011.
- [10] G. Altanis, M. Boloudakis, S. Retalis and N. Nikou, “Children with Motor Impairments Play a Kinect Learning Game : First Findings from a Pilot Case in an Authentic Classroom Environment”, *Interaction Design and Architecture(s) Journal - IxD&A*, vol.19, pp 91-104, 2013.
- [11] L. Freina, M. Ott, “Discussing Implementation Choices for Serious Games Supporting Spatial and Orientation Skills” in 2014, Proceedings of ICERI2014 Conference, pp 5182-5191.

# Social and Economic Challenges of Adopting Sustainable Urban Development in Developing Economy: A Stakeholder's Perception

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## I. INTRODUCTION

**Abstract**—Due to rapid urbanization, developing countries faced significant urban challenges that accompanied the population growth such as the inability to provide adequate housing; sustain human and community's health and wellbeing; ensure the safety in urban areas; the prevalence corruption; lack of jobs; and a shortage of investment. The destruction, degradation, and lack of planning are acute in countries such as Iraq that have suffered for more than four decades because of war and international sanctions, resulting in severe damages to the ecology sector, social utilities, housing, infrastructure, as well as the disruption of the economic sector. Many of significant urban development, housing, and regeneration projects are currently underway in different regions in Iraq, labelled as a means to reform the environmental, social, and economic sectors. However, most often with absence of public participation. Hence, there is an urgent need for understanding public perception, especially of urban socio-economic challenges, which represents a crucial concern for many planners, designers, and policy-makers in order to develop effective policies in addition to increasing their participation. The aim of this study is to investigate stakeholder perceptions of the socio-economic challenges of urban development and their priorities in the all Iraqi provinces. A nationwide questionnaire has been conducted (N = 643) across Iraq, using 19-item structured questionnaire where the stakeholder's perspectives were collected on a 5-point Likert-type scale. The indicators were identified through deep investigation in previous studies. Principal component analysis (PCA) and statistical tests were utilized to the collected responses in order to investigate the linkage between the perceptions of socio-economic challenges and demographic factors. A high value of internal consistency and reliability of the instrument has been achieved (Cronbach's  $\alpha = 0.867$ ). Five principal components have been identified, namely: economic, cultural aspects, design context, employment, security and housing demands. The item 'safety of public places' was ranked as the most important, followed by the items 'minimize unplanned housing', and 'provision of affordable housing', respectively. Promote high-rise housing from the housing demands group, was ranked the lowest component between all indicators. 'Using sustainable local materials in construction' item had the second lowest mean score. The results also illustrate a link between deficiencies in the social and economic infrastructure because of the destruction and degradation caused by political instability in Iraq in the last few decades.

**Keywords**—Public participation in development, socio-economic challenges, urban development, urban sustainability.

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Urban life is now the reality for the majority of Earth's population due to the rapid urbanization, where projection indicates that about 70% of the world population will live in urban areas by 2030 (Komeily & Srinivasan, 2015, Ameen & Mourshed 2017). A substantial proportion of the increase, especially in developing countries, will be living in informal settlements (e.g.) slums (Hassan, 2012), and suffering from many health problems, in addition to unemployment (Arnott, 2008). Urban areas represent a very complicated environment with the diversity of environmental, social, and economic indicators have an impact on community's health and wellbeing (Cutter, Boruff, & Shirley, 2003). Socio-economic urban factors, in particular, such as housing, safety, local culture, employment, and investments are likely to be more challenging for many developing countries in the near future (Mason, 2015). In addition, the local and international urban factors such as natural hazards, wars crises, financial and administrative corruption, and economic recession can aggravate the situation (Cammett, Diwan, Richards, & Waterbury, 2015; Smith, 2013). Many studies have pointed out that cities, especially, in developing countries were affected adversely by rapid urbanization and unprecedented population growth (Molla, 2015; Wei & Ye, 2014), in particular, the intrinsic socio-economic impacts of urbanization. The scale of the urban challenges is such that several authors went as far as to label the urban development factors as uncontrollable and unpredictable, at present and in the future (Freire, 2006; Rana, 2010). Hence, it is important to identify the socio-economic urban challenges, and realize their importance to stakeholders, in order to develop appropriate policies and urban solutions based on their local priorities, which are often different from the global context (Raed Fawzi Mohammed Ameen, Mourshed, & Li, 2015). The determination of socio-economic challenges aims to understand the interaction between the society and other factors such as; economy, culture, housing, health, education, markets, moral commitments, etc. It is a multi-disciplinary approach using diverse methods from economics, psychology, sociology, and history (ICSU, 2011). For that, there is considerable global interest to draw attention to the ways in which urbanization occurs, and that provides an opportunity to identify urban challenges in order to address and improve the urban environment (GRNUHE, 2010). Hence, increasing interest of investigate socio-economic challenges have essential influences, whether on human and environment in which live, or the area that drive economic competitiveness. To suggest a development can change the lives of current

and future of a community (Awosusi & Jegede, 2013).

Rakodi (2001), and Satterthwaite (2001) reported on initiatives for tackling urban socio-economic challenges in Asia, South Africa, and Latin America by repeating the successful planning practices around the world; e.g. World Health Organization (WHO) and International

Institute for Environment and Development (IIED). Most of these efforts focused on strengthening the capacity of national strategies and local decision-makers to mitigate urban challenges in critical areas such as urban poverty, healthy community, squatter settlement, health, education, and social well-being (Vanclay, 2003). Occasionally some efforts may fail as a result of lack of understanding of the urban socio-technical dynamics of the adoptive initiatives countries (Rakodi, 2001). The socio-economic challenges identification represents a very crucial concern for many planners, designers and policy-makers, and requires gathering both quantitative and qualitative indicators of the impacts of urban development that may contribute to improving the quality of these indicators such as: providing employment opportunities in the community; create demand for housing; affordable housing; promote cultural aspects; achieve urban safety and security. Also, it is important for suggested urban development to be consistent with a commitment to preserving the local characteristics of the community (Gavalda-Miralles et al., 2014).

The aspiration to create an understanding of the applicable on a global scale of the urban challenges that can be seen in the development of sustainability assessment methods. Despite the adoption in diverse countries, well-known sustainability assessment tools have been noticed to be in a limited application context in the developing countries (Raed Fawzi Mohammed Ameen et al., 2015). Which is characterized by different socio-economic trajectories than the developed countries, the assessment tools were initially have been developed to enhance economic development performance and well-being achievement. They were often exceeding the overarching sustainability targets; e.g. improve healthy environment, public sustainable awareness, social cohesion, and boost the economy.

The authors submit an optimistic vision aims to achieve sustainability goals through efficacious management of social requirements, processes and the main actors (i.e., stakeholders), by integrating the opinions of the local stakeholders and their perceptions in all lifecycle phases of urban development projects.

The adoption of urban sustainable strategies should be preceded by the determination of the local challenges of urban development, especially for cities with high population density in the developing countries that facing significant current and future challenges of different magnitudes; e.g., social problems; safety in urban areas; housing; health and education sectors; and economic downturn are the key socio-economic issues affecting cities in the developing countries identified in the previous literature (Kraas, 2007; Simkhada, Teijlingen, Porter, & Simkhada, 2008).

Iraq provides one of the individual cases where cities suffered from devastation, degradation and lack of planning due to successive wars and international sanctions forty

years. Resulting in severe damages to infrastructure, insufficient water supply systems for significant sections of the population, a severe lack of the economy and helped the emergence of socio-economic of urban problems such as air quality, waste generation, health problems, traffic congestion, unplanned changes in land use, lack of security, and spread of informal settlement (HRW, 2013; MOE, 2013; UNHABITAT, 2010). Related publications, including The Iraq National Development Plan (2013-2017) had specified several socio-economic urban challenges of Iraqi cities, such as housing deficits, the safety in urban areas; lack of jobs; and the absence of investment in sustainable development (CSO, 2013).

Rebuilding and rehabilitation are, therefore, fundamental while starting to establish new urban projects in several Iraqi cities to meet the growing demand. With the new economic prosperity and oil boom, there is also an emerging desire towards an improved standard of living for Iraqi citizen. Due to this, public involvement represents a central part of sustainable development strategies and policies to achieve economic, social and environmental improvements. As well as adding new notions, approaches, brings more points of view, and uses knowledge around local urban conditions, which might not be widely known (DETR, 2000).

This research aims to investigate stakeholder perception of socio-economic challenges, in order to identify their priorities. It is considered the first step towards the integration of their aspirations in the urban development policies and activities, as well as to promote their participation toward a share and sustainable future for Iraqi cities.

The rest of the study is structured as follows, where the introduction is followed by the discussion on the methodology of the identification of the socio-economic urban indicators development, the conduct of the questionnaire, data analysis, extensive discussion of the results, and ends with conclusion.

## II. METHODOLOGY

Public participation and reconnoitring diverse opinions of individuals considered a fundamental method to make decisions (Rowe & Frewer, 2000). It was applied as a mean to investigate the public perception of the urban socio-economic challenges in Iraqi cities and to determine the actual needs of their communities, in various fields of life such as Living, work, travel, education, health, and play, in order to improve the local environment (DETR, 2000). Therefore, a nationwide 25-item questionnaire was conducted to investigate the public perception of the indicators influencing urban socio-economic development in Iraqi cities, and stakeholder's perceptions analysis method was selected as the main approach for this study. Questionnaire approach is an essential technique aims to capture the opinions of a large group of people in an efficient and consistent way. The questionnaire represents one of the most common approaches for data collection (Huang, 2006). The study methodology is as follows:

### A. Questionnaire preparation

The questionnaire was developed in five stages as follows:

Stage 1, an initial list of 19 socio-economic urban indicators was identified based on a comprehensive review of the previous literature on urban environmental and sustainable development targets. Attention was given to the relevance of the identified urban indicators to the cities and regions of the Middle East, including Iraq.

Stage 2, a field visits have been carried out by one of the authors to some Iraqi cities (i.e. regions) Baghdad, Karbala, Babel, and Al-Najaf between November and December 2014. Stakeholders from the public, professional, and governmental groups have been contacted by phone, mobile, and through social media, and via internal communications with relevant government departments (e.g., the Ministry of Housing), municipalities (e.g., the Municipality of Karbala, Najaf, and Babylon). In addition to the Institute of Urban and Regional Planning, National Investment Commission, and the civil society and NGO, e.g., Human Connection Rings Organization; and Ein Iraq net. Interviews have been held with willing stakeholders to investigate their views on the identified urban indicators, and other relevant local socio-economic urban challenges. In the light of these face-to-face interactions, the list of urban indicators was updated, their definitions were revised to promote clarity – resulting in a final list of 19 items, as summarized in Table 1.

Stage 3, a draft online survey was developed depending on the two preceding stages. The questionnaire was first produced in English and then translated into the Arabic to enable wider participation from the public who may not be well-versed in English. Two professional translators reviewed the draft to check for accuracy and clarity of the content. The questionnaire draft was evaluated in a pilot survey to analyse the thoroughness and clarity of the urban items related with the psychometric features of the instrument. The pilot study participants (N= 16), included urban designers, city planners, university professors, architects, engineers and the different members of the public. All participants have been asked to comment on if there were any lack or ambiguity in the content, the length of the survey, the level of understanding of the components, other potential perceptions, and the importance of the general urban items. The result of the pilot questionnaire was adopted in the amended final questionnaire with the improved validity of the content.

Stage 4, the 'online distribution technique' as an approach was used in this study. It is a rapid method compared with the manual questionnaire, as well as less expensive (Huang, 2006; Stanton, 1998; Weible & Wallace, 1998), especially when it needs to be distributed at the national level (Hamilton-MacLaren, Loveday, & Mourshed, 2013). A snowball sampling technique also has been utilized, which is considered a robust academic approach, as well as suitable for large-scale distribution, to reach many respondents across all cities/ regions (Dragan & Maniu, 2013). The survey was conducted with Survey Monkey (SurveyMonkey, 2015) between December 2014 and April 2015. This web tool facilitates the widespread distribution of questionnaires and enables the authors to control and monitor the responses, and to get a preliminary analysis of

the results in a short time (Baker, Singleton, & Veit, 2010). The final version of the survey included 19- structured items to rate stakeholders' perceptions of the importance of the dimensions of the urban development challenges.

Stage 5, face to face interviews have been conducted with some age groups; e.g., 55-60 years and 61 years and above that have the lowest internet usage rate. One of the researchers went through the questions from the questionnaire during the interview and recorded the responses on the SurveyMonkey web tool an internet enabled Tablet.

In both stages 4 and 5, participants were asked to rate their perceptions of the questionnaire items on a 5-point Likert-type scale, ranging from 1 to 5, where 1= unimportant; 2= of little importance; 3= moderately important; 4= important; and 5= very important. The questionnaire also included open-ended questions to enable participants to provide comments on the items listed, or other considerable factors they thought were important. Demographic information such as age, gender, occupation, academic qualification, governorate (i.e., location) and the location type (i.e., urban or suburban or rural), were included.

### B. Survey respondents

The study was conducted as a thorough questionnaire for both genders from diverse social sectors, included occupations and qualifications. All Iraqi regions were selected for this research, which covers the northern, central and southern regions that make up the eighteen cities. The only requirement to participate in the survey was that the participants were over the age of eighteen. The participants were informed in writing that participating was voluntary in the survey, also giving the commitment to maintain the privacy and confidentiality of all the data.

### C. Sampling and data collection

The snowball sampling technique was utilized in this study, to ensure large-scale distribution of the questionnaire (Dragan & Maniu, 2013) across all Iraqi provinces. The snowball sampling technique has been represented one of suitable, efficient and economical method (Padam, Arvind, & Rani, 2007). The snowball technique works through the distribution of a survey, by an author to participants. Then, the first group of participants forward the survey to other potential participants, and so forth, until a high rate of participation is achieved. The use of this sampling technique expanded the reach of a survey to cover a large number of hitherto unknown respondents, as reported in some previous studies (Aldossary, Rezgui, & Kwan, 2015; Padam et al., 2007). After issuing the survey, and by using SurveyMonkey, the link was sent to a group of potential respondents in all Iraqi cities by email, text messages, and messaging in social networks. The same procedure was repeated several times during the survey period until the required number of stratified samples were collected. Also, a few face to face interviews were conducted as discussed in § 2.1. The statistical analysis of the questionnaire data has been completed with IBM SPSS Statistics for Windows, Version 20.0 ((Leech, Barrett, & Morgan, 2015). Descriptive statistics on the urban indicators and scale frequencies, response percentages, means, modes and standard deviations (SD) have been computed. Then, the

demographic data were analysed descriptively by computing frequencies and percentages. Internal consistency reliability was assessed via Cronbach's alpha coefficient ( $\alpha$ ) (Cronbach, 1951). The alfa coefficient provided a single estimate to determine internal consistency or average correlation of questionnaire items in order to measure its reliability (Webb, Shavelson, & Haertel, 2006), enabling the assessment of the overall correlation between questionnaire items within scale reliability. Several social studies suggested that the average coefficient of internal consistency ( $\alpha = 0.70$ ) is considered to be acceptable reliability (Katz, Golstand, Bar-Ilan, & Parush, 2007; Tavakol & Dennick, 2011). In this study, the average coefficient of all extracted components was 0.867. Its considered good and indicating a very high internal consistency or reliability (Ahmad & Ahlan, 2015; Wright, Scott, Woloschuk, & Brenneis, 2004). Principal Component Analysis (PCA) was carried out as a mathematical technique on all 19 items in this study to determine the underlying structure, characterizing a group of correlated variables. The importance of a component was evaluated by testing scree plots and the contribution of each component to total variance ( $> 5\%$ ). Variance Maximization (varimax) as an orthogonal rotational strategy was applied using the results of the (PCA), directing all factors to be extracted. Rotation can reduce the number of factors on which the variables under investigation have high loadings and make the interpretation of the analysis easier (Floyd & Widaman, 1995; Mourshed & Zhao, 2012). Items that were included had factors loadings more than 0.40. Five components were extracted as follow: economic; cultural aspects; safety and security; design context; and housing demands. Then, internal consistency and validity were established for the items of the questionnaire. Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity were to identify significant correlation between survey items. Sampling adequacy was measured with KMO, the level was 0.892. KMO values  $> 0.8$  can be considered good and indicates that PCA is useful for these variables (Alkhatabi, Neagu, & Cullen, 2010; Cerny & Kaiser, 1977).

### III. THE RESULTS ANALYSES

#### A. Demographic characteristics of the respondents

Total final responses were 643 were received, of which 570 were valid. Demographic and work-related characteristics of the participants are summarized in Table 2 across all Iraqi cities. Among the respondents, 367 (64.4%) were male, and 203 (35.6%) were female. With regards to age, 18.4% were aged between 25 and 30 years, representing the highest rate of participation, followed by 17.1% for 41–45 years and 14.9% for 31–35 years. Age groups 18–24, 36–40, 46–50, 51–55 and 56–60 years accounted for 14%, 13.2%, 8.1%, 5.4% and 4.6% ( $n=26$ ), respectively. The age group above 61 years represented the lowest participation, at 3.9% ( $n=22$ ).

Table 1: Socio-economic indicators description identified from the literature review

Item	Impact
Minimize unplanned (random) housing	The unplanned or random housing on urban development can lead to a chain of proceedings affecting people, economies as well as the entire ecosystem. It can result in deterioration of the environment, social, infrastructure services, land use, sewerage and the rest of urban design elements (Aluko, 2010; Tabassum, 2014). Informal settlements phenomenon considered one of the main urban challenges in Iraq; they constitute about 7.3% of the total number of housing units in Iraq (CSO, 2013).
Provision of affordable housing	Affordability of housing offers considerable insights impact on the urban growth management, economic, planning, real estate, land and housing markets (Nelson, Pendall, Dawkins, & Knaap, 2002). Affordable housing policy in Iraq is most urgent issues in last decades, particularly regarding with low-income and poor families (UNHABITAT, 2010).
Safety of public places	Safety of urban spaces need to be designed with flexible uses such as; provision wide range of activities; easy access to connect surrounding community; a safe and attractive place to meet people. Taking into account the sunlight, shade, and water bodies (Loukaitou-Sideris, 2006), as well as protection from various types of violence (Marcuse, 2006). Enhancing urban safety and security considered a fundamental and vital issue of urban development in Iraq (Rathmell et al., 2006).
Preservation of historical buildings	Historical areas embody the values of traditional urban cultures that are threatened today or destroyed, by the influence of urban development and urbanization in various societies. Often leading to irreversible cultural, social, and even economic losses (Rodwell, 2003; Tweed & Sutherland, 2007). It is a demand for protection, conservation, and restoration of historic cities and areas in Iraq, as well as their potential adaptation with a contemporary urban environment.
Promote and provide integrated urban security systems	In Iraq, presently, there is an urgent need for integrating protective security measures to be part of urban design process, to mitigate the threat from, and reduce the damage caused by terrorist acts, in order to secure integrated protection that fit with the actual threats (Coaffee, 2009).
Development of the tourism sector	Tourism is one of the largest growing economic sectors worldwide, locally and globally. It is a relevant factor for development policies, particularly in ecotourism conservation, which can generate high revenue for economy can be utilized to find solutions to urban challenges, creating economic development plans, as well as contributing to creating opportunities for urban projects in developing economies (Steck, 1999). In Iraq, archeological and religious tourism represent the most important types, which attracting millions of tourists every year (CSO, 2015).
Preservation of vernacular buildings	The process of long-range preservation and valorization of vernacular buildings can promoting sustainable development and preserve vernacular heritage (Filippi & Balbo, 2005). Especially for countries that possess considerable cultural heritage such as Iraq.
Increasing housing projects	Housing production considered a highly productive activity in economy sector, able to generate direct employment, income multipliers and employment, as well as, social factor, which responds to the basic needs of the citizen. Especially with a large deficit in the housing sector estimated at 2 million housing units in Iraq by 2016 (UNHABITAT, 2010).
Encourage investment in urban projects	Investment in urban communities, especially in developing economies, can encourage and support a wide variety of urban development projects such as affordable housing construction, job creation, healthcare and educational facilities, businesses as a part of ongoing effort to empower local communities to control of urban problems, as well as promote long-term economic growth (Wu, 2001).

To cover a broad range of people with diverse occupations to be involved in the survey. More than half of the respondent 54.9% ( $n=309$ ) of all the respondents were selected to be a government employee. Because the rate of government employment constitutes more than 20% of the labor force in the country (Alwardi, 2015). Besides that, about 70% the urban development institutions are owned and run by the government such as universities, diverse engineering disciplines, urban planning and design centers, housing, schools, healthcare, municipal services, public services, industrial sector (CSO, 2010). In addition to many of the employees could have access to internet service that has provided for free in most government departments in Iraq (Heshmati, Al-Hammadany, & Bany-Mohammed, 2014). The other occupations, which included the unemployed, homemakers, and students has a second highest percentage 16.3% ( $n=93$ ). Other positions were, in descending order: Self-employed has 15.1% ( $n=86$ ), and non- government employee has 14.4% ( $n=82$ ).

A broad knowledge base was initialized depending on different academic qualifications of the participants, which can help to achieve the goals of the study (OPM, 1990). More than half of the respondents 52.8% were undergraduate degree holders, followed by about one- third of the participants 29.5% were post- graduate degree

holders. Up to secondary school accounted for 17.8 %, which included the secondary and primary school certificate holders, as well as the participants who don't have any academic qualifications.

The rate of participation exceeded expectations. The highest response rate was in the southern region, which was 62.9% of the respondents, followed by 34.8% for the central region. Whilst the lowest rate of the responses recorded was 2.3% in the northern region. At the same time, the participation varied in different parts. The majority of the respondents who live in urban areas was 84.5%, followed by 12.9% in suburban areas while only 2.7% of the respondents of rural areas. The diversity of different occupations, qualifications, for all Iraqi governorates, were included in this study. With an emphasis on urban areas, because it represents the study area.

A descriptive analysis of the socio- economic factors was given in Table 3. It represented the percentage of response for each option on the 5-point Likert-type scale. Mean, mode and standard deviations (SD) of responses are computed for each item. The socio-economic items were listed in a descending order, based on the mean response score (e.g., safety of public places; mean = 4.598, mode = 5, SD = 0.764) and relatively greater for lower mean scores (e.g., promote high- rise housing; mean = 3.56, mode = 5, SD = 1.312).

Table 2: Background factors of the respondents

Variable	Scale	Frequency	Total %
Gender	Male	367	64.4
	Female	203	35.6
Age group (yr)	18- 24	80	14
	25- 30	105	18.4
	31- 35	85	14.9
	36- 40	75	13.2
	41- 45	100	17.1
	46- 50	46	8.1
	51- 55	31	5.4
	56- 60	26	4.6
	>61	22	3.9
Occupation	Government employee	310	54.2
	Non-government employee	82	14.4
	Self-employed	87	15.1
	Other	91	16.3
Qualification	Post-graduate degree	168	29.5
	Undergraduate degree	301	52.8
	Up to secondary school	101	17.8
Location	Central Region	191	34.8
	Southern Region	367	62.9
	Northern Region	12	2.3
Location type	Urban	489	84.5
	Suburban	67	12.9
	Rural areas	14	2.7

Table 3: Descriptive analysis of the socio- economic factors

Items	Response* (%)					Mean	Mode	SD
	1	2	3	4	5			
Safety of public places	1.1	1.6	6.1	19.0	72.3	4.598	5	.764
Minimize unplanned (random) housing	2.9	1.8	5.5	12.4	77.3	4.593	5	.901
Provision of affordable housing	1.3	2.1	5.9	20.6	70.0	4.557	5	.809
Develop the tourism sector	.8	1.9	8.3	19.3	69.7	4.552	5	.790
Preservation of historical buildings	.8	2.1	7.9	21.1	68.1	4.53	5	.793
Promote and provide integrated urban security systems	.8	2.4	7.9	22.4	66.5	4.51	5	.804
Development of traditional buildings methods	1.8	2.1	16.6	34.3	45.1	4.51	5	.804
Increasing housing projects	.3	1.8	7.9	29.3	60.7	4.48	5	.742
Securing in buildings	1.1	1.1	9.5	27.4	60.9	4.46	5	.793
Encourage investment in urban projects	.3	3.2	10.2	23.6	62.7	4.45	5	.823
Preservation of vernacular buildings	2.1	1.1	12.1	24.3	60.4	4.39	5	.895
Contribution of urban projects in the provision of employment opportunities	.8	3.5	12.6	27.3	55.8	4.33	5	.885
Promote identity and local culture	.8	2.9	12.4	35.4	48.5	4.27	5	.848
Promote qualitative housing	1.4	4.9	20.3	27.9	45.5	4.11	5	.986
Preservation of the hierarchy in public and private places	1.8	3.4	20.3	38.0	36.4	4.03	4	.933
Provide minimum standards based on household size	2.9	5.8	16.4	37.2	37.7	4.01	5	1.018
Promote individual housing units	4.2	13.2	25.3	28.0	29.3	3.64	5	1.155
Using sustainable local materials in construction	5.3	10.6	30.6	25.6	28.0	3.60	3	1.153
Promote high-rise housing	9.5	12.9	21.4	24.0	32.2	3.56	5	1.312

Notes:  
 \*Response scales are as follows:  
 1. Unimportant; 2. Of little importance; 3. Moderately important; 4. Important; 5. Very important

**B. Principal component analysis (PCA)**

A principal component analysis (PCA), a mathematical technique, was conducted on the 19 survey items, to identify the underlying structure that characterizes a group of highly correlated variables. The suitability analysis of the measurement matrix was detected that all survey items involved from the scale, and each item had a substantial factor in the range of (0.4) to (0.8). Variance Maximization (varimax), an orthogonal rotational strategy has been chosen. Five summated components were extracted from the 19 questionnaire items represented: economic; cultural aspects; safety and security; design context; and housing demands respectively. The preliminary analysis has been run for each component, in order to obtain eigenvalue over Kaiser’s criterion, which is greater than (1.0). The eigenvalues of the five factors were ranged from (7.068), (1.273) in the middle, and (1.033) for the lowest value. Based on Bartlett’s test of sphericity as a factor solution showed a significant correlation value among questionnaire items (p<0.000), suggesting that all selected variables were related to each other and suitable for further analysis. The Kaiser Meyer Olkin (KMO) measure verified that the sampling adequacy KMO= 0.892 indicates that the chosen of the questionnaire variables is suitable for factor analysis and can be considered high (Parsian & Dunning, 2009; Zhao & Mourshed, 2012), and the matrix was suitable for PCA.

As shown in Table 4, the total variance extracted was (63.860%). The first component (economic) clustered by six items representing the largest percentage of explained variance (37.199%). The second (cultural aspects) component contained five items accounting for (8.552%) of the variance. The third component (safety and security) had three items accounting (6.702%) of the variance. The fourth component (design context) had three items accounting (5.971%) of the variance. Eventually, the fifth component (housing demands) had two items, accounting for (5.436%)

of the variance.

Given the large sample size, the convergence of the scree plot and Kaiser's criterion on five components have been retained in the final analysis. Table 5 also shows the principal component analysis (PCA), the values of the factors scale (loading) after rotation, eigenvalues and percentage. Meanwhile, the scree plot that contained the five components suggests in the model equals the number of eigenvalues that exceeded (1.0).

The interpretation was based on the factors loadings of each item. Two of the 19 items had dual loadings on two factors as shown in Table 4. The item, 'provide minimum standards based on household size' had loadings of 0.524 and 0.536 on housing demands and design context factors respectively. 'Development of traditional methods of natural lighting and ventilation for buildings' had loadings of 0.427 and 0.499 on cultural aspects and design context factors respectively. To investigate further, if the items were deleted, Cronbach alpha was examined for each item; the value will decrease to less than 0.8 if any of the items was deleted. On the other hand, with a mean score of 4.01 out of 5.00, the item 'provide minimum standards based on household size' was ranked as very important by the respondents. Considering the above, both factors were retained in the 'design context' component and along with the original loadings of the items.

Table 4: Rotated Component Matrix of the socio-economic items

Item	Component				
	Economic	Cultural aspects	Safety and security	Design context	Housing demands
Encourage investment in urban projects	.825	.141	.141	.042	.107
Develop the tourism sector	.809	.228	-.007	.024	.044
Provision of affordable housing	.765	.126	.275	.209	.090
Contribution of urban projects in the provision of employment opportunities	.656	.157	.378	.089	.101
Minimise unplanned (random) housing	.383	.168	.270	.350	.247
Preservation of vernacular buildings	.264	.824	.149	.051	.053
Preservation of historical buildings	.314	.792	.255	-.045	.125
Preservation of the hierarchy in public and private places	.074	.609	.288	.340	-.019
Promote identity and local culture	.196	.595	.204	.204	.250
Using sustainable local materials in construction	-.008	.534	.033	.489	.055
Securing in buildings	.141	.264	.828	.135	.107
Safety of public places	.197	.153	.766	.108	.088
Promote integrated urban security systems	.207	.280	.692	.170	.063
Promote individual housing units	.103	.112	.134	.754	-.102
Provide minimum standards based on household size	.186	.023	.143	.536	.524
Development of traditional buildings methods	.112	.427	.239	.499	.117
Promote high-rise housing	.020	.148	.001	-.139	.864
Promote qualitative housing	.231	.040	.310	.131	.470
Increasing housing projects	.394	.233	.327	.257	.446
Cronbach's alpha coefficient (0.867)	.827	.803	.801	.546	.544
Eigenvalues	7.068	1.625	1.273	1.134	1.033
Percentage of explained variance (63.860)	37.199	8.552	6.702	5.971	5.436

### C. INTERNAL CONSISTENCY RELIABILITY

Generated components have been tested for internal reliability using Cronbach's alpha Coefficient estimate, as shown in Table 4, all values that have been obtained from the reliability estimates were greater than (0.50). This indicates that the items among questionnaire items have the same attributes (Cerny & Kaiser, 1977). The internal consistency reliability which was represented by Cronbach's coefficient of all extracted components was 0.867,

indicating a very high level of internal reliability. This shows a very high level of reliability (Ahmad & Ahlan, 2015).

### D. The relationship between personal information and socio-economic perceptions

To summarize data analysis and interpretation, participants were regrouped, and the variables were re-categorized to indicate six different groups. Data distribution was not normal; non-parametric tests, therefore, were implemented on the 19 questionnaire items by following a non-normal distribution (Callao, Jarne, & 'nez, 2007) according to the five components that were extracted from PCA, and reported in Table 5. A Mann-Whitney U-test was carried out on 'gender' while Kruskal-Wallis test was carried out on 'gender', 'occupation', 'qualification', 'location' and 'location type'. The results show that there is no significant difference in perception in occupation in the five summated indices of socio-economic urban challenges.

There are significant different perceptions of the age group can be seen on the many items 'minimize unplanned (random) housing, preservation of vernacular buildings, preservation of historical buildings, promote identity and local culture. Also 'securing in buildings', 'safety of public places', 'promote individual housing units', 'provide minimum standards based on household size', and 'increasing housing projects'. Significantly differences in perception between male and female on develop the tourism sector and minimize unplanned (random) housing. Qualification accounted for significant differences in the stakeholder perception of 'preservation of vernacular buildings' and 'promote and provide integrated urban security systems' items. Besides, the location variable has significant influences on the items: 'preservation of the hierarchy in public and private places' and 'promote high-rise housing'. Finally, location type has a significant difference in perception of 'safety of public places' item. The socio-economic urban challenges indicators have a high level of significance of ( $p < 0.05$ ).

Table 5: Results of non-parametric test

## IV. DISCUSSION

The stakeholder considered one of the fundamental pillars of information to investigate the socio-economic urban challenges in Iraqi cities. Their perceptions originate from their daily living, places of work and study, and monitoring of existing urban problems in their cities. The whole 19 investigated socio-economic aspects were ranked depending on the mean value of high scores ranging between 3.56 and 4.598, from the lowest to the highest, on a Likert scale of (1- 5). Overall, among the urban factors that have been evaluated by 643 participants, 'safety of public places' (mean = 4.598) and lowest standard deviation (SD= 0.764). It was ranked as the most important socio-economic urban challenge for Iraqi cities, followed by 'minimize unplanned (random) housing' (mean= 4.593) and (SD= 0.901). The indicator 'provision of affordable housing' (mean= 4.557) and (SD= 0.809) was ranked third, followed by 'develop the tourism sector' (mean= 4.552) and 'preservation of historical buildings' (mean= 4.53) respectively. At the same time, the item 'promote high-rise housing' (mean= 3.56), and highest standard deviation (SD= 1.312) was considered to be the less important item of the

analysed aspects. While the items 'using sustainable local materials in construction' (mean= 3.60) and 'promote individual housing units' (mean=3.64) were the second and the third less important items. The results indicated that the Iraqi stakeholders are more concerned about socio-economic aspects such as safety, housing, healthcare, investments, tourism sector, and cultural aspects.

It is worth mentioning, many of responses agreed with previous findings in the sense that all socio-economic urban factors, which were initially identified through the review of the literature, had high mean scores indicating their importance to the stakeholders. 16 of the total 19 socio-economic urban indicators had mean scores greater than 4 (= important), and only three items had mean scores greater than 3 (= moderately important). The findings of the PCA highlighted five structured components. Generally, the internal consistency was high, even when some of the components include only three items. The discussion of socio-economic urban indicators, therefore, will be depending on PCA components according to the importance and priorities of the items. With the possibility of distributing the fourth component 'design context' items between the 'cultural aspects' and 'housing demands' components, in accordance to the direct correlation between each other. This complex structure coincides with the results of previous academic and government studies that have confirmed the importance of identifying the socio-economic urban challenges at the local level, which is considered the cornerstone for guiding decision-makers to achieve sustainable urban development (Cammatt et al., 2015; CSO, 2013; Marcuse, 2006).

*A. Security and safety factors*

Despite the deterioration of security and political violence that swept Iraq after the regime change in 2003, and the insecurity taking place, especially in the north-west region (Rathmell, Oliker, Kelly, Brannan, & Crane, 2006). Many parts, which constitute more than two-thirds of Iraq regions, can be considered relatively stable with very low-intensity of violence. Especially the northern region, areas to the south and east of Baghdad, all the way to the port city of Basra that located southernmost, particularly after 2005 (MOE, 2013; WorldBank, 2015). Although, there is an urgent need to understand the nature of threats and secure integrated protection compatible with environmental and social risks. The terrorist acts have become one of the current urban challenges for limited areas of the Iraq. Therefore, it is necessary to be part of urban design process, in order to mitigate the threat, and reduce the damage, whether for urban places or individual buildings.

It is important to add physical security measures designed to protect the population and material possessions that are proportionate to the potential threats such as terrorist bombs, explosive belts, vehicle-borne, etc. At the same time, to ensure that the required level of protection is provided without compromising the capability to create aesthetic and functional urban spaces (UNHSP, 2007). Enhancing urban safety and security considered fundamental and vital issue of urban development in Iraq (Rathmell et al., 2006).

Consequently, the questionnaire findings indicate that the safety of open places occupied the priority in order of socio-economic urban challenges of Iraq, with a mean score (4.598). As well as the topping of the safety and security

component of PCA, and followed by 'promote and provide integrated urban security systems' (mean= 4.51) and 'securing in buildings' (mean= 4.46) respectively, as shown in Fig. 1. Besides, both of items 'Safety of public places' and 'Provide integrated urban security systems' had received the highest rates (72%) and (66.5%) respectively in 'very important' level. While the item 'Security in building' has received rate (60.9%), as illustrated in Fig. 2. This indicates that the safety and security urban of urban places received public attention on a large scale in addition to the concern of the of individual buildings safety, according to the point of view of the Iraqi stakeholder.

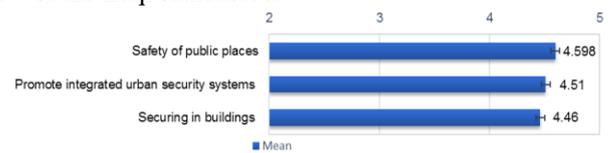


Fig. 1 The level of importance of the safety and security factors Iraqi cities

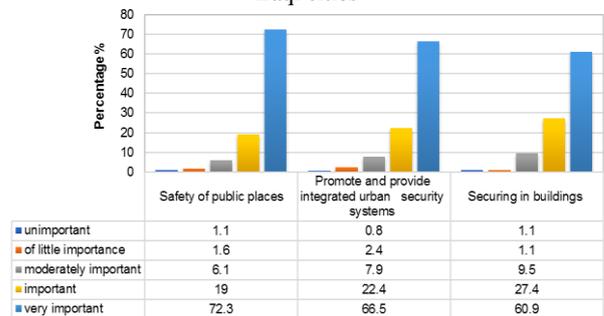


Fig. 2 Public evaluation of the safety factors of Iraqi cities

*B. Economic factors*

Iraqi cities had faced severe conditions as a result of wars and international sanctions for more than for decades. Reviving the economy, therefore, represents an essential need for helping Iraq to restore the damaged and neglected infrastructure and expanding core services. In addition to creating a market-based economy, and to develop other various sectors (e.g.) housing, health, education, and industry (UNDP, 2015). The phenomenon of random housing in Iraq emerged after 1990 and worsened after 2003. It represents an economic and social urban challenges reflecting deficits in infrastructure, services, and being the hotbeds of poverty in addition to poor sanitary conditions. These informal settlements constitute according to the Ministry of Planning report in 2013, estimated at 7.3% of the total number of housing units in Iraq (CSO, 2013). Hence, the item 'Minimize unplanned (random) housing' was ranked as the second important item. The mean score was (4.593) with a nuance for the first position, referring to the equal importance of providing safety and housing Iraqi cities. Also, it was the important factor among other economic factors, as shown in Fig. 3, followed by 'provision of affordable housing' with mean score (4.557). Tourism sector and the investment in the urban development projects also occupies a particular importance in the development of the economy of Iraqi cities. Tourism is one of the largest growing economic sectors worldwide, locally and globally, and it is a relevant factor for development policies. Particularly in ecotourism conservation, which can generate high revenue for the economy can be utilized to find solutions to urban challenges, creating economic development policies, as well as contributing to creating

opportunities for urban projects in developing economies (Steck, 1999).The item ‘develop the tourism sector’ was ranked third with mean score (4.552), followed by ‘encourage investment in urban projects’ and ‘Contribution of urban projects in the provision of employment opportunities’ with a mean score (4.45) and (4.33) respectively.

C. Housing development challenge

Housing represents one of the important social factors for developing countries, including Iraq, which consider one of the fundamental needs of the nations. Housing is an essential socio- economic urban challenge for Iraqi cities. The non-fulfilment of the housing requirements as a result of the inability to produce new homes in sufficient quantities to cover the needs of an increasing population. Especially some official reports referred that about two million housing unit will be required in Iraq cities by 2016. (UNHABITAT, 2010). In addition to the severe shortage of housing, another problem has emerged such as participation of a number of individuals in one dwelling. Nowadays, more than (13%) of Iraqi households have more than ten occupants living together in one residential unit (UNDP, 2015).

According to Fig.4: the item ‘Increasing housing projects’ was ranked the important factor among other with a mean score (4.48), referring that the questionnaire findings were compatible with the government reports and expert opinions on the importance of the housing sector for the Iraq context nowadays. The item ‘promote qualitative housing’ came in second with a mean score (4.11), followed by followed by ‘provide minimum standards based on household size’, ‘Promote individual housing’ and ‘promote high-rise housing’ respectively. Besides, Fig. 5 pointed out the preference of housing development types for Iraqi citizens. About 61% was ‘very important’ for the item ‘promote qualitative housing’, followed by 37.7 % for the item ‘provide minimum standards based on household size’. While the item ‘promote high-rise housing’ had 32.2% and 29.3% for ‘promote individual housing’ respectively.

The results reflected the urgent need to accelerate housing production process, to meet the demand of the community and enable economic growth. The socio-economic policy has the fundamental and important role of the housing sector in responding to the needs of all Iraqis, consistent with the changing demographics of the country. As well as, it considers a vital sector for public investment, both for the social and economic growth as a whole and for the provision of housing for poor and low-income groups.

The questionnaire also, addresses public preference of regions for establishing housing development in Iraq, as shown in Fig. 6; suburban regions had received the highest preferential (mean= 4.31), followed by (mean= 3.80) for rural region, (mean= 3.49) for city centres. While, desert region had received the less value (mean= 3.19) among the other factors.

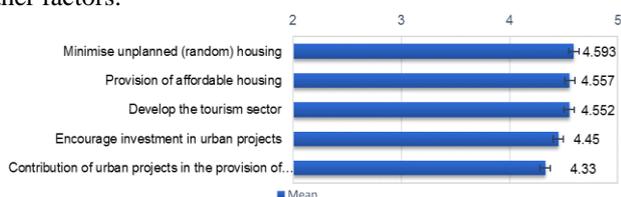


Fig. 3 The economic development factors accordance with priority for Iraqi cities



Fig. 4 The importance of the housing factors of Iraqi cities

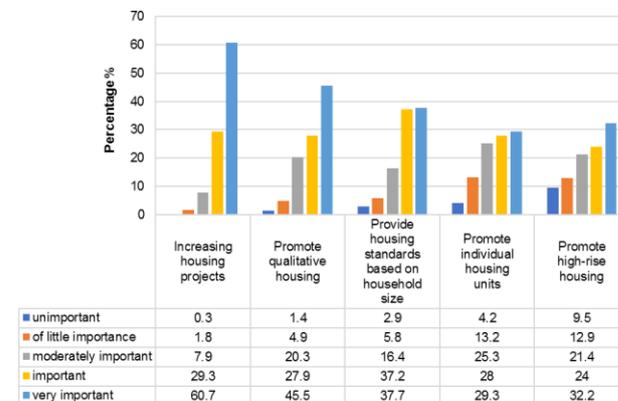


Fig. 5 Preference of housing development types for Iraqi citizens

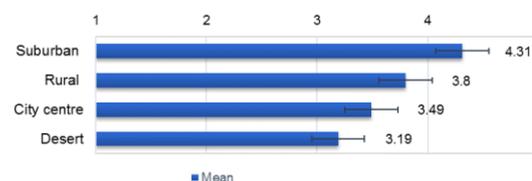


Fig. 6: Public preference of regions for establishing housing development in Iraq

4.4

D. Historical and cultural factors

The history of Iraqi cities is the most diverse in the Arabic world, being the birthplace of history and the first civilization of the ancient world. The Iraqi culture presents a rich mixture of traditions from many civilizations that passed on Iraqi history (Tripp, 2002). The ancient Iraqi civilization was rich with architectural heritage elements. Nevertheless, there is an absence of local style in current architecture, especially in the development of new architectural forms on the urban level (Al-Thahab, 2013). The employment of diverse local culture elements in urban development gives robust features that cities are viable by providing fertile ground for future generations to develop urban projects with the local characteristics (Modak, Jemian, Hongyuan, & Mohanty, 2012). As well as, to create sustainable cities using cultural indicators as a crucial tool for policy makers in community development, environmental awareness, balanced economic growth, and contributing to urban decision-making (Raed F.Mohammed Ameen, Li, & Mourshed, 2014).

The stakeholder’s perceptions pointed out the importance of restoring the historical legacy and local architectural attention to the Iraqi cities. The questionnaire findings showed high awareness of the respondents towards an emphasis on the cultural heritage for the development of new urban design projects in the Iraqi context. Preservation of historical and heritage buildings occupied the importance in perceptions of stakeholders in addition to drawing attention to the traditional building methods and maintaining the buildings of national importance. As shown in Fig. 7, the

item ‘preservation of historical buildings’ was ranked the important factor among other with a mean score (4.53), followed by ‘development of traditional buildings method’ with a mean score (4.51) and ‘preservation of vernacular buildings’ with a mean score (4.39). Referring that the results of the survey confirm the results of the survey confirms on the preservation of historical and heritage buildings in addition to drawing attention to the traditional building methods and maintaining the buildings of national importance. The item ‘promote identity and local culture’ came in four with a mean score (4.27), followed by followed by ‘provide minimum standards based on household size’, preservation of the hierarchy in public and private places’ with a mean score (4.03). While the item ‘Using sustainable local materials in construction’ had a mean score less than 4, indicating to less importance than the rest of the component items from the perspective of the respondents.

Also, Fig. 8 pointed out stakeholder evaluation of the cultural factor for Iraqi cities. The item ‘‘preservation of historical buildings’ had received the highest rate 68.1% as a ‘very important’ factor, followed by 60.4 % for the item ‘preservation of vernacular buildings’, and 48.5% for the item ‘promote identity and local culture’. Also the item ‘development of traditional method for building’ had received 45.1%, followed by 36.4% for the item ‘preservation of the hierarch in public and private places’. While the item ‘development of traditional method for building’ had received 28% as an ‘important’ factor. The findings indicate that the employment of heritage elements by adopting of environmental practice (vernacular) in new urban projects occupied greater importance than the abstract use of traditional materials in external facades to give intimation of cultural heritage to the country or region.

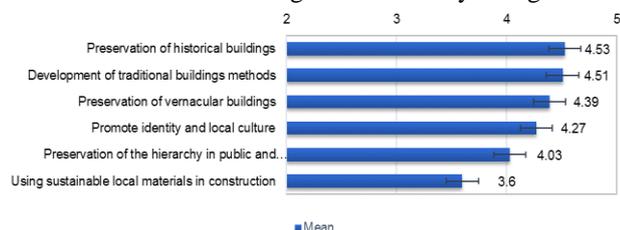


Fig. 7: The importance of the cultural aspects factors of Iraqi cities

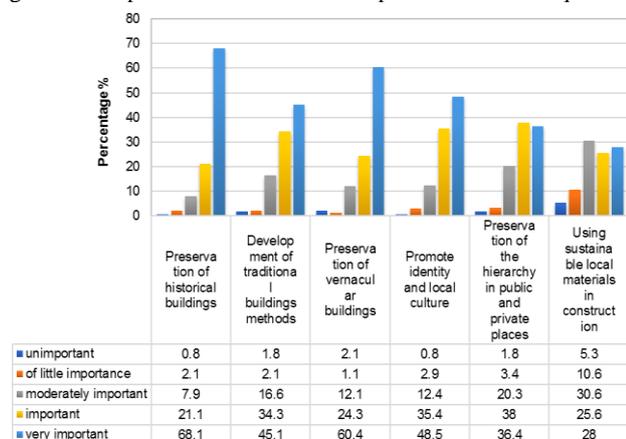


Fig. 8: The stakeholders’ evaluation of the cultural factor for Iraqi cities

V. CONCLUSION

There is now a broad agreement that socio- economic issues are of paramount importance for communities in their present and future. Stakeholder engagement in identifying

socio- economic urban challenges is essential to decision making. This study provides an interactive experience between the community and the urban challenges that are facing their cities and regions, as well as, to compensate the severe shortage of comprehensive social and economic studies of Iraqi context. Through conducting a nationwide survey, many of socio- economic challenges of urban development were investigated, according to the local stakeholders’ perceptions of. 19- Structured item was developed on a 5-point Likert-type scale. Descriptive analysis and principal component analysis (PCA) were conducted on the collected data. Non-parametric tests were implemented to identify any significant differences in stakeholder’s opinions of the PCA items based on applications of indicators as a measure of public perception. PCA distributed the dimensional structure of the questionnaire items for five components, thorough socio-economic factors, with high levels of internal consistency reliability. Therefore, these statistical scales can be considered sufficiently related. Most aspects related to the housing demands; cultural issues; and safety and security were perceived to be more important stakeholders than other factors that related to local materials and considered to be of less impact. The study highlighted the importance of other economic factors with high mean such as: ‘development of the tourism sector’ with mean score 4.552, ‘encourage investment in urban projects’ with mean score 4.45, and ‘contribution of urban projects in the provision of employment opportunities’ with a mean score 4.33. They are indicating that although the factors with a mean score were less than 4.0, the participants consider them to be important, but not as important as the socio-economic indicators that preceded. The lowest ranked indicator was ‘promote high-rise housing’ with mean score 3.56. It was preceded by ‘Using local sustainable materials in construction’ and ‘Promote individuals housing’ respectively.

There were at the end of the list with less important of socio-economic challenges for Iraqi provinces. A comparatively good response rate refers that the findings of this study are suitable to propose sustainable development policies at urban planning and design for Iraqi cities. As well as they can provide an urban data that is critical towards finding urban solutions to create a sustainable development for urban projects in Iraq.

REFERENCES

Ahmad, B. I., & Ahlan, A. R. (2015). Reliability and validity of a questionnaire to evaluate diabetic patients’ intention to adopt health information technology: A pilot study. *Journal of Theoretical and Applied Information Technology*, 77(2), 253-264.

Al-Thahab, A. A. L. (2013). The Absence of a Local Pattern in Iraqi Architecture. *Journal of Babylon University/Engineering Sciences*, 21(3), 927-938.

Aldossary, N. A., Rezgui, Y., & Kwan, A. (2015). An investigation into factors influencing domestic energy consumption in an energy subsidized developing economy. *Habitat International*, 47, 41-51. doi:10.1016/j.habitatint.2015.01.002

Alkhatabi, M., Neagu, D., & Cullen, A. (2010). Information quality framework for e-learning systems. *Knowledge Management & E-Learning: An International Journal (KM&EL)*, 2(4), 340-362.

Allwood, J. M., Cullen, J. M., Carruth, M. A., Cooper, D. R., McBrien, M., Milford, R. L., . . . Patel, A. C. (2012). *Sustainable materials: with both eyes open: UIT Cambridge Cambridge*.

Aluko, O. (2010). The Impact of Urbanization on Housing Development: The Lagos Experience, Nigeria. *Ethiopian Journal of Environmental Studies and Management*, 3(3).

Alwardi, S. (2015). Structural Corruption in the State of Iraq. *Journal of University Heritage College*, 13(Baghdad, Iraq), 1-10.

- Ameen, R. F. M., Li, H., & Mourshed, M. (2014). Sustainability assessment methods of urban design: a review. Paper presented at the The 21st International Workshop: Intelligent Computing in Engineering 2014 (ISBN: 978-0-9930807-0-8), Cardiff, UK.
- Ameen, R. F. M., Mourshed, M., & Li, H. (2015). A critical review of environmental assessment tools for sustainable urban design. *Environmental Impact Assessment Review*, 55, 110-125. doi:10.1016/j.eiar.2015.07.006
- Ameen, R.F.M. & Mourshed, M. (2017). Urban environmental challenges in developing countries—stakeholder perspective. *Habitat International* 64(2017):1-10. DOI10.1016/j.habitatint.2017.04.002
- Arnott, R. (2008). Housing policy in developing countries: The importance of the informal economy. *Urbanization and growth*, 167.
- Awosusi, O. O., & Jegede, A. O. (2013). Challenges of Sustainability and Urban Development: A Case of Ado-Ekiti, Ekiti State, Nigeria. *International Education Research*, 1(1(2013)), 22-29.
- Baker, H. K., Singleton, J. C., & Veit, E. T. (2010). *Survey Research in Corporate Finance: Bridging The Gap Between Theory and Practice*: Oxford University Press.
- Boyne, G. (2002). Public and private management: what's the difference? *Journal of management studies*, 39, 97-122.
- Bugliarello, G. (2006). Urban sustainability: Dilemmas, challenges and paradigms. *Technology in Society*, 28(1-2), 19-26. doi:10.1016/j.techsoc.2005.10.018
- Callao, S., Jarne, J. I., & 'inez, J. e. A. L. (2007). Adoption of IFRS in Spain: Effect on the comparability and relevance of financial reporting. *Journal of International Accounting, Auditing and Taxation*, 16, 148-178.
- Cammett, M., Diwan, I., Richards, A., & Waterbury, J. (2015). *A political economy of the Middle East*: Westview Press.
- Cerny, B. A., & Kaiser, H. F. (1977). A study of a measure of sampling adequacy for factor-analytic correlation matrices. *Multivariate Behavioral Research*, 12(1), 43-47.
- Coaffee, J. (2009). Protecting the urban the dangers of planning for terrorism. *Theory, Culture & Society*, 26(7-8), 343-355.
- Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *psychometrika*, 16(3), 297-334.
- CSO. (2010). Environmental statistics report of Iraq for 2009. Retrieved from Central Statistical Organisation/ Ministry of planning, Iraq:
- CSO. (2013). The Iraq National Development Plan (2013-2017) Retrieved from Central Statistical Organisation/ Ministry of planning, Iraq:
- CSO. (2015). Environmental statistics report of Iraq for 2014. Retrieved from Central Statistical Organisation/ Ministry of planning, Iraq:
- Cutter, S. L., Boruff, B. J., & Shirley, W. L. (2003). Social vulnerability to environmental hazards\*. *Social science quarterly*, 84(2), 242-261.
- DETR. (2000). *Public Participation in Making local environmental Decision*. Retrieved from London, UK:
- Dragan, I. M., & Maniu, A. I. (2013). Snowball Sampling Completion. *Journal of Studies in Social Sciences*, 5(2), 160-177.
- Filippi, F. D., & Balbo, R. (2005). VERNACULAR ARCHITECTURE. IDENTIFICATION, PRESERVATION AND UPGRADING PRINCIPLES. Paper presented at the CIPA XX. International Symposium, Torino, Italy.
- Floyd, F. J., & Widaman, K. F. (1995). Factor analysis in the development and refinement of clinical assessment instruments. *Psychological assessment*, 7(3), 286.
- Freire, M. (2006). Urban planning: challenges in developing countries. *Human Development Madrid*, 1(2006), 1-14.
- Gavaldà-Miralles, A., Choffnes, D. R., Otto, J. S., Sánchez, M. A., Bustamante, F. E., Amaral, L. A., . . . Guimerà, R. (2014). Impact of heterogeneity and socioeconomic factors on individual behavior in decentralized sharing ecosystems. *Proceedings of the National Academy of Sciences*, 111(43), 15322-15327.
- GRNUHE. (2010). Improving urban health equity through action on the social and environmental determinants of health. Retrieved from London, England:
- Hamilton-MacLaren, F., Loveday, D. L., & Mourshed, M. (2013). Public opinions on alternative lower carbon wall construction techniques for UK housing. *Habitat International*, 37, 163-169.
- Hassan, G. F. (2012). Regeneration as an approach for the development of informal settlements in Cairo metropolitan. *Alexandria Engineering Journal*, 51(3), 229-239.
- Heshmati, A., Al-Hammadany, F. H., & Bany-Mohammed, A. (2014). Analysis of Internet Usage Intensity in Iraq: An Ordered Logit Model. *Journal of Knowledge Management, Economics, and Information Technology*, 3(3), 1-21.
- HRW. (2013). *World Report/ 2013- Events of 2012*. Retrieved from USA:
- Huang, H.-M. (2006). Do print and Web surveys provide the same results? *Computers in Human Behavior*, 22(3), 334-350.
- ICSU. (2011). *Health and Wellbeing in the Changing Urban Environment: a Systems Analysis Approach*. Retrieved from Paris, France:
- IWS. (2014). *Internet World Stats*. Retrieved from <http://www.internetworldstats.com/middle.htm>
- Katz, N., Golstand, S., Bar-Ilan, R. T., & Parush, S. (2007). The Dynamic Occupational Therapy Cognitive Assessment for Children (DOTCA-Ch)- A New Instrument for Assessing Learning Potential. *American Journal of Occupational Therapy*, 61(1), 41-52.
- Komeily, A., & Srinivasan, R. S. (2015). A need for balanced approach to neighborhood sustainability assessments: A critical review and analysis. *Sustainable Cities and Society*, 18, 32-43. doi:10.1016/j.scs.2015.05.004
- Kraas, F. (2007). Megacities and global change: key priorities. *The Geographical Journal*, 173(1), 79-82.
- Leech, N. L., Barrett, K. C., & Morgan, G. A. (2015). *IBM SPSS for intermediate statistics: Use and interpretation*: Routledge.
- Loukaitou-Sideris, A. (2006). Is it safe to walk? 1 neighborhood safety and security considerations and their effects on walking. *Journal of Planning Literature*, 20(3), 219-232.
- Marcuse, P. (2006). Security or safety in cities? The threat of terrorism after 9/11. *International Journal of Urban and Regional Research*, 30(4), 919-929.
- Mason, C. (2015). Spatial variations in enterprise: the geography of new firm formation. *Deciphering the Enterprise Culture: Entrepreneurship, Petty Capitalism, and the Restructuring of Britain.-1991,-P, 74-107.*
- Modak, P., Jieman, Y., Hongyuan, Y., & Mohanty, C. (2012). *Shanghai Manual-A Guide for Sustainable Urban Development in the 21st Century*. United Nations, Chapter 9.
- MOE. (2013). *The National Environmental Strategy and Action Plan for Iraq (2013-2017)*. Retrieved from Iraq:
- Moffatt, R. E. (1983). Crime prevention through environmental design-a management perspective. *Canadian J. Criminology*, 25(4), 19-31.
- Molla, M. B. (2015 ). Urbanization process in developing countries: A review on urban ecosystem degradation and public health effect *Research Journal of Agriculture and Environmental Management*, 4(4), 291-298.
- Mourshed, M., & Zhao, Y. (2012). Healthcare providers' perception of design factors related to physical environments in hospitals. *Journal of Environmental Psychology*, 32(4), 362-370.
- Nelson, A. C., Pendall, R., Dawkins, C. J., & Knaap, G. J. (2002). The link between growth management and housing affordability: The academic evidence. *Growth management and affordable housing: Do they conflict*, 117-158.
- OPM. (1990). *Administrative Analysis Grade Evaluation Guide*. Retrieved from USA:
- Padam, S., Arvind, P., & Rani, A. A. (2007). House-to-house survey vs. snowball technique for capturing maternal deaths in India: A search for a cost effective method *Indian Journal of Medical Research*, 125(4), 550-556.
- Parsian, N., & Dunning, T. A. (2009). Developing and validating a questionnaire to measure spirituality: A psychometric process. *Global journal of health science*, 1(1), 2.
- Policy, E. R. (2009). *Promoting Sustainable Urban Development in Europe*. European Commission: Brussels.
- Rakodi, C. (2001). Forget planning, put politics first? Priorities for urban management in developing countries. *International Journal of Applied Earth Observation and Geoinformation*, 3(3), 209-223.
- Rana, M. M. P. (2010). Urbanization and sustainability: challenges and strategies for sustainable urban development in Bangladesh. *Environment, Development and Sustainability*, 13(1), 237-256. doi:10.1007/s10668-010-9258-4
- Rashed, S. (2013). An overview on Internet in Iraq. (REAP Masters), The Hafen City University, Hamburg, Germany.
- Rathmell, A., Oliker, O., Kelly, T. K., Brannan, D., & Crane, K. (2006). *Developing Iraq's Security Sector: The Coalition Provisional Authority's Experience*: Rand Corporation.
- Roaf, S., Crichton, D., & Nicol, F. (2009). *Adapting buildings and cities for climate change: a 21st century survival guide*: Routledge.
- Rodwell, D. (2003). Sustainability and the Holistic Approach to the Conservation of Historic Cities. *Journal of Architectural Conservation*, 9(1), 58-73. doi:10.1080/13556207.2003.10785335
- Rowe, G., & Frewer, L. J. (2000). Public participation methods: A framework for evaluation. *Science, Technology & Human Values*, 25(1), 3-29.
- Satterthwaite, D. (2001). Reducing urban poverty: constraints on the effectiveness of aid agencies and development banks and some suggestions for change. *Environment and Urbanization*, 13(1), 137-157.
- Simkhada, B., Teijlingen, E. R. v., Porter, M., & Simkhada, P. (2008). Factors affecting the utilization of antenatal care in developing

- countries: systematic review of the literature. *Journal of advanced nursing*, 61(3), 244-260.
- Smith, K. (2013). *Environmental hazards: assessing risk and reducing disaster*: Routledge.
- Stanton, J. M. (1998). An empirical assessment of data collection using the internet. *Personal Psychology*, 51(3), 101-107.
- Steck, B. (1999). Sustainable tourism as a development option. Practical guide for local planners, developers and decision makers. Federal Ministry of Economic Cooperation and Development, Germany.
- Tabassum, N. (2014). IMPACT OF UNPLANNED DEVELOPMENT IN LEH. *International Journal of Physical and Social Sciences*, 4(4), 496-506.
- Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. *International Journal of Medical Education*, 2, 53-55. doi:10.5116/ijme.4dfb.8dfd
- Tripp, C. (2002). *A History of Iraq*. Cambridge, UK: Cambridge University Press.
- Tweed, C., & Sutherland, M. (2007). Built cultural heritage and sustainable urban development. *Landscape and Urban Planning*, 83(1), 62-69. doi:10.1016/j.landurbplan.2007.05.008
- UNDP. (2015). United Nations Development Programme in Iraq. Retrieved from <http://www.iq.undp.org/content/iraq/en/home/countryinfo.html>
- UNHABITAT. (2010). Iraq National Housing Policy. Retrieved from Jordan:
- UNHSP. (2007). ENHANCING URBAN SAFETY AND SCURITY. Retrieved from London, UK:
- Vancly, F. (2003). International Principles For Social Impact Assessment. *Impact Assessment and Project Appraisal*, 21(1), 5-12. doi:10.3152/147154603781766491
- Webb, N. M., Shavelson, R. J., & Haertel, E. H. (2006). Reliability coefficients and generalizability theory.
- Wei, Y. D., & Ye, X. (2014). Urbanization, urban land expansion and environmental change in China. *Stochastic Environmental Research and Risk Assessment*, 28(4), 757-765.
- Weible, R., & Wallace, J. (1998). Cyber research: The impact of the Internet on data collection. *Marketing Research*, 10, 19-26.
- WorldBank. (2015). INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT PROJECT APPRAISAL DOCUMENT ON A PROPOSED LOAN IN THE AMOUNT OF US\$ 350 MILLION TO THE REPUBLIC OF IRAQ FOR AN EMERGENCY OPERATION FOR DEVELOPMENT. Retrieved from
- Wright, B., Scott, I., Woloschuk, W., & Brenneis, F. (2004). Career choice of new medical students at three Canadian universities: family medicine versus specialty medicine. *Canadian Medical Association Journal*, 170(13), 1920-1924.
- Wu, F. (2001). China's recent urban development in the process of land and housing marketisation and economic globalisation. *Habitat International*, 25(3), 273-289.
- Zhao, Y., & Mourshed, M. (2012). Design indicators for better accommodation environments in hospitals: Inpatients' perceptions. *Intelligent Buildings International*, 4(4), 199-215.

# Removal of Pb(II) Ions from Aqueous Solution Using Complexation-Ultrafiltration

Deniz Sahin Tas

**Abstract**—Ligand-modified micellar-enhanced ultrafiltration (LM-MEUF) is a membrane technique based on a separation process which can be used for removal of target metals from an aqueous solution. This method adding involves both a metal complexing ligand and surfactant molecule to the aqueous solution under conditions where most of the molecules are present as micelles. The ligand can have attached to the surface of micelles by solubilization and forms the ligand complexes of the metal ion. The aqueous solution is then treated through a membrane which has to be smaller sizes than those of the complexes. Hence, permeate water is then purified from the heavy metals. In this study, divalent lead is the target ion in a solution. Filtration experiments were performed with ultrafiltration membrane system, equipped with a regenerated cellulose membrane with a 5000 Daltons cut-off. The pressure was fixed at 4.0 bar with a permeate flow rate of 500 mL min<sup>-1</sup>. Complexes of Pb<sup>2+</sup> ions with three ligands were investigated in micellar medium of different surfactants at different pH values to determine the ligands which could provide separation. Different parameters affecting the percentage rejection of the Pb<sup>2+</sup>, such as pH and surfactant concentration, were also discussed. Results have shown that the maximum percentage of the Pb<sup>2+</sup> ions rejection was obtained using sodium dodecyl sulfate (SDS) as a surfactant and dithizone (DZ) as the lead-specific ligand. A waste stream sample from a battery plant was subjected to LM-MEUF process in the optimum conditions determined in this study, and it was shown that Pb<sup>2+</sup> ions in a waste stream could be removed by LM-MEUF effectively.

**Keywords**—DZ, ligand-modified MEUF, Pb<sup>2+</sup> ions, SDS

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# Methodology of Automation and Supervisory Control and Data Acquisition for Restructuring Industrial Systems

Lakhoua Najeh

**Abstract**—Introduction: In most situations, an industrial system already existing, conditioned by its history, its culture and its context are in difficulty facing the necessity to restructure itself in an organizational and technological environment in perpetual evolution. This is why all operations of restructuring first of all require a diagnosis based on a functional analysis. After a presentation of the functionality of a supervisory system for complex processes, we present the concepts of industrial automation and supervisory control and data acquisition (SCADA). Methods: This global analysis exploits the various available documents on the one hand and takes on the other hand in consideration the various testimonies through investigations, the interviews or the collective workshops; otherwise, it also takes observations through visits as a basis and even of the specific operations. The exploitation of this diagnosis enables us to elaborate the project of restructuring thereafter. Leaving from the system analysis for the restructuring of industrial systems, and after a technical diagnosis based on visits, an analysis of the various technical documents and management as well as on targeted interviews, a focusing retailing the various levels of analysis has been done according a general methodology. Results: The methodology adopted in order to contribute to the restructuring of industrial systems by its participative and systemic character and leaning on a large consultation a lot of human resources that of the documentary resources, various innovating actions has been proposed. These actions appear in the setting of the TQM gait requiring applicable parameter quantification and a treatment valorising some information. The new management environment will enable us to institute an information and communication system possibility of migration toward an ERP system. Conclusion: Technological advancements in process monitoring, control and industrial automation over the past decades have contributed greatly to improve the productivity of virtually all industrial systems throughout the world. This paper tries to identify the principles characteristics of a process monitoring, control and industrial automation in order to provide tools to help in the decision-making process.

**Keywords**—automation, supervision, SCADA, TQM

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# Automatic Detection of Weld Defects Based on Hough Transform

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**Abstract**—The detection of weld defect is an important application in the field of Non-Destructive Testing (NDT). These defects are mainly due to manufacturing errors or welding processes. Radiography is the most used technique to generate Radiographic images. In this context, image processing especially segmentation is proposed to detect and localize efficiently different types of defects. It is a challenging task since radiographic images have deficient contrast, poor quality and uneven illumination caused by the inspection techniques. In this article, a robust method is presented to detect linear defect based on canny detector and pattern recognition technique ‘Hough Transform’. This task can be subdivided into following procedures: firstly, preprocessing step with Gaussian filter and contrast stretching; secondly, segmentation technique to isolate weld region from background and non-weld using Adaptive Thresholding and to extract edges; thirdly, detection and location of linear defect by Hough Transform. The experimental results show that our proposed method gives good performance for radiographic images.

**Keywords**—Weld defect, radiography, NDT, Hough Transform, Canny, Adaptive Thresholding

## I. INTRODUCTION

The radiography is one of the most used techniques in weld defect inspection. It could become a challenging task since Radiographic films usually have noise and deficient contrast due to intrinsic factors involved in the inspection technique, such as non-uniform illumination and the limited range of intensities of the image capture device [1].

The traditional interpretation of radiography images by artificial methods is subjective, time-consuming, and easy to cause fatigue, due to the problems associated with manual detection. In order to improve the automation level, there is currently a great deal of work and research on non-destructive testing (NDT) methods for detecting welding defects [31, 25, 26]. Generally, there are five major types of weld defects: incomplete fusion, incomplete penetration, slag inclusion, gas cavity and crack which are presented in Fig.1.

The objective is to develop an automated method using image processing detection of defects techniques that is precise and objective. The purpose of the automation of the process of analysis of digitized radiography is to reduce the analysis time, eliminate the subjective aspect in the analysis done by the inspector and improve the quality of those images.

However, Image segmentation is a fundamental topic in image processing and it is often considered the most complex task in the processing of images. Researches in this area are copious but specific to the material being analyzed. In the case of the present investigation, different strategies and methods have been

evaluated in term of defects detection in welding images [9, 10]. The literature reviewed includes a large quantity and variety of methodologies for the detection of welding defects, such as interpolating the image’s background curves, neuronal networks for classification but the inconvenient of this technique resides in its speed of execution that is slow enough [7,8].

However, several works are made for segmentation such as Thresholding techniques which have been studied extensively. Large number of Thresholding methods [2] have been published such as in [3] authors applied sauvola Thresholding with mathematical morphology for weld seam extraction and the Geometric Features for classification. Moreover, some researchers used system of pattern recognition based on texture features analysis [4].

The results are impressive, but require a complex implementation and significant computing time. Furthermore, several researchers of active contours (snakes, level set) [28] have been often adopted to deal with contour estimation of weld defect problems but they are adapted for a certain class of problems, and they fail in the presence of noise. Moreover, they are sensitive to initialization.

Indeed, radiographic image of lengthened, smooth and rectangular shape called lack of penetration defect that occurs in weld is taken for this work.

The most pertinent segmentation techniques apply a complete procedure which selects the region of interest ROI of the defect from the original image. The preoccupation of this work is to present a complete and automatic procedure of line defect detection: we don’t have to use a ROI or interfere the expert to have a diagnosis. Because of the corruption aspect of our images with noise and the meeting of gray level, the segmentation step needs an effective procedure for region separation based on Thresholding method.

In this context we propose a new procedure based on Adaptive Thresholding and Hough transform. In fact, the standard Hough Transform is an efficient technique to find and link line segments in an image [5, 6, 12, 23]. Indeed, it is a transform between image space and parameter space, and it is suitable to detect a particular shape within an image. It is used to detect lines in pipe (crack), cable inspection, tracking road sign identification, lane detection, and many other industrial and medical applications. Moreover, it treats the cases of noisy shapes due to its voting scheme and it can be extended to detect shapes other than lines [26].

In this context we propose a new approach based canny detector to extract edges and Hough Transform to detect defects from original image in weld inspection.

Firstable, a preprocessing stage for edge detection is made to differentiate between real intensity transitions and sudden noise transitions. This is an important problem and each algorithm treats it differently [25, 4]. Hence we propose in this work to use the Adaptative Thresholding which gives a threshold for each pixel in the image, to better recognize region and to avoid elimination of same defect. Furthermore, edge extraction by canny is prior to reduce the amount of data in an image, while preserving the structural properties to be used for defect recognition and location.

This article is organized as follows: Section 1 present an overview of related work in this context. I n section 2, we will detail the proposed method for line defect and the solution scheme of segmentation procedure developed in this study. Section 3 present image pre-processing to ameliorate the quality of the image. Section 4 present the results obtained (an object having linear shape is detected and classified by Hough Transform as weld defect).

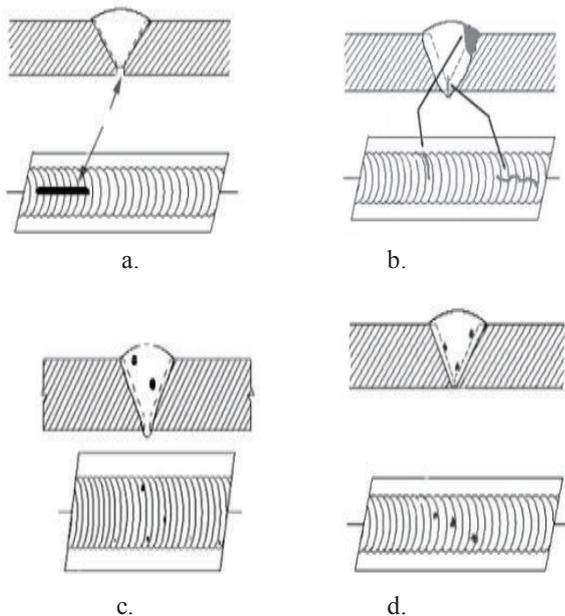


Fig. 1 Weld defects. (a) crack; (b) lack of penetration, (c) porosity, (d) slag inclusion.

## II. RELATED WORK

Many related work for linear shape detection has been carried out in recent years in many domains. Hough Transform has been regarded as a robust detection approach for analytic shapes such as lines, ellipses as well as arbitrary shapes [12]. It is widely used in the detection of straight lines [24].

In [29], an approach is presented for using the HT in detecting line segments. A set of small windows are used to

divide the task of finding line segments in an image into a set of subtasks of detecting short line segments in small windows. After obtaining line segments from windows, a combining strategy is used to combine collinear and overlapping line segments into one line segment.

Researches in [30] find and track road lanes using lines snakes and the Hough transform is used to obtain an initial position estimation of the lane boundaries on the road then the line snake ALM improves the initial approximation to an accurate configuration of the lane boundaries. Molina, Elyson A. N. Carvalho' in [23] propose an new approach based on texture segmentation and on a variation of the Standard Hough Transform, in which the choice of the parameters that determine the straight line that better represents the image is based on the contour conditions of the particular case of weld line detection on fuel storage tanks.

It has been applied in [5] a method for the automated detection of welding defects was presented by Yan Wang and Yi Sun, in which detection follows a pattern recognition methodology to extract features and exploit SVM technique to classify the features. Actually, in every block that contains the defect, they perform Hough transform to remove the noisy pixels (removing pixels which the distance to detected line is larger than a fixed threshold) and get the accurate segmentation and location of the defect.

The authors in [6] propose an effective and adaptive method to automatically detect weld defects using defect tracking in real-time radiographic image sequence of a moving weld. Firstly, a defect segmentation algorithm with low threshold is used to segment all of the potential weld defects in each image of the sequence Then the modified Hough transform is employed to track the center of gravity of potential defects in image sequence, and the potential defects that cannot be tracked are eliminated as false contours.

In [22] authors propose an active contour model based intima-media segmentation approach that simultaneously estimates the initial by using Hough transform on partitioned image segments and combines the independent deformations of two contours together by minimizing a unified energy functional.

## III. PROPOSED METHOD FOR LINEAR WELD DEFECT RECOGNITION

We proposed a new procedure to remedy the problem of linear defect detection and location in noisy condition images based Hough Transform technique. The proposed approach consists of four main stages. Each stage consists of a number of processes, which are carried out sequentially in order to correctly interface with the input of the following stage until the recognition report is obtained.

It is often necessary to start with the preprocessing stage, digital image processing techniques are employed to lessen the

noise effects and to improve the contrast, so that the principal objects in the image become more apparent than the background. Thirdly, segmentation stage: using an Adaptive segmentation method for region separation and edge detection. Canny catch as many edges as possible but it is accompanied with discontinuous and fine contours. So, we applied local thresholding for the binarization before canny to better separate the defect zone from background and to minimize the false contours and to avoid the elimination of same defect. Finally, determination of shapes from the binarized image using Hough Transform. Hough linear Transform gives a meaningful set of lines that are weld and non-weld. So, the variation of Hough's parameters is done to find lines that are weld and the external lines which limits the defect. The block diagram of the proposed automatic defect identification approach is shown in Fig. 2. The functionality of each stage will be described in more detail in the following sections.

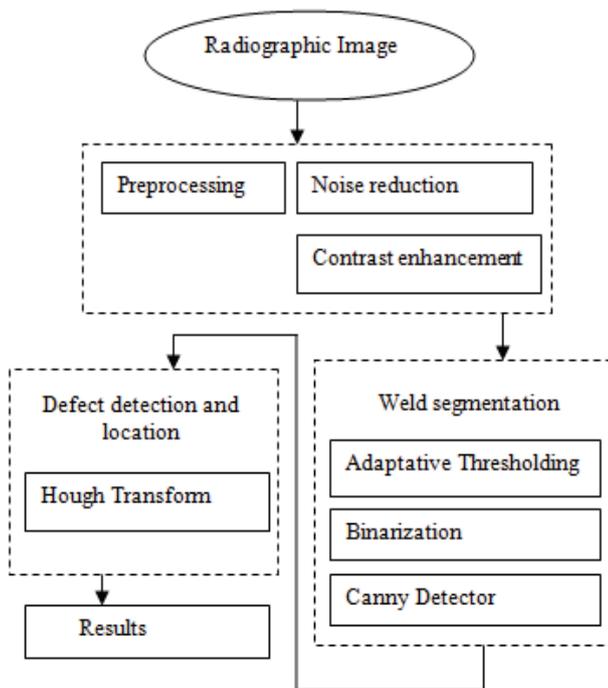


Fig. 2 Procedure for the automatic welding defect detection system.

#### A. The pre-processing step

Radiographic image enhancement is effectively used for better radiograph interpretation. The film digitization process may produce small-contrast images containing some granularities. Image enhancement [15] is required to improve the visibility of the images by eliminating unwanted deformations or by ameliorating the contrast between the image background and the weld defect areas and for removing any noise resulting from the digitization process. Two original images representing lack

of penetration defect are represented in Fig.3. In this section, the radiographic images are contrast enhanced and filtered as described in the following sub-sections.

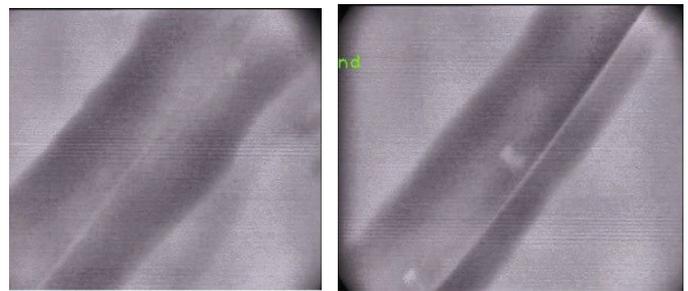


Fig. 3 The original images. (a) Mono weld defect.; (b) Multi weld defect..

#### 1) Noise Reduction

The automatic acquisition of internal welding images is carried out via a linear X-ray sensor for weld inspection. These images obtained in the X-ray or gamma-ray imaging systems contain random fluctuations due to the statistics of the absorption of the quantum of radiation whereas the fundamental noise is due to the discrete nature of the X-ray photons [16, 17]. This noise can impede the reliability of the detection of small discontinuities. In Digitized film-screen images, other sources due to the digitizer, the structure of the intensifying fluorescent screen and the granularity of the film emulsion contribute to noise. So, a periodic noise was added by the system to the "ideal" image. The source is dithering (a variation in contrast of an image when it is digitized due to paper scanning).

Radiographic images indicate considerable variation depending on the testing technique adopted, which makes it difficult to choose a standard filter for noise elimination [14]. The choice of an operator is not simple and quite often a compromise must be found between speed of execution, and quality of result. Thereby, the right choice must keep the improvement of the visibility of our images according to the characteristics of the noise

We found that Gaussian filter is the most appropriate filter to apply to our images. It can easily observe that applying Gaussian filter eliminates most of the noise. So, the principle of Gaussian filter [18] is applied in this work. The Gaussian filter makes it possible to maintain clearer contours than the others.

#### 2) Contrast enhancement

Contrast enhancement is important step to improve the perception for further processing; it can sharpen the image border and improve the accuracy by accentuating the brightness difference between background and foreground.

The idea behind enhancement techniques is to bring out detail that is obscured, or simply to highlight certain features of interest in an image [19].

Contrast stretching is one of the image enhancement techniques that are commonly used for medical images[.]. It attempts to improve the contrast in an image by stretching the range of the intensity values it contains to span a desired range

of values. In our work, we have applied the Adjust Contrast tool which is an interactive contrast and brightness adjustment tool.

### B. Segmentation step

The segmentation aims at extracting sets of points corresponding to significant parts of the "global shape" represented by the image [21].

In pixel detection we have thresholding which is a widespread technique as it allows the conversions of an image in grey scale to a binary image in such a way as to separate background objects according to a specified threshold. The Watershed transform (Beucer et al, 1979) is used in region detection. This technique makes use of morphological mathematics and allows the generation of regions based on cavity filling by simulating a valley filling with water; in the measure that the water level raises, adjacent regions start forming unions.

Liao and Ni [25] proposed a method based on the observation that the intensities of pixels in the weld area distribute more as a Gaussian distribution than other areas in the image. This method had been proved effective, however, only to segment linear welds.

Wang et al. [26] have combined image processing techniques: background and histogram thresholding were implemented to separate defects from the background.

Our images have concentration of the gray levels in a narrow band of values, making difficult the segmentation, even using an optimal method for the choice of a global threshold. Moreover, we know that the defect is brighter than background. So, we can calculate a threshold for each pixel in the image, to better recognize defect's zone. Exactly, the selection of local threshold to statistically examine the intensity values of the neighborhood of each pixel by using an adaptive segmentation algorithm. Thus, it can be a useful for edge detection step without suppression of defects and good separation of regions.

In many studies, the edge detection was performed using gradient approaches such as The Roberts, Prewitt, Sobel and Laplace of Gaussian filters. These calculate the gradient and according to some threshold level determine if a possible edge exists and sophisticated operator like canny [20] which uses a combination of techniques, such as the Gaussian Filter for the elimination of noise, as well as making use of directional gradients, thus allowing the selection of only those edges that are found within the specified threshold. In addition, edges define the boundaries between regions in an image, which helps with segmentation and object recognition. Welding inspection films always have much detail information around the edges which make more difficult to specify and detect the contours so we applied canny.

#### 1) Adaptive Thresholding and binarization

Our images contain weld defects placed in background with different intensities. For such images, intensity is a distinguishing feature that can be used to extract the defects from the background. Thus, it is useful to have it preceded with segmentation step using thresholding for background subtraction. It is evident that for this kind of image as it is

detailed in this section a global threshold is not the best solution so, Adaptive Thresholding is applied to separate desirable foreground image objects from the background based on the difference in pixel intensities of each region. The Local threshold is found by examining statistically (mean, median) the intensity values of the local neighborhood of each pixel. Simple and fast functions include the mean of the local intensity distribution. Generally, the statistic which is most appropriate depends largely on the input image. We calculate the local mean.

by filtering the image with 2D Gaussian smoothing to in general. This procedure also offers the possibility of using median filtering as a robust alternative to the mean.

If the pixel value is below the threshold it is set to the background value, otherwise it assumes the foreground value.

After adopting the value of threshold we use binarization to convert our image to a binary image used after that for edge extraction step.

#### 2) Canny Detector Step

Canny edge detector [11] approximates the operator that optimizes the localization. It is a good detector of edges for noisy images especially while combined to thresholding method. The next advantage is improving the signal to noise-ratio and this is established by Non maxima suppression method.

By fixing the values of Sensitivity threshold and the Standard deviation of the filter to 0.1 and 2. Finally, we can apply canny detector to detect the contours from binary image.

### C. Line detection Step

#### 1) Hough Transform method

Some of the most important achievements of Hough are presented previously. Many researchers used Hough Transform for line detection [22,23,5].

Since it is a robust method that converts the straight line detection problem to a peak seeking problem in the parameter space (also called HT space or Hough space).

In fact, Hough transform applies some transform between image space and parameter space to detect a particular shape within an image.

Generally, a straight line is represented by slope and intercept of y-axis as follows:

$$b=y-kx \quad (1)$$

where  $k$  is the slope of the straight line, and  $b$  is the intercept of the straight line with y-axis.

In the  $(k,b)$  parameter space, a single point  $(k,b)$  corresponds to a unique straight line in image space. This method for the detection of straight lines suffers from horizontal and vertical line detection problems because the slope and the intercept are unbounded. So it was suggested to replace the slope-intercept parameters by angle-radius parameters. The polar representation of straight lines is used as follows:

$$\rho = x \cos\theta + y \sin\theta, \quad (5)$$

where  $\rho$  is the distance between the origin of the coordinate and the straight line  $l$ , and  $\theta$  is the angle between  $\rho$  and X-axis.  $\rho$ ,  $\theta$  and  $l$  are shown in Fig. 4.

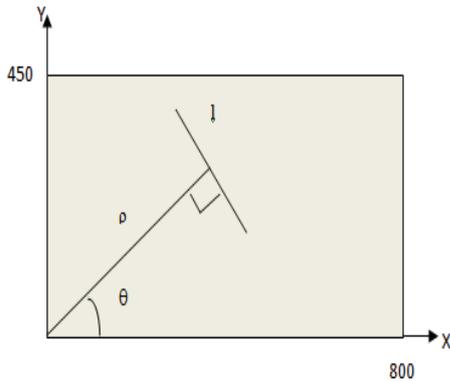


Fig. 4 Line detection

In the  $(\rho, \theta)$  parameter space, a single point  $(\rho, \theta)$  corresponds to a unique straight line. In practical implementations of line detection procedures, both  $\theta$  and  $\rho$  have to be quantized into several discrete values and each point  $(x,y)$  in the image has its relevant  $(\rho, \theta)$ . Then we can construct two dimensional accumulator array  $H(\rho, \theta)$  that denotes the number of the collinear points with respect to  $(\rho, \theta)$  in the binary image. Last, the maximal  $H(\rho, \theta)$  is the peaks. In this way, the problem of detecting collinear points in image space is converted to the problem of finding peaks in parameter space. So, the line with the highest value of peak indicates the straight line of defect in the weld or external lines of defect zone.

## 2) Segmenting the defect

Canny gives the binary image with discrete point at the edges and where the intensity level changes. So these may or may not be in the same line. To detect the co-linearity of the points the Hough transform is then applied.

The contour extraction of the binarized image is performed to reduce the number of pixels to be processed by Hough transform. By observing Fig. 8 (a) and (c) we note that the distribution of defects is in the form of a line and our image contain more than one straight line which contains the defect and external lines which limits the defect

By applying Hough, for segmented image resulting from canny and Thresholding procedure we aim to detect lines and recognize the defect's line. As shown in Fig. 4, we establish a XOY coordinate system with the origin at the left-bottom of the binary image.  $\theta$  should be in the range  $[-90, 89]$ , so that every pixel with value of 1 in the binary image can be detected.

$$\rho < |OA| = \sqrt{450^2 + 800^2} = 917$$

therefore, the range of  $\rho$  is  $[0,917]$ .

Consequently, we can get a two-dimensional accumulator array  $H(\rho, \theta)$  with the size of  $1835 \times 180$ . The selected intervals of  $\theta$  and  $\rho$  are proved to meet the accuracy requirement for detection. We calculate the values of the accumulator array  $H(\rho, \theta)$  for all pixels with the value of 1 in the binary image. The corresponding parameter matrix of edge image and the sinusoidal lines are points in X-Y plan and peaks point of Hough of Fig (3.b) are presented in Fig. 5. By taking  $(\rho, \theta)$  corresponding to the maximal value of the accumulator array as the parameter of the most significant detecting line in the binary image we find that doesn't correspond to the defect's line. So, it is souhaitble to apply different post processing algorithms to detect the defect's line from others.

Indeed, we propose an algorithm to extract the defect's line by using the parameter of Hough  $\rho$ . The defect is always in the middle and is surrounded by two external lines so our goal is to detect and to draw the external lines and after that select the interior line which is the defect.

We note that those lines correspond to the two lines with min and the max of  $\rho$ . So we follow those steps:

Fistable, we have eliminated the lines with  $\theta$  equal to  $-90$ ,  $90$  and  $0$  because those lines are the borders of the image. Secondly, we consider that the line with a minimum value of  $\rho$  is the first external line detected in the image as shown in Fig. 9. Thirdly, we consider the first line with  $\rho$  superior to the minimum and inferior to the maximum is our defect.

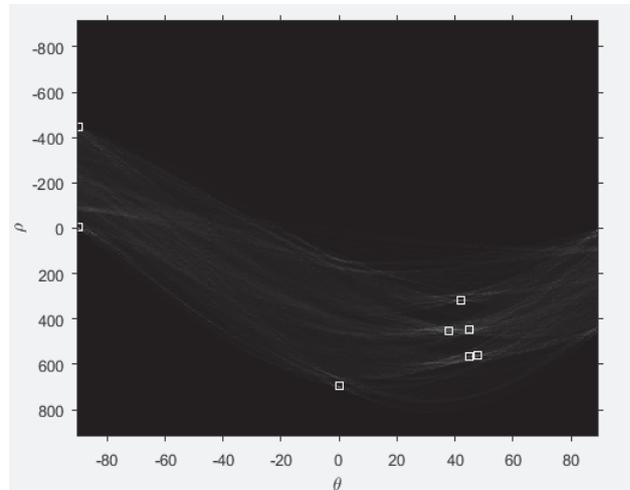


Fig. 5 Peak points in the Hough transform

## IV. EXPERIMENTAL RESULTS AND DISCUSSIONS

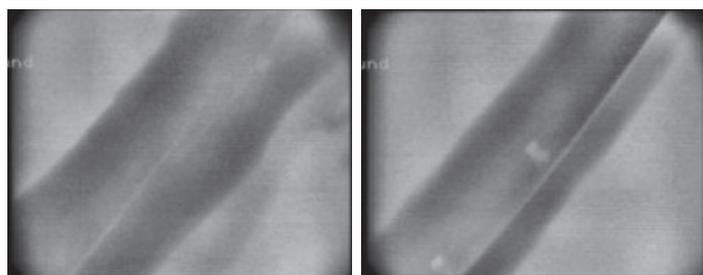
To validate the efficiency and robustness of our algorithm using our images. We applied our procedure already stated on our images. The performance of the proposed approach in noisy environments is proved and the detailed results are presented below.

### A. Preprocessing Results

Fig. 6, 7 shows the effect of the image enhancement stage on two of the digitized radiographic images. Fig. 6(a) and (b) shows the enhanced image after Gaussian filter. Contrast stretching effects is shown in Fig. 7 (a) and (b) respectively. For quantitative evaluation of the image enhancement process, one parameter has been calculated for the enhanced image. This parameter is the Peak Signal-to-Noise Ratio (PSNR) applied after each process and original image is summarized in Table. I

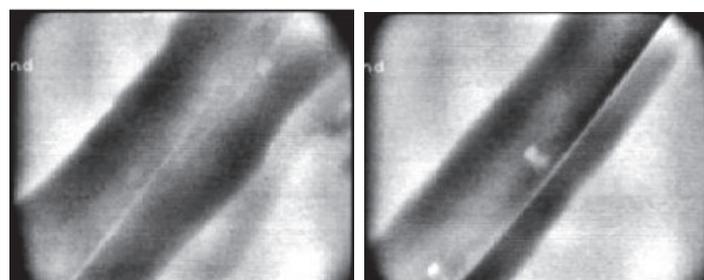
TABLE. I. THE VALUE OF PSNR OF FIG (2. b)

PSNR After Gaussian Filter (db)	28.0095
PSNR After Contrast enhancement(db)	28.0111



a. b.

Fig. 6 Results of noise – removal. (a) Applied to Fig (2.a); (b) Applied to Fig (2.b).



a. b.

Fig. 7 Contrast enhancement by stretching. (a) Applied to Fig (3.a); (b) Applied to Fig (3.b).

As we can see from the above figures, the implementation results of Gaussian filter eliminates most of the noise and the contrast enhancement improve the visibility of our images and make the contours more pronounced and the value of PSNR became higher.

*B. Defect segmentation and location*

This section presents the results of the proposed segmentation method. Starting by image segmentation step which is proceeded as follows; application of Adaptive Thresholding for region separation and defect's zone recognition, after that image binarization and edge detection are shown in Fig.8 (a),

(b), (c), (d) respectively. Finally, detection and location of linear defect by Hough Transform presented in Fig. 9. The results show that the usage of this approach gives good results especially Hough Transform.

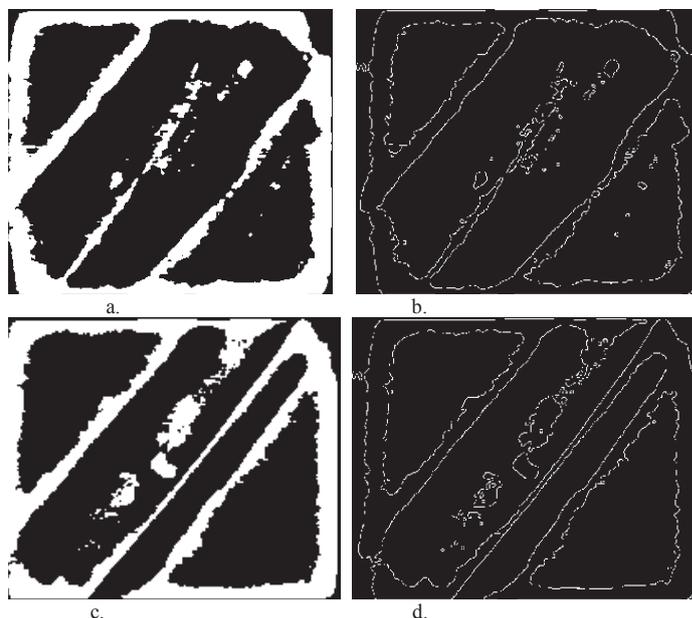


Fig. 8 Adaptive Thresholding, binarization and canny detector. (a) Applied to Fig (3.a); (b) Applied to Fig (3.b).

It can easily observe that applying the above segmentation steps our images are well segmented. Thus, we noted two classes of pixels in the image with the accentuation of defect's region, defect's zone is pronounced and contours are outlined. For quantitative evaluation, PSNR value is calculated after process of segmentation and preprocessing image. We find that is equal to 51.7289 db. The resultant straight lines are shown in Fig.9, plotted over the canny detection image

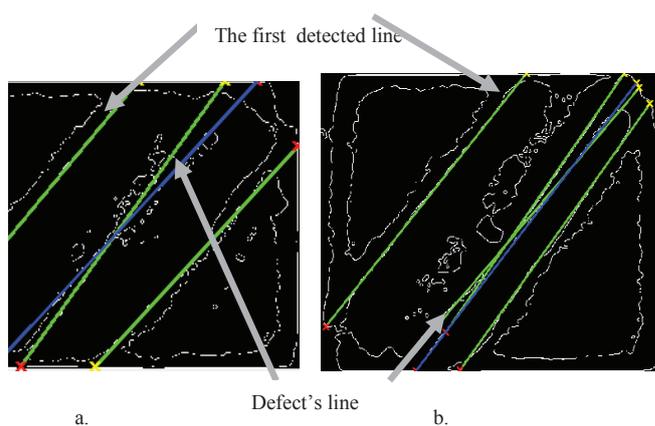


Fig. 9 Detected lines and defect's line on canny image, (a) Applied to Fig (3.a); (b) Applied to Fig (3.b).

We can deduce that one important difference between the Hough Transform and other approaches is resistance of the former to noise in the image and its tolerance towards holes in the boundary line.

## V. CONCLUSION

This paper presented an approach for automatic weld defect detection and localization from radiographic images. The proposed approach starts with image enhancement through contrast enhancement and noise reduction. After that the segmentation process of defects which is done by a combination of Adaptive Thresholding and Hough transform. So, we have performed at first Adaptive Thresholding and canny detector to segment the image and extract edges then Hough Transform to detect and locate the linear defect. The experimental results show that the proposed approach is reliable for the automatic defect detection from radiographic images in noisy environment.

## REFERENCES

- [1] N. Nacereddine, M. Zemat, S. S. Belaïfa and M. Tridi, "Weld defect detection in industrial radiography based digital image processing," *Proceedings of world Academy of science Engineering and technology vol. 2, January 2005*
- [2] M. Sezgin, B. Sankur, "Survey over image thresholding techniques and quantitative performance evaluation". *Journal of Electronic imaging 13(1), Jan. 2004, pp. 146-165.*
- [3] J. Hassan, A. Majid Awan, A. Jalil, "Welding Defect Detection and Classification Using Geometric Features", *10th International Conference on Frontiers of Information Technology, 2012.*
- [4] D Mery, M A Berti, "Automatic detection of welding defects using texture features", (CTIP-2003), June 23-25, 2003, Berlin.
- [5] Yan Wang , Yi Sun, Peng Lv, Hao Wang, "Detection of line weld defects based on multiple thresholds and support vector machine", *NDT&E International 41 (2008) 514-524*
- [6] Yan Wang , Yi Sun, Peng Lv, Hao Wang. Detection of line weld defects based on multiple thresholds and support vector machine. *NDT&E International 41 (2008) 514-524*
- N. Nacereddine, M. Tridi, "Computer-aided Shape Analysis and Classification of Welded Defects in industrial Radiography based Invariant Attributes and Neural Networks", *Proceeding of the 4th IEEE International Symposium on Image and Signal Processing and Analysis, Zagreb, Croatia, pp. 88-93, 2005.*
- [7] Rafael Vilar, Juan Zapata, Ramon Ruiz, "An automatic system of classification of weld defects in radiographic images," *Ndt&E International 42 , 2009.*
- [9] M. Sezgin, B. Sankur, "Survey over image thresholding techniques and quantitative performance evaluation," *Journal of Electronic imaging 13(1), pp. 146-165, Jan. 2004.*
- [10] N. Nacereddine, L. Hamami, M. Tridi, and N. Oucief, "Non-parametric histogram-based thresholding methods for weld defect detection in Radiography," *World Academy of Science, Engineering and Technology International Journal of Electrical, Electronic Science and Engineering, vol.1, 2007.*
- [11] G.T. Shrivakshan, Dr.C. Chandrasekar , "A Comparison of various Edge Detection Techniques used in Image Processing", *IJCSI International Journal of Computer Science Issues, Vol. 9, Issue 5, No 1, September 2012*
- [12 ] H. Kälviäinen, P. Hirvonen, L. Xu and E. Oja, "Probabilistic and non probabilistic Hough Transforms: Overview and Comparisons," *Image and Vision Computing, Vol. 13 N. 4, May 1995.*
- [13] Veerapathirapillai Vinoharan\*, Amirthalingam Ramananj, and Saluka R. Kodituwakku , "A Wheel-based Side-view Car Detection using Snake Algorithm", *ICIAfS'12 Radiographic image sequence", NDT & E International, Volume 46, March 2012, Pages 14-21*
- [14] N. Nacereddine, M. Zemat, S. S. Belaïfa and M. Tridi, "Weld defect detection in industrial radiography based digital image processing," *Proceedings of world Academy of science Engineering and technology vol. 2, January 2005.*
- [15] R. C. Gonzalez and R. E. Woods. *Digital Image Processing*. Prentice-Hall, Inc., 2002.
- [16] A. Kehoe, "The detection and evaluation of defects in industrial images," Ph.D. Thesis, University of Surrey, 1990.
- [17] Y. Zheng, J.P. Basart, "Image analysis, feature extraction and various applied enhancement methods for NDE X-Ray images," *Review of Progress in QNDE, vol. 7, pp. 813-820, 1988*
- [18] Martine Bergounioux, "Quelques méthodes de filtrage en Traitement d'Image," HAL archives-ouvertes, 29 Aug 2010 (v1).
- [19] G. Deng and L. W, "An Adaptive Gaussian Filter For Noise Reduction and Edge Detection," *Cahill.Nuclear Science Symposium and Medical Imaging Conference, 1993 IEEE Conference Record.*
- [20] S.S. Al-amri, N.V. Kalyankar and K.S.D, "Image Segmentation by Using Edge Detection," *Proc.(IJCSSE) International Journal on Computer Science and Engineering, vol. 2, pp. 804-807, 2010.*
- [21] Antonio Alves de Carvalho, Raphael Carlos de Sá Brito Suinta, Romeu Ricardo da Silva, João Marcos, and Alcoforado Rebello, "Evaluation of the Relevant Features of Welding Defects in Radiographic Inspection," *Materials Research, vol. 6, pp. 427-432, 2003.*
- [22] Xiangyang Xua, Yuan Zhoua, "Ultrasound intima-media segmentation using Hough transform and dual snake model," *Computerized Medical Imaging and Graphics 36 (2012) 248-258.*
- [23] Lucas Molina, Elyson A. N. Carvalho, "A Robotic Vision System Using a Modified Hough Transform to Perform Weld Line Detection on Storage Tanks," *Robotic Symposium, 2008. LARS '08.*
- [24] Duda RO, Hart PE. Use of the Hough transformation to detect lines and curves in pictures. *Communications of the ACM 1972;15:11-5.*
- [25] T. W. Liao and J. Ni, "An automated radiographic NDT system for weld inspection, Ch. I: Weld extraction," *NDT & E Int. 29 (3), 157-162 (1996).*
- [26] G. A. Wang and T. W. Liao, "Automatic identification of different types of welding defects in radiographic images," *NDT & E Int. 35 (8), 519-528 (2002).*
- [27] Nobuyuki Otsu, A threshold selection method from graylevel histograms *IEEE transactions on systems, man, and cybernetics, 1979, Vol. SMC-9, No. 1: p. 62-66.*
- [28] Kass M, Witkin A, Terzopoulos D. Snakes ,active contour models, ' *International Journal of Computer Vision 1988;1(4):321-31.*
- [29] Y. Zhang, and R. Webber, "A Windowing Approach to Detecting Line Segments Using Hough Transform", *Pattern Recognition, Vol. 29, No. 2, 1996, pp. 255-265.*
- [30] Dong Jung Kang, Jang Won Choi, In So Kweon, ' Finding and Tracking Road Lanes using "Line-Snakes", *semantic scholar,2004*
- [31] Gang Wang, T. Warren Liao, "Automatic identification of different types of welding defects in radiographic images," *NDT&E International 35 (2002) 519-528*

# Drying Characteristics of Shrimp by Using the Method of Oven

I. A. Simsek, S. N. Dogan, A. S. Kipcak, E. Moroydor Derun, N. Tugrul

**Abstract**—In this study, drying characteristic of shrimp are studied by using the oven method. Drying temperatures are selected between 60 and 80 °C. The effect of temperature on moisture content showed that drying time decreased when the drying temperature increased. Drying times required to reach the final moisture content of the samples were 240, 180 and 150 min at the drying temperatures of 60, 70 and 80 °C, respectively and the drying rates decreased continuously with moisture content decrease. The effective moisture diffusivity ( $D_{eff}$ ) values were calculated using the Fick's second law's cylindrical coordinate approximation and are found between  $3.38 \times 10^{-8}$  and  $4.94 \times 10^{-8}$  m<sup>2</sup>/s. The activation energy ( $E_a$ ) was calculated using modified form of Arrhenius equation and found as 18.57 kJ/mol.

**Keywords**—Activation energy, drying, effective moisture diffusivity, modelling, oven, shrimp.

## I. INTRODUCTION

MARINE products for the human nutrition are very important. Among the main reasons for this is the necessity of consuming the food products in terms of healthy nutrition. Marine products, in other words, aquatic products, constitute an important group of protein foods consumed today. World average consumption of water products is 12.2 kg/year. In European Union water products have the average consumption of is 19.3 kg/year [1], [2].

Turkey is a country having surrounded by three seas and has the potential in terms of shellfish, fish and seafood but the consumption is limited. Aquatic products' fat content is very low and it is quite rich in terms of the essential amino acids. Experiments show that there are significant amounts of vitamins and minerals in fish and aquatic products other than any other protein products [1], [2].

The Caridea, which are generally known as caridean shrimp, are widely found in fresh and salty waters around the world. With the majority of marine species, Carideans are found in every kind of aquatic habitat. In fresh waters about a quarter of the species are found. On the other hand, almost all the members of *Atyidae* and the *Palaemonidae* subfamily *Palaemoninae*. *Macrobrachium rosenbergii*, which is found on every continent except Antarctica is one of the commercially important species [1], [2].

Due to the microbiological activity, food products can easily spoil and decay. This problem can be solved by

decreasing the moisture content of the food products. Drying is a traditional method that is used in the food industry. The drying process is aimed to remove moisture from foods to prevent microbial deterioration, herewith extending the shelf-life and decreasing volume and mass [3]-[6].

In literature, researchers investigated the drying characteristics of several vegetables, fruits and meat type products with different drying techniques. Barley [7], onion [8], carrot [9] and soybean [10] can be given as examples of vegetable drying studies. Banana [11], apple [12] and cranberries [13] can be given as the examples of fruit drying studies. On the meat products, beef [14], [15], meat-based product [16], meat pieces [17] are studied with several techniques such as; vacuum drying, convective drying, sun-drying and oven-drying. Chicken meat [14], [18], chicken meat enriched baguette bread slices [19] are dried with the methods of superheated-steam drying, convection oven, convective air and ultrasonic vacuum drying. On the aquatic products, several researchers studied the drying characteristics of brown algae (*Macrocystis pyrifera*) [20], African catfish (*Clarias gariepinus*) [21], sardine fish [22] and mussels [3], [6] with the methods of convective dehydration, microwave and infrared methods. As can be seen, drying characteristics of vegetables and fruits were widely studied. For the meat type products several researches and for the aquatic products only a few researches were made. Thus, in this study we have aimed to investigate the drying characteristics, effective moisture diffusivities and activation energy of shrimps with the oven method.

## II. EXPERIMENTAL

### A. Materials and Method

Shrimps, China origin (Fig. 1), were obtained from local supermarket in Istanbul and put in the refrigerator till the drying experiments. Before the drying experiments, shrimps were put in a desiccator for 2 h at the room temperature. The initial moisture content of the samples was determined by using oven at 105 °C for 24 h. Triplicate samples were used for the determination of moisture content and the average values were calculated as 83.09%, wet base (w.b.), which equals to 3.97 kg water/kg dry matter.



Fig. 1 China origin fresh shrimps

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**B. Drying Experiments**

Drying experiments were carried out in Ecocell LSIS-B2V/EC55 model oven (MMM Medcenter Einrichtungen GmbH, Planegg, Germany). The experiments were carried out at three different temperatures of 60, 70 and 80 v °C. Fresh and the dried shrimp photos are given in Fig. 2.

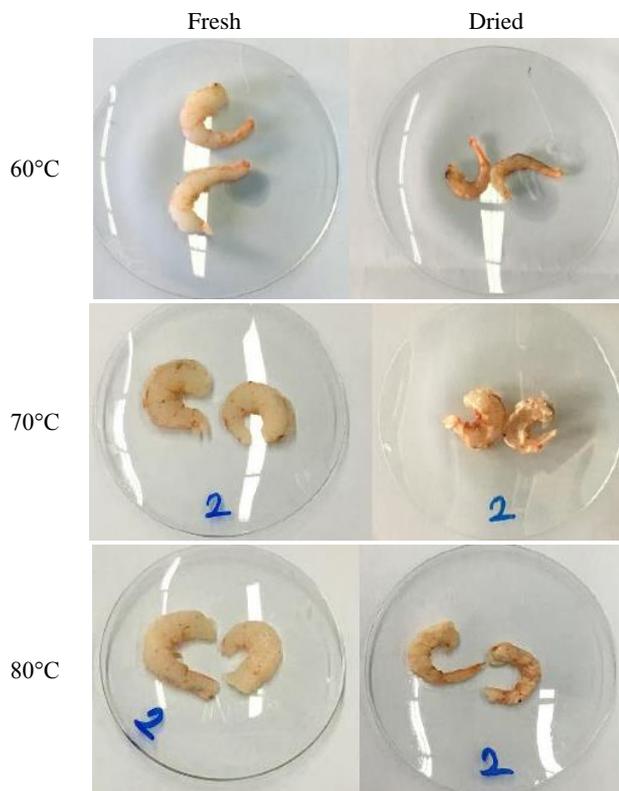


Fig. 2 Fresh and dried Shrimps at different temperatures

Dried shrimps were cooled at room temperature for about 10 min in a desiccator and then packed in low-density polyethylene bags that were heat-sealed. The experimental tests were replicated three times at each temperature and weight loss averages are reported.

**C. Calculation of Effective Moisture Diffusivity**

For drying agricultural products with a falling rate period, Fick’s second law of diffusion is used. Based on Fick’s 2<sup>nd</sup> law of diffusion a model of diffusion was evaluated for the moisture transport, and given as (1) [4]:

$$\frac{\partial M}{\partial t} = \frac{\partial}{\partial x} \left( D_{eff} \frac{\partial M}{\partial x} \right) \quad (1)$$

The analytical solution of Fick’s second law for a finite cylinder with the assumptions of (i) uniform initial moisture distribution (ii) negligible shrinkage (iii) constant diffusion coefficients and temperature during the drying process is given in (2) [4]:

$$MR = \frac{8}{\pi^2} \left[ \sum_{n=1}^{\infty} \frac{4}{a^2 \alpha_n^2} \exp \frac{Ka^2 \alpha_n^2 t}{\pi^2} \right] \left[ \sum_{n=0}^{\infty} \frac{4}{(2n+1)^2} \exp \left[ -K(2n+1)^2 t \left( \frac{a}{l} \right)^2 \right] \right] \quad (2)$$

where a is taken as the radius of finite cylinder as m, l is the one-half length of cylinder as m, K is the D<sub>eff</sub> (Effective

moisture diffusivity, m<sup>2</sup>/s) × π × a<sup>2</sup>. The complex (7) can be simplified and by taking the ln of both sides and putting the K value D<sub>eff</sub> can be calculated from the plot of ln(MR) versus t as given in (3);

$$\ln(MR) = \ln \left( \frac{8}{\pi^2} \right) - \frac{D_{eff} \times \pi^2}{a^2} \times \left( \frac{a}{l} \right)^2 \times t \quad (3)$$

**D. Determination of Activation Energy**

The dependence of the effective diffusivity equation on temperature is described by the Arrhenius equation (4) [3]:

$$D_{eff} = D_0 \exp \left( - \frac{E_a}{R(T + 273.15)} \right) \quad (4)$$

where D<sub>0</sub> (m<sup>2</sup>/s), E<sub>a</sub> (kJ/mol), R (kJ/molK) and T (°C) are the pre-exponential factor of Arrhenius equation, activation energy, universal gas constant and temperature, respectively.

**III. RESULTS AND DISCUSSION**

**A. Drying Curves**

The effect of temperature on moisture content corresponding to drying times is shown in Fig. 3. The results showed that drying time decreased when the drying temperature increased.

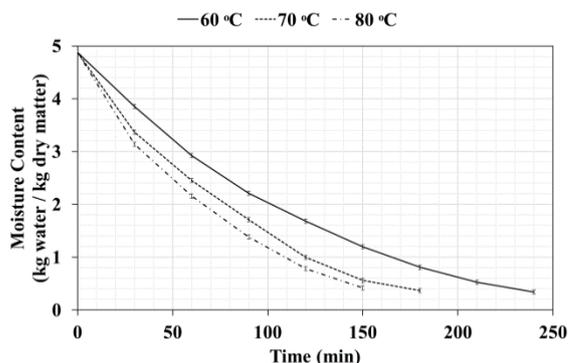


Fig. 3 The effect of temperature on moisture content correspond to drying times

The drying time required to reach the final moisture content of samples were 240, 180 and 150 min at the drying temperatures of 60, 70 and 80 °C, respectively. The drying rate curves of shrimps are shown in Fig. 4. It is clear that the drying rate decreases continuously with moisture content decreases.

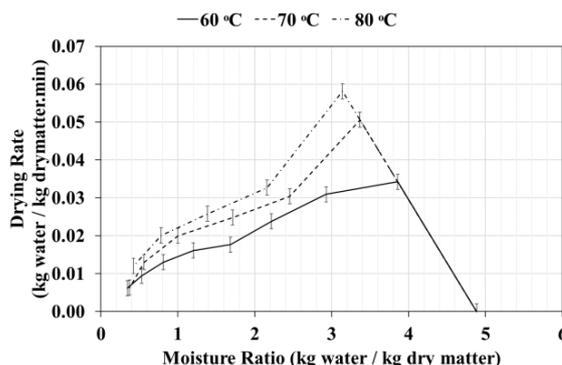


Fig. 4 Drying rate curves with respect to moisture contents

During drying, the drying rates were higher in the beginning of the process, and after that decreased with decrease of moisture content in the samples. The reason for reduction of drying rate might be due to reduction in porosity of samples due to shrinkage with advancement, which increased the resistance to movement of water leading to further fall in drying rates [3]-[6]. Fig. 4 showed that the constant drying rate period was not observed in any cases.

**B. Effective Moisture Diffusivity**

In Fig. 5 by using experimental data, the logarithm of moisture ratio (MR) is plotted versus drying time for different drying temperatures. Obtained equations are given in (5)-(7).

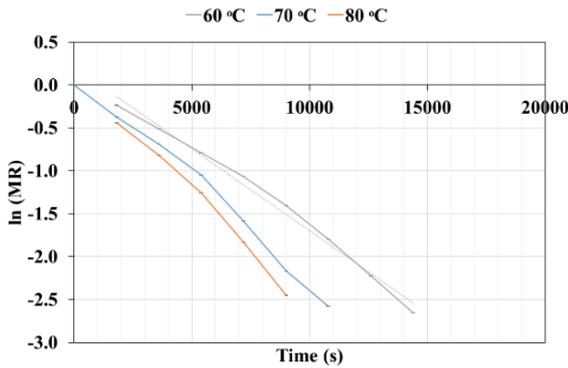


Fig. 5 ln(MR) values with respect to time (s)

$$\ln(D_{eff}) = -0.000191t + 0.210299 \rightarrow (60^\circ\text{C}) \quad (5)$$

$$\ln(D_{eff}) = -0.000242t + 0.103438 \rightarrow (70^\circ\text{C}) \quad (6)$$

$$\ln(D_{eff}) = -0.000279t + 0.148326 \rightarrow (80^\circ\text{C}) \quad (7)$$

The values of effective diffusivity ( $D_{eff}$ ) were calculated using (4). The  $D_{eff}$  values of oven dried shrimps varied between  $3.38 \times 10^{-8} \text{ m}^2/\text{s}$  and  $4.94 \times 10^{-8} \text{ m}^2/\text{s}$  and are given in Fig. 6. It can be seen that  $D_{eff}$  values increased with increasing drying temperature. Drying at  $80^\circ\text{C}$  has the highest value of  $D_{eff}$  and the lowest value was obtained at  $60^\circ\text{C}$ . The values of  $D_{eff}$  from this study lie within in general range  $10^{-12}$  to  $10^{-8} \text{ m}^2/\text{s}$  for drying of food materials [3]-[6].

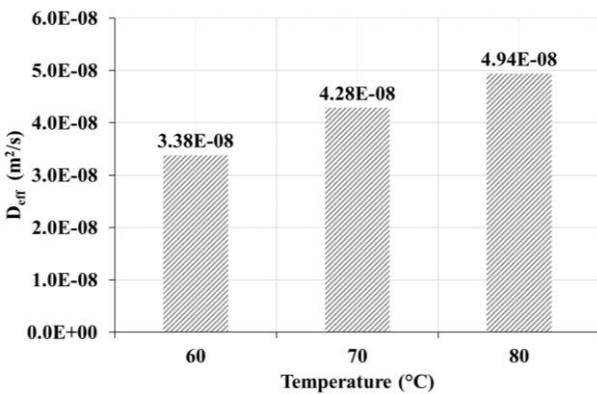


Fig. 6 Calculated  $D_{eff}$  values

The dependence of  $D_{eff}$  with temperature can be given with (8):

$$D_{eff} = 8 \times 10^{-9}T + 3 \times 10^{-8} \rightarrow (R^2 = 0.9916) \quad (8)$$

**C. Activation Energy Calculation**

From the Arrhenius plot, the activation energy can be determined easily, which was given in (9). The  $\ln(D_{eff})$  as a function of  $1/T \text{ (K}^{-1}\text{)}$  was plotted in Fig. 7. The slope of the line is  $(-E_a/R)$  and the intercept equals to  $\ln(D_0)$ .

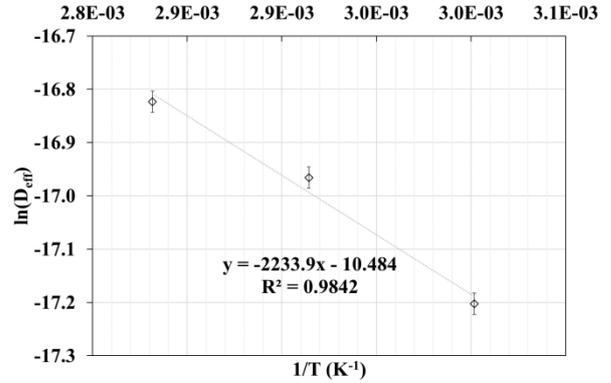


Fig. 7  $\ln(D_{eff})$  values with respect to  $1/T \text{ (K}^{-1}\text{)}$

$$\ln(D_{eff}) = 2233.9 \times \frac{1}{T} - 10.484 \quad (9)$$

The estimated values of  $D_0$  and  $E_a$  are  $2.79 \times 10^5 \text{ m}^2/\text{s}$  and  $18.57 \text{ kJ/mol}$ , respectively.

**IV. CONCLUSIONS**

In this study, the drying behaviour of shrimps was investigated in a laboratory type oven. Since temperature is an important factor in drying time, several different temperatures were studied. Drying time decreased considerably with increasing drying temperature. The effective moisture diffusivity at drying temperature was determined by Fick's second law of diffusion. And an increase in the drying temperature led to increase in the effective moisture diffusivity between  $3.38 \times 10^{-8}$  and  $4.94 \times 10^{-8} \text{ m}^2/\text{s}$ . The dependence of effective moisture diffusivity on drying temperature was expressed by Arrhenius type equation and estimated as  $18.57 \text{ kJ/mol}$ .

**REFERENCES**

- [1] A. Hacioglu, Gama ışınlarının karides ve midyelerin raf ömrü üzerine etkileri, Namik Kemal University, Institute of Science, Ph.D. Thesis, 2010.
- [2] S. De Grave, Y. Cai, A. Anker, Global diversity of shrimps (Crustacea: Decapoda: Caridea) in freshwater, *Hydrobiologia* 595, 287-293, 2008.
- [3] A. S. Kipcak, İ. Doymaz, E. M. Derun, Infared drying kinetics of blue mussels and physical properties. *Chemical Industry & Chemical Engineering Quarterly*. DOI: 10.2298/CICEQ170808014K, 2018.
- [4] A. S. Kipcak, O. İsmail, Comparison of the microwave drying kinetics of culture and natural asparagus. *Acta Scientiarum Technology*. 40, e39922. DOI: 10.4025/actascitechnol.v40i1.39922, 2018.
- [5] O. İsmail, A. S. Kipcak, İ. Doymaz, S. Piskin, Thin Layer Drying Kinetics of Nectarine Slices Using IR, MW and Hybrid Methods. *Bulgarian Chemical Communications*. 49(1), 92-100, 2017.
- [6] A. S. Kipcak, Microwave drying kinetics of mussels (*Mytilus edulis*). *Research on Chemical Intermediates*. 43(3), 1429-1445, 2017.
- [7] T.M. Afzal, T. Abe, Simulation of moisture changes in barley during far infrared radiation drying. *Computers and Electronics in Agriculture*, 26, 137-145, 2000.
- [8] G. P. Sharma, R. C. Verma, P. B. Pathare, Thin-layer infrared radiation drying of onion slices. *Journal of Food Engineering*, 67,

361-366, 2005.

- [9] C. Xu, Y. Li, H. Yu, Effect of far-infrared drying on the water state and glass transition temperature in carrots. *Journal of Food Engineering*, 136, 42-47, 2014.
- [10] C. Niamnuy, M. Nachaisin, N. Poomsa-ad, S. Devahastin, Kinetic modelling of drying and conversion/degradation of isoflavones during infrared drying of soybean. *Food Chemistry*, 133, 946-952, 2012.
- [11] I. Das, S. K. Das, S. Bal, Drying kinetics of high moisture paddy undergoing vibration-assisted infrared (IR) drying. *Journal of Food Engineering*, 95, 166-171, 2009.
- [12] D. Nowak, P.P. Lewicki, Infrared drying of apple slices. *Innovative Food Science and Emerging Technologies*, 5, 353-360, 2004.
- [13] J. Yongsawatdigul, S. Gunasekaran, Microwave-vacuum drying of cranberries: part II. Quality evaluation. *Journal of Food Processing and Preservation*, 20, 145 – 156, 1996.
- [14] M. Başlar, M. Kılıçlı, O. S. Toker, O. Sağdıç M. Arici, Ultrasonic vacuum drying technique as a novel process for shortening the drying period for beef and chicken meats. *Innovative Food Science and Emerging Technologies*, 26, 182-190, 2014.
- [15] T. Ahmat, M. Barka, A. W. Aregba, D. Bruneau, Convective drying kinetics of fresh beef: an experimental and modeling approach. *Journal of Food Processing and Preservation*, 39, 2581-2595, 2015.
- [16] S. Simal, A. Femenia, P. Garcia-Pascual, C. Rossello, Simulation of the drying curves of a meat-based product: Effect of the external resistance to mass transfer. *Journal of Food Engineering*, 58, 193-199, 2003.
- [17] B. A. Ayanwale, O. B. Ocheme, O. O. Oloyede. The effect of sun-drying and oven-drying on the nutritive value of meat pieces in hot humid environment. *Pakistan Journal of Nutrition*, 6, 370-374, 2007.
- [18] A. Natharanakule, W. Kraiwanchkul, S. Soponronnarit, Comparative study of different combined superheated-steam drying techniques for chicken meat. *Journal of Food Engineering*, 80, 1023-1030, 2007.
- [19] C. L. Hii, C. E. Itam, S. P. Ong, Convective air drying of raw and cooked chicken meats. *Drying Technology*, 32, 1304-1309, 2017.
- [20] A. Vega-Gálvez, A. Ayala-Aponte, E. Notte, L. De La Fuente, R. Lemus-Mondaca, Mathematical modeling of mass transfer during convective dehydration of brown algae *Macrocystis pyrifera*. *Drying Technology*, 26: 1610-1616, 2008.
- [21] O. P. Sobukola, S. O. Olatunde, Effect of salting techniques on salt uptake and drying kinetics of African catfish (*Clarias gariepinus*). *Food and Bioproducts Processing*, 89, 170-177, 2010.
- [22] H. Darvishi, M. Azadbakht, A. Rezaeiasl, A. Farhang, Drying characteristics of sardine fish dried with microwave heating. *Journal of the Saudi Society of Agricultural Sciences*, 12: 121-127, 2013.

# Zinc Adsorption Determination of H<sub>2</sub>SO<sub>4</sub> Activated Pomegranate Peel

S. N. Turkmen Koc, A. S. Kipcak, M. B. Piskin, E. Moroydor Derun, N. Tugrul

**Abstract**—Active carbon can be obtained from agricultural sources. Due to the high surface area, the production of activated carbon from cheap resources is very important. Since the surface area of 1 g activated carbon is approximately between 300 and 2000 m<sup>2</sup>, it can be used to remove both organic and inorganic impurities. In this study, the adsorption of Zn metal was studied with the product of activated carbon, which is obtained from pomegranate peel by microwave and chemical activation methods. The microwave process of pomegranate peel was carried out under constant microwave power of 800 W and 1 to 4 minutes. After the microwave process, samples were treated with H<sub>2</sub>SO<sub>4</sub> for 3 h. Then prepared product was used in synthetic waste water including 40 ppm Zn metal. As a result, removal of waste Zn in waste water ranged from 91% to 93%.

**Keywords**—Activated carbon, chemical activation, H<sub>2</sub>SO<sub>4</sub>, microwave, pomegranate peel.

## I. INTRODUCTION

ACTIVATED carbon which has highly developed porosity and surface area is a black solid charcoal [1]. Using physical method, chemical method or two methods together can be produced activated carbon from lots of raw materials such as coal, wood, industrial waste products and some agricultural products [2]. Physical activation have two steps of carbonization step (thermal decomposition of the raw material) and activation step (the activation of the carbonized structure) [3]. By the chemical activation, a raw material is impregnated with an activating reagent and the impregnated raw material is heated under an inert atmosphere. In industry, zinc chloride (ZnCl<sub>2</sub>), phosphoric acid (H<sub>3</sub>PO<sub>4</sub>) and potassium hydroxide (KOH) are most commonly used chemicals [4]. Chemical activation is generally carried out at a lower temperature and shorter time comparing with physical activation. Chemical activation process is more effective for development of a porous structure [5].

In literature it is reported that microwave process can be used instead of pyrolysis [6]-[8]. Microwave heating has lots of advantages, such as high heating rates, controllable and selective heating; energy and time savings as compared with conventional heating [9]. Microwave processes in pilot scale and industrial scale is very important for the production with

stability and purity of the extracts of plant materials [10], [11]. Several researchers studied the parameters such as; temperature of decomposition, heating rates and requirement for feedstock pre-processing (e.g. shredding or drying) with microwave and convection heating [12]-[16].

All living organisms at food chain are affected from heavy metals on industrial waste water which has severe toxicity. Before waste water is released to environment, heavy metals should be made to remove from waste water with aim of the regulatory safe discharge standards [17]. Removal of heavy metals from aqueous solution is performed with several methods such as membrane separation, chemical coagulation, adsorption, ion exchange, extraction, and chemical precipitation [18]. Initial cost, simple design, and easy operation are important for adsorption process [19]. Activated carbon (as powder, granular or fiber) is the most widely used adsorbent because of having large surface area, porous structure, high adsorption capacity and large reactive surface [20]. Among various heavy metals, Zn(II) is a common pollutant in different industrial applications such as natural ores, acid-mine drainage, galvanizing plants and municipal waste water treatment plants [21].

In this study, the effect of microwave process is investigated for the removal of Zn metals from aqueous solution. First of all, pomegranate peel was subjected to 800 W microwave power for 1 to 4 minutes. Then the chemical activation with H<sub>2</sub>SO<sub>4</sub> is conducted. Finally removal of Zn(II) from waste water was measured by obtained activated carbons.

## II. EXPERIMENTAL

### A. Materials and Method

Pomegranate peel was obtained from local juice bar. The residual parts inside pomegranate peel in the end of juicing process are discharged. After pomegranate peel was washed with tap water, it was dried overnight at 70 °C. Then it was grinded and eliminated from 20 mesh sieve. Dry pomegranate peel was put into low density polyethylene bags.

The MW treatment of dry pomegranate peel was carried out using a Robert Bosch HMT72G420 Microwave Oven which has maximum power of 800 W with an operating microwave frequency of 2.45 GHz (wavelength 12.2 cm).

Dry pomegranate peel (1 g) was put into two watch glasses and placed in microwave oven. Microwave process was done for 1 to 4 minutes. Process was carried out under constant MW power (800 W) and air condition. At the end of microwave process, samples were weighed and loss weight was noted.

At this step, 3 ml of H<sub>2</sub>SO<sub>4</sub> was added for each 1 g of pretreated samples. At the end of 3 h, it was rinsed with

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deionized distilled water several times until pH 5.5. Same chemical activation process was carried out for dry pomegranate peel without microwave treatment. Product dried over night at 105 °C.

Adsorption of Zn was examined by mixing 0.25 g of the product with 40 ppm of Zn solutions (50 ml) at room temperature ( $22 \pm 0.5$  °C). Stirring speed and time were selected as 500 rpm and 2 h, respectively. At the end of adsorption experiment, solution was separated from activated carbon by filter paper.

#### Characterization

Fourier Transform Infrared Spectroscopy (FTIR) spectra with Universal ATR sampling accessory – Diamond / ZnSe Crystal were recorded in the 1800–650  $\text{cm}^{-1}$  region by a Perkin Elmer Spectrum One (Fig. 1 (b)).

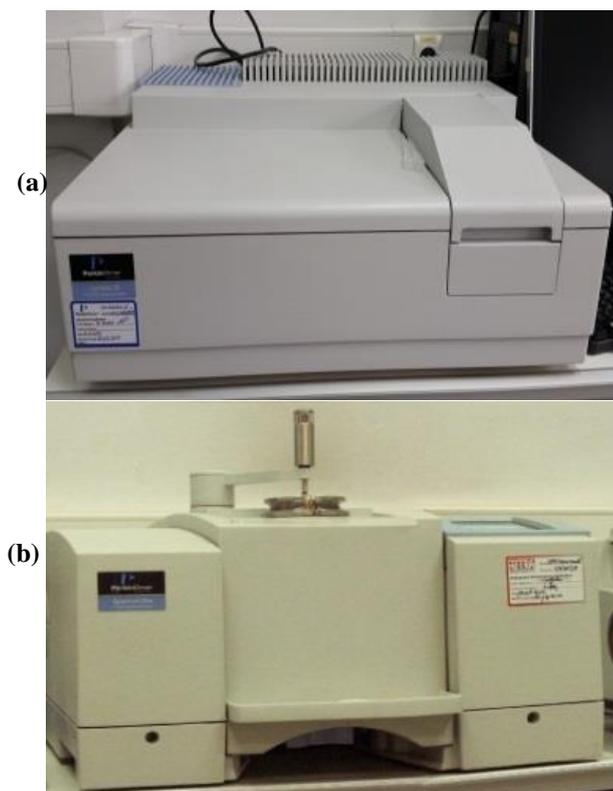


Fig. 1 (a) Perkin Elmer 35 Lambda UV/Vis Systems, (b) Perkin Elmer Spectrum One FT-IR

### III. RESULTS AND DISCUSSION

For measurement of equilibrium concentrations of Zn, Perkin Elmer 35 Lambda UV/Vis Systems spectrophotometer (Fig. 1 (a)) was used at wavelength 300 nm.

#### Results of Microwave Pre-Treated Samples

After microwave process, loss weight results of samples are shown in Fig. 2.

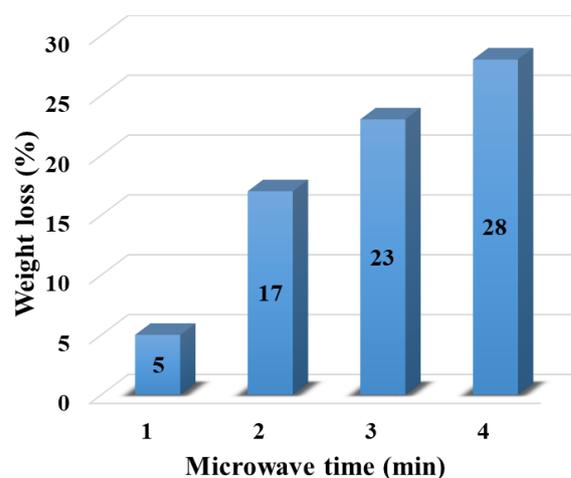


Fig. 2 Weight loss of the samples with increasing microwave treatment time

As shown in Fig. 2, loss weight depends on time of microwave. Because of volatilization of some volatile substances, loss weight can increase with increasing time.

#### Characterization of Activated Carbons

FTIR spectra and spectroscopic assignment of synthesized activated carbons and raw material are shown in Fig. 3 (a). Also FTIR spectra of commercial activated carbon are given in Fig. 3 (b). The numbers used as symbol in Fig. 2 (a) are the microwave times as min.

In Fig. 3 (a), transmittance peaks are approximately 1715 and 1595  $\text{cm}^{-1}$  of the wave number for activated carbon and 1014  $\text{cm}^{-1}$  of the wave number for raw material. Also commercial activated carbon has peaks about 1580, 1100 and 790  $\text{cm}^{-1}$ . Also due to C=C tensions, many carbonaceous materials make absorption in the region of approximately 1600  $\text{cm}^{-1}$  peak. The small peak at about 1700  $\text{cm}^{-1}$  results from C = O tensions. Kinonik groups (1550-1680  $\text{cm}^{-1}$ ), carboxylic acid (1665-1760  $\text{cm}^{-1}$ ) and lactones (1675-1790  $\text{cm}^{-1}$ ) show absorbance in this region. And in the FT-IR spectrum of raw material, C–O–C (1057  $\text{cm}^{-1}$ ) tension is observed.

In the FTIR spectra, all samples have similar bands. But observed peak around 1000  $\text{cm}^{-1}$  in the band of raw and commercial material disappear in bands of the activated carbons.

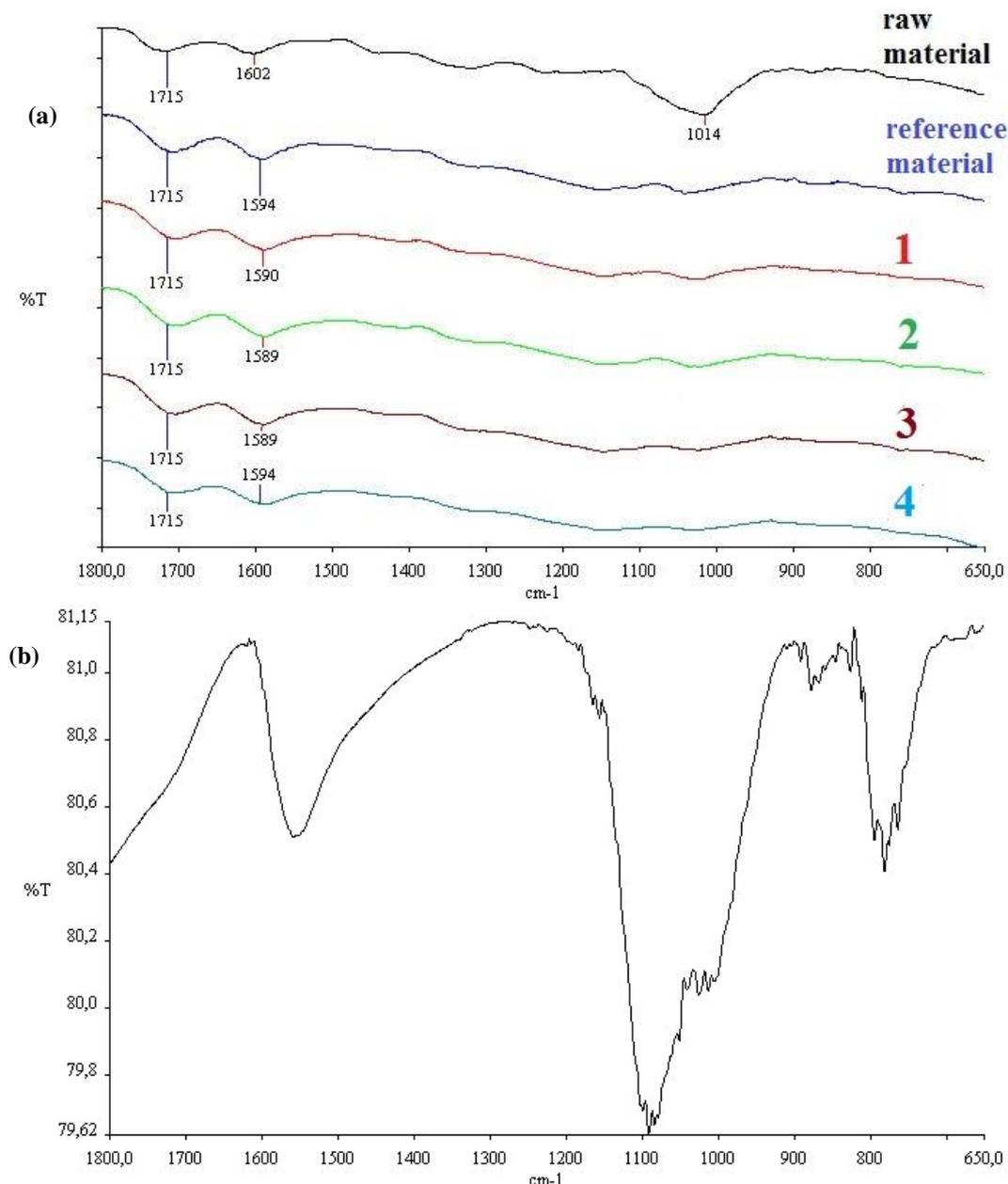


Fig. 3 FT-IR spectrum (a) synthesized activated carbon and raw material, (b) commercial activated carbon

#### Results of Adsorption of Zn (II) by Activated Carbon

In Fig. 4, the removal of Zn (II) ions in solution, which the initial concentration is 40 ppm is presented. Numbers using for synthesized activated carbon in Fig. 4 represent microwave times.

As seen from the results the maximum absorption was occurred at the 1 min microwave treated sample and the minimum absorption was occurred at the 3 min microwave treated sample.

#### IV. CONCLUSIONS

Activated carbon is most popular material for removal of heavy metals from waste water. For this reason, investigations oriented reducing cost are continued. In recent years, researchers have been directed towards production of activated carbon with microwave energy due to advantage saving energy and time.

In this study, H<sub>2</sub>SO<sub>4</sub> was used as an activation agent after the microwave pretreatment for pomegranate peel. And

obtained activated carbon was used for adsorption of Zn (II) ions in the Zn solution. Although significant weight loss is observed in the microwave process, there is substantially no effect on the zinc removal. Produced activated carbon by using only chemical activation is quite successfully for adsorption.

In the future studies, firstly chemical agent then microwave process will be used to produce activated carbon.

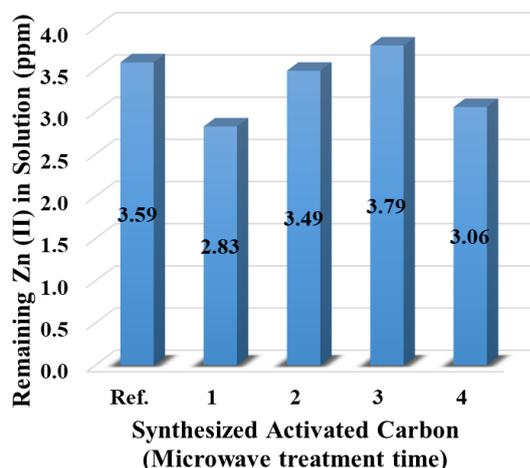


Fig. 4 Removal of Zinc (II) solution with respect to microwave treatment time

#### REFERENCES

- [1] J. N. Sahu, J. Acharya, B.C. Meicap, Optimization of production conditions for activated carbons from tamarind wood by zinc chloride using response surface methodology, *Bioresour. Technol.*, vol. 101 1974–1982, 2010.
- [2] J. Guo, A. C. Lua, Characterization of chars pyrolyzed from oil palm stones for the preparation of activated carbons, *J. Anal. Appl. Pyrol.*, vol. 46, 113–125, 1998.
- [3] B. S. Girgis, L. B. Khalil, T. A. M. Tawfik, Porosity development in carbons derived from olive oil mill residue under steam pyrolysis, *Journal of Porous Materials*, vol. 9, 105–113, 2002.
- [4] J. W. Patrick, Porosity in carbons: characterization and applications, Edward Arnold, 331 p, 1995.
- [5] S. Yorgun, N. Vural, H. Demiral, Preparation of high-surface area activated carbon from Paulownia by  $ZnCl_2$  activation, *Micropor. Mesopor. Mater.*, vol.122, 189–194, 2009.
- [6] M. Miura, H. Kaga, A. Sakurai, T. Kakuchi, K. Takahashi, Rapid pyrolysis of wood block by microwave heating, *J. Anal. Appl. Pyrolysis*, vol. 71, 187–199, 2004.
- [7] H. Akitoshi, N. Yosuke, N. Toshio, C. Saika, K. Hisanori, K. Shunsaku Manufacturing method of activated carbon by microwave heating and its device, Patent of Japan, JP 2004-352595, 2004.
- [8] K. Setsihi, A. Seiichi, K. Shiro, O. Masaharu, Carbonization and production of activated carbon, Patent of Japan, JP 2000-034114, 2000.
- [9] D.A. Jones, T. P. Lelyveld, S. D. Mavrofidis, S. W. Kingman, N. J. Miles, Microwave heating applications in environmental engineering- a review, *Resources, Conservation and Recycling.*, vol.34, 75-90, 2002.
- [10] D.E. Clark, W.H. Sutton, Microwave processing of materials, *Annual Review of Materials Research*, vol. 26 299–33, 1996.
- [11] “Crodarom production facilities,” 2015. (Online). Available: <http://www.crodarom.com/home.aspx?s=110&r=124&p=896>
- [12] V. L. Budarin, J. H. Clark, B. A. Lanigan, P. Shuttleworth, D. J. Macquarrie, Microwave assisted decomposition of cellulose: a new thermochemical route for biomass exploitation, *Bioresour. Technol.*, vol. 101, 3776–3779, 2010.
- [13] L.G. Da Silv, A. Domínguez, J. A. Menéndez, M. Inguanzo, J. J. Pis, Production of bio-fuels by high temperature pyrolysis of sewage sludge using conventional and microwave heating, *Bioresour. Technol.*, vol. 97, 1185–1193, 2006.
- [14] X. Zhao, Z. Song, H. Liu, Z. Li, L. Li, C. Ma, Microwave pyrolysis of corn stalk bale: a promising method for direct utilization of large-sized biomass and syngas production, *Journal of Analytical and Applied Pyrolysis*, vol. 89, 87–94, 2010.
- [15] F. Yu, P. H. Steele, R. Ruan, Microwave pyrolysis of corn cob and characteristics of the pyrolytic chars, *Energy Sources, Part A: Recovery Utilization, and Environmental Effects*, vol. 32, 475–484, 2010.
- [16] E. Yagmur, M. Ozmak, Z. Aktas, A novel method for production of activated carbon from waste tea by chemical activation with microwave energy, *Fuel*, vol. 87 3278–3285, 2008.
- [17] A. K. Meena, C. Rajagopal, Kiran, G. K. Mishra, Removal of heavy metal ions from aqueous solutions using chemically ( $Na_2S$ ) treated granular activated carbon as an adsorbent, *J. Sci. Ind. Res.*, vol. 69, 449–453, 2010.
- [18] S. H. Lin, S. L. Lai, H. G., Leu, Removal of heavy metals from aqueous solution by chelating resin in a multistage adsorption process, *J. Hazard. Mater.*, vol. 76(15), 139–153, 2000.
- [19] V. Meshko, L. Markovska, M. Minceva, A. Rodrigues, Adsorption of basic dyes on granular activated carbon and natural zeolite, *Water Res.*, vol. 35(14), 3357–3366, 2001.
- [20] C. C. Bansal, J. B. Donnet, F. Stoeckli, *Active Carbon*. Marcel Decker, New York, 1988.
- [21] L. Norton, K. Baskaran, S. T. McKenzie, Biosorption of zinc from aqueous solutions using biosolids, *Adv. Environ. Res.*, vol. 8, 629–635, 2004.

# Chemical Analysis and Sensory Evaluation of “Domiaty Cheese” Using Strains Isolated from Algerian Goat’s Milk

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## Abstract

A total of 153 wild lactic acid bacteria were isolated from goat’s milk collected from different areas in Western Algeria. The strains were screened for production and technological properties such as acid production, aminopeptidase activity, autolytic properties, antimicrobial activity and exopolysaccharide production. In general most tested isolates showed a good biomass separation when collected by centrifugation; as for the production of the lactic acid, results revealed that our strains are weakly acidifying; nevertheless, lactococci showed a best acidifying activity compared to lactobacilli. Aminopeptidase activity was also weak in most strains; but, it was generally higher for lactobacilli compared to lactococci. Autolytic activity was generally higher for most strains, more particularly lactobacilli. Antimicrobial activity was detected in 50% of the isolates, particularly in lactobacilli where 80% of strains tested were able to inhibit the growth of other strains. The survey of the profile of the texture, the proteolysis as well as the development of the flavor in the Domiaty cheese made on the basis of our isolated strains have been led during the ripening. The sensory assessment shows that the cheese salted in milk received the best scores in relation to cheese salted after drainage. Textural characteristics, such as hardness, cohesiveness, gumminess and chewiness decreased in the two treatments during the 60 days of ripening. Otherwise, it has been noted that adhesiveness and adhesive force increased in the cheese salted in milk.

**Keywords:** Lactic acid bacteria; Technological properties; Acidification; Aminopeptidase activity (AP), Autolysis; Bacteriocin; Exopolysaccharides (EPS); textural properties.

## Introduction

To assess, on a practical level, the technological achievements of our isolated strains, a soft white cheese type Domiaty was made.

Talaga or Domiaty is an Egyptian soft cottage cheese. Few data are available on the properties of proteolysis and texture of Domiaty cheese. It was made in order to evaluate the technological properties of strain mixture *Lactobacillus rhamnosus* 7S3, CH88, 9S4, 9S9 and 9S10 during cheese ripening and to determine the effect of selected starters on proteolysis and texture of the cheese during the ripening period by estimating the organoleptic, physico-chemical, textural and sensory.

For this, we have selected strains which showed a good and a high rate of autolysis and aminopeptidase activity and showing no antagonistic effect when grown in association. Since, the majority of our strains were weakly acidifying, we used a commercial yeast (FRC 60a = *Lc. lactis* ssp. *cremoris*, *Lc. lactis* ssp. *lactis*, *Streptococcus thermophilus*, *Lb. delbrueckii* subsp. *bulgaricus* from Hansen Denmark firm).

## Preparation of concentrates of selected strains (yeast)

Before the preparation of mixtures which should be used as ripening starter, strains were concentrated using the following protocol:

The cultures are activated in their growth medium for 24h. Then they were inoculated with 10% in vials containing 50 ml of culture medium and incubated for 24 h. This medium was used to inoculate flasks containing 500 ml of culture medium (10%). The growth of inoculated bacteria is followed by measuring the DO<sub>650nm</sub> until early stationary phase. The cells were collected by centrifugation at 10000 rpm at 4 ° C for 10 min. The pellet was washed twice in potassium phosphate buffer (pH 7, 0.01M) under the same conditions as above. The bacterial cells are washed and suspended in 100 ml of the buffer used for washing, stored at -20 ° C and will be used for the preparation of starter (mixed strains). Note: We used two methods of salting; one in a brine bath for 25 minutes after draining and salting live in the vessel containing the milk during coagulation.

## Parameters measured during the cheesemaking

The cheeses were analyzed during the manufacturing and refining at different stages: manufacturing milk, cheese vat and during ripening (D +1, D +30 and D +60).

## Physico-chemical analysis

### -Measurement of pH and acidity of milk

The pH of milk is measured by pH meter (Cole-Parmer LCD model 5994-10), while the acidity (% lactic acid) is measured by titration of 10 ml of milk with a solution of NaOH 1/9N in the presence of phenolphthalein.

During manufacture, the pH and acidity of milk and whey are constantly measured.

### -Determination of fat

The fat in cheese is also measured using the method described by Gerber Ling (1963), using concentrated sulfuric acid and

n-amyl alcohol (3 g cheese / 1 ml alcohol / 1 ml sulfuric acid) except that in this case is added to the sample 1.5 ml of distilled water.

#### **Determination of protein**

Milk proteins were measured according to the method described by AOAC (1960) which consist to titrate the acidity of the first 10 ml of milk by 0.1 N sodium hydroxide in the presence of potassium oxalate (0.4 ml), phenolphthalein (2 drops), followed by titration of acid functions of proteins by sodium hydroxide in the presence of formalin (2 ml).

The protein content is calculated by multiplying the volume of 0.1 N sodium hydroxide in the second titration by the coefficient 1.7.

Besides measuring the chemical and biochemical parameters of cheeses, they will be subjected to texture analysis as well as sensory analysis by a panel consisting of members of the Laboratory of Biochemistry and Microbiology of Lactic Acid Bacteria from the University of Alexandria.

#### **Analysis of cheese**

In the end of manufacture, and during the ripening of cheese, that is to say the first day of production after 30 and 60 days, samples will be collected for the measurement of chemical parameters mentioned up and assessment of proteolysis (varying content of free amino acids).

The cheeses were analyzed for fat content by Gerber method (AOAC, 2000) and total protein by Kjeldahl method (AOAC, 2000).

Moisture was determined using a device Moisture Analyzer (Mettler Toledo Model HR 73, Switzerland). The pH was measured by dissolving 10 g of grated cheese in 10 ml of distilled water in a pH-meter Precisa.

#### **Determination of free amino acid groups**

The concentrations of free amino acid groups in cheeses are determined by the Cd-ninhydrin method cited by Folkertsma and Fox (1992). The principle is based on tracing a standard curve with different concentrations of leucine at concentrations ranging from 0.125 to 2.0 mM. 50  $\mu$ l of the extract of cheese dissolved in water are added to 950  $\mu$ l of water to have a volume of 1 ml. Then 2 ml Cd-ninhydrin reagent (1 g CdCl<sub>2</sub> dissolved in 1 ml of water, 0.8 g of ninhydrin, 80 ml of 90% ethanol and 10 ml of glacial acetic acid) are added to the extract and heated to 84 ° C for 5 min.

The absorbance of OD was measured at 507 nm, then reading this DO is converted to its equivalent in mg leucine. g<sup>-1</sup> cheese.

Free amino acids for each treatment are determined on the 1st, 30th and 60th day in two repetitions.

#### **Sensory evaluation of cheese**

The sensory evaluation was estimated by a panel of 10 persons constituting the technical staff of the Laboratory of Microbial Biochemistry, Department of Science and Technology of Milk, Faculty of Agriculture, University of Alexandria. Panelists considered the samples for appearance, flavor, aroma and texture.

#### **The analysis of texture**

The sensory evaluation by a taste panel can be replaced by an objective measure using a device. The profile of the texture analysis (TPA) is the key instrumental method used in order to correlate with sensory texture parameters.

The properties of Domiati cheese texture were evaluated using texture analyzer (CNS/FARNELL LFRA, Borehamwood, Hertfordshire, England) in two replications. The texture analyzer is fitted with a needle probe (30 ° and a diameter of 25 mm) at a strain rate of 1 mm. s<sup>-1</sup> and a penetration distance of 10 mm.

### **Results**

#### **Evaluation of physico-chemical properties of Domiati cheese**

The process of cheese ripening corresponds to an enzymatic digestion phase of the curd cheese and allows to acquire the desired organoleptic properties. Microbial enzymes and those originally present in the cheese milk and rennet remaining involved in the processing of cheese during ripening. Thus during ripening, several types of degradations are performed, including among other things, the fermentation of lactose and protein hydrolysis and to a lesser extent, fats (Mc Sweeney and Sousa, 2000).

It is within this context that we have manufactured a type of cheese (Domiati) using strains that we isolated with the technological properties (autolytic and proteolytic activity and having no antagonist activity at a combination culture) were acceptable.

Domiati cheese is a made from Egyptian cow's milk and buffalo.

The chemical composition of cheese during and after two months of ripening are summarized in Table 01. It appears from the results that pH decreases during the period of ripening. The pH reached 5.75 and 4.44 for the salty cheese in milk and salt to the tank (after draining), respectively, after two months of ripening.

The rate of fat and protein has evolved during the ripening period in both types of cheese. This can be attributed to the release of fatty acids and amino acids after two months of ripening. We recorded an increase in salt levels in both types of cheese by hand, it was found that the moisture of the cheese decreased with time due to water loss during ripening.

#### **Evaluation of free amino acids during cheese ripening Domiati**

The corresponding levels of total free amino acids as determined by the Cd-ninhydrin method revealed that the salty cheese in milk contains significantly higher concentrations of free amino acids compared to that in the salty brine bath. A slight difference was observed during the first month of ripening in the rate of free amino acids between the two types of cheese where we recorded the values of 0.08 and 0.11 mM leucine / g cheese in the cheese and salted after draining the salt tank respectively (Table 02).

**Table 01:** Physico-chemical properties of Domiati cheese during ripening

Kind	Analysis period	pH	% Fat	% Moisture	% Proteins	% Salt
Salted in milk (in tank)	Zero Time	6.14	4.5	53.83	18.3	4.3
	One month	5.86	19.5	53.27	20.1	5
	two months	5.75	21	52.13	20.9	5.1
Salted after draining (in brain)	Time zero	4.36	6	50.78	20.2	4.8
	After one month	4.70	27.5	45.91	24.2	5.7
	After two months	4.44	27.8	45.54	24.7	6

**Table 02:** Free amino amino acids evolution during reipening

Sample	Ripening time (days)		
	1	30	60
Salted after draining (in brain)	0.04 <sup>a</sup>	0.08	0.13
Salted in milk (in tank)	0.09	0.11	0.17

<sup>a</sup>: (mM Leucine/g fromage)

### Organoleptic evaluation of Domiati cheese

After 30 and 60 days of ripening, sensory evaluation was made by a trained panel to identify attributes of two cheeses with a descriptive analysis of profile-type files. In this type of assessment judges are invited to list their own descriptors (sensory attributes).

Average levels of intensity of flavor and acceptability of the texture of the cheeses after 30 and 60 days of ripening are shown in Table 3.

Generally, the cheese salted in raw milk received a score higher than after saline drip, but both aged cheeses were considered acceptable. The texture of salt in milk cheese was softer compared to salted after draining. The flavor intensity increased with the period of ripening. Nevertheless, the salty flavor of the cheese after draining was described by panelists as bitter.

The results of sensory analysis showed that the two types of cheese were comparable in terms of intensity of flavor.

**Table 3:** Organoleptic evaluation of Domiati cheese

Type	After one month of ripening		After two months of ripening	
	Flavor	Texture	Flavor	Texture
Salt in milk	Fresh cheese flavor	Firm texture	Fresh cheese flavor, no ripening in the flavor of the cheese	Firm texture
Brine	Bitter flavor	Hard texture	Bitter flavor	Hard texture

### Profile Analysis of texture

The rheological properties of cheese manufactured Domiati were determined using the texture analyzer (CNS-Farnell, England).

These properties (hardness, consistency, adhesiveness, elasticity, chewiness and gumminess) were calculated as described by Bourne (1978).

Changes in parameters of texture profile during the ripening of experimental cheeses are listed in Table No. 04.

Results showed that cheese salted in the vat was firmer than that after saline drip, which confirmed the results obtained texturometer. In addition to being softer texture of the cheese salted in the vat was more sticky and less cohesive.

The results indicate that the values of hardness, cohesiveness, elasticity and chewiness TPA for semi-solid foods (gumminess) decreased with the ripening period. Moreover, we noted that the values of the adhesion and cohesion increase particularly in the salty cheese vat. The hardness of cheese Domiati decreased 84.25 to 52.4 g and 180.9 to 141.6 g during two months of maturing the cheese in milk and salted after draining respectively

The hardness of salted cheese after draining was higher compared to the salty cheese in milk; hardness and consistency decrease with the ripening time.

Adhesiveness is the work done with tongue to loosen a product (cheese) stuck to the palate and teeth (Bourne, 1978). From the results obtained, it appears that this parameter decreased during the first month of ripening and tends to increase after 60 days of ripening and for the two types of cheese. Elasticity is the extent to which a deformed material returns to its original condition by removing the deforming force (Bourne, 1978). The results indicate a decrease in this parameter during ripening for both types of cheese. Chewiness (semi-solid foods) (Gumminess) is the force necessary to disintegrate a semi-solid food to be swallowed: hardness x cohesiveness (Bourne 1978). This value was lower in cheese salted after draining. Chewiness (foods) Chewiness is the force required to chew solid food into a state where it is ready to swallow (Bourne, 1978). The results indicate a trend in this parameter during the first month of ripening of 377.26 g and 487.37 g and 232.51 g and 250.45 g for salty cheese in milk and the salt after draining respectively. There is a close relationship between hardness and this parameter since it is difficult to swallow a hard cheese (Beal and Mittal, 2000). The results indicate that the level of flexibility (Chewiness) in the salty cheese after draining after 60 days is lower compared to salt in milk, this may be related to the degree of proteolysis (Awad, 2006).

**Table 04** : Texture profile analysis of Domiati during ripening

Texture parameters	Type					
	Salt in milk			Brine		
	0 <sup>a</sup>	30	60	0	30	60
Hardness (g)	84.25	68.7	52.4	180.9	167.2	141.6
Adhesive force (g)	-3.6	-5.8	-4.2	-1.8	-3.9	-2.4
Consistence (g/s)	745	584	369	1605	1213	819
Cohesiveness	-11.6	-9.7	-8.3	-10.2	-8.6	-7.4
Elasticité (mm)	7.21	6.4	5.9	6.8	5.3	4.7
Gumminess (g)	175.47	123.34	84.61	96.88	77.23	54.27
Chewiness (g.s <sup>-1</sup> )	377.26	487.37	669.54	232.51	250.45	261.52

<sup>a</sup>: Ripening time (days).

#### References:

- A.O.A.C.**, 1960. Official methods of analysis. Association of Official Analytical Chemists, Washington, D. C., U.S.A.
- AOAC.**, 2000. Official methods of analysis. Arlington, VA: Association of Official Analytical Chemists.
- Beal, P and Mittal, G.S.**, 2000. Vibration and compression responses of cheddar cheese at different fat content and age. *Milchwissenschaft.*, 55: 139-142.
- Bourne, M.**, 1978. Texture profile analysis. *Food Technol.*, 32: 62-66.
- Ling, E.R.**, 1963. A textbook of dairy chemistry. Vol. 2. 3<sup>rd</sup> ed., Chapman and Hall, London.

# Analysis of Citation Rate and Data Reuse for Openly Accessible Biodiversity Datasets on Global Biodiversity Information Facility

Nushrat Khan, Mike Thelwall, Kayvan Kousha

**Abstract**—Making research data openly accessible has been mandated by most funders over the last 5 years as it promotes reproducibility in science and reduces duplication of effort to collect the same data. There are evidence that articles that publicly share research data have higher citation rates in biological and social sciences. However, how and whether shared data is being reused is not always intuitive as such information is not easily accessible from the majority of research data repositories. This study aims to understand the practice of data citation and how data is being reused over the years focusing on biodiversity since research data is frequently reused in this field. Metadata of 38,878 datasets including citation counts were collected through the Global Biodiversity Information Facility (GBIF) API for this purpose. GBIF was used as a data source since it provides citation count for datasets, not a commonly available feature for most repositories. Analysis of dataset types, citation counts, creation and update time of datasets suggests that citation rate varies for different types of datasets, where occurrence datasets that have more granular information have higher citation rates than checklist and metadata-only datasets. Another finding is that biodiversity datasets on GBIF are frequently updated, which is unique to this field. Majority of the datasets from the earliest year of 2007 were updated after 11 years, with no dataset that was not updated since creation. For each year between 2007 and 2017, we compared the correlations between update time and citation rate of four different types of datasets. While recent datasets do not show any correlations, 3 to 4 years old datasets show weak correlation where datasets that were updated more recently received high citations. The results are suggestive that it takes several years to cumulate citations for research datasets. However, this investigation found that when searched on Google Scholar or Scopus databases for the same datasets, the number of citations is often not the same as GBIF. Hence future aim is to further explore the citation count system adopted by GBIF to evaluate its reliability and whether it can be applicable to other fields of studies as well.

**Keywords**—data citation, data reuse, research data sharing, webometrics

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# Analyzing the Implementation of the Responsibility to Protect Doctrine in South Sudan

Abhiraj Goswami, Rasmika Ghosh

**Abstract**—The doctrine of Responsibility to Protect (R2P) saw its inception in a 2001 report by the International Commission on Intervention and State Sovereignty and in the outcome document of the 2005 World Summit. R2P challenges the very nature of state sovereignty, re-interpreting it as a responsibility, rather than a right. It is a preventive measure to tackle mass atrocities and crimes against humanity. The continent of Africa has been a testing ground for the principle, not only because it is dotted with internal conflict but also because the African Union welcomed the doctrine by the adoption of the Ezulwini Consensus document in 2005, as a measure to prevent perpetual war crimes. South Sudan was knee-deep in conflict ever since it achieved statehood in July 2011, but the conflict took a new turn in 2013 when an altercation had broken out between Salva Kiir, the President, and Riek Machar, the then-Vice President of the republic. Fighting had initially commenced between the Sudan People Liberation's Movement (SPLM) and the Sudan People Liberation's Movement-In Opposition (SPLM-IO). With the steady involvement of other factions over time, the situation had developed into a full scale civil war. The most notable incident is the Bentiu Massacre in 2014 that resulted in 600 recorded casualties. The United Nations Mission in South Sudan (UNMISS) was a silent observer to this atrocity. Thus, this paper deals with the analysis of a pro-active R2P implementation in South Sudan similar to those done previously in Libya and the Ivory Coast, as the situation fulfills all three pillars of the doctrine. The R2P doctrine was meant primarily to deal with the regional stability of Africa and was endorsed by the same. We believe that an internationally sanctioned interventionist strategy has the potential to bring order to the situation in the world's newest country.

**Keywords**—international security, intervention, genocide prevention, regime stability

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# Approximation of Selenium Content in Watermelons for Use as a Food Supplement

Roggers Mutwiri Aron

**Abstract**—Watermelons are fruits that belong to the family cucurbitaceous. There are many types of watermelons have been positively identified to exist in the world. A watermelon consists of four distinct parts namely; seeds, pink flesh, white flesh and peel. It also contains high content of water of approximately 90% that is rich in essential minerals such as, phosphorous, calcium, magnesium, and potassium, sodium trace amounts of copper, iron, zinc and selenium. Watermelons have substantial amounts of boron, iodine, chromium, silicon and molybdenum. The levels of nutrients in different parts of the watermelons may be different. Selenium has been found to be a very useful food supplement especially for people living with HIV/AIDS. An experimental study was carried out to estimate the amount Se in different parts of the watermelon. Analysis of sampled watermelons was conducted using atomic absorption spectrophotometer. The results of the study indicated that high content of Se was present in the seeds compared to the other parts. High content of Se was also found in the water contained in the watermelon seeds.

**Keywords**—food supplement, watermelons, HIV/AIDS, nutrition, fruits

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# Investigation of Absorber Layer Thickness Effect on CIGS Solar Cell in Different Cases of Buffer Layers

Dennai Benmoussa, Benslimane Hassane

**Abstract**—This study investigates the interplay between the absorber layer of Cu(In,Ga)Se<sub>2</sub> solar cells and the buffer layer of these devices. Cu(In,Ga)Se<sub>2</sub> devices with absorbers of different thicknesses and different buffer layers are simulated. We found that the reduction in thickness of the CIGS cell leads to decrease short-circuit current, it is the main cause of degradation photovoltaic conversion efficiency. It has been found that substitution of the CdS buffer layer by other materials such as ZnS can limit this performance degradation.

**Keywords**—solar cells, AMPS-1d, buffer layer, efficiency

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# Applied Linguistics and Teaching Languages

Samia Djabari

**Abstract**—What really draws attention is that awareness of the importance of research in educational methodology Languages have evolved significantly in recent years, as the mind has gone The students differ in their scientific orientations and the different linguistic schools to which they belong To intensify efforts to develop the pedagogic view of promoting performance In the field of education, making it scientific legitimacy to become a branch of On the one hand, the study of linguistics on the one hand and psychology on the other

**Keywords**—Definition of Applied Linguistics, Characteristics of Applied Linguistics, Applied Linguistics and Language Teaching, Basic Principles of Applied Sanskrit in Language Education

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# Exact Soliton Solutions of the Integrable (2+1)-Dimensional Fokas-Lenells Equation

Meruyert Zhassybayeva, Kuralay Yesmukhanova, Ratbay Myrzakulov

**Abstract**—Integrable nonlinear differential equations are an important class of nonlinear wave equations that admit exact soliton solutions. All these equations have an amazing property which is that their soliton waves collide elastically. One of such equations is the (1+1)-dimensional Fokas-Lenells equation. In this paper, we have constructed an integrable (2+1)-dimensional Fokas-Lenells equation. The integrability of this equation is ensured by the existence of a Lax representation for it. We obtained its bilinear form from the Hirota method. Using the Hirota method, exact one-soliton and two-soliton solutions of the (2 +1)-dimensional Fokas-Lenells equation were found.

**Keywords**—Fokas-Lenells equation, integrability, soliton, the Hirota bilinear method

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# Machine Learning Model to Predict Missing People Status

Enrique J. Delahoz, Silvana C. Mendoza, Tomas J. Fontalvo

**Abstract**—The phenomenon of missing persons is a global problem, each year 10 million people disappear worldwide. Therefore, the main motivation to characterize and model the process of missing persons has two dimensions: First, the police agencies, which usually have limited resources and therefore need information that allows prioritizing search tasks based on objective information, promoting the efficient use of resources. On the other hand, we found the familiar and emotional core of the missing person, for whom it is impossible to quantify the suffering and despair caused by the disappearance of a loved one, in these cases the ability to generate information relevant to future status disappeared person, means an advance to cover that space of uncertainty and misinformation. This research presents a model to predict and classify the status of missing persons, using 20 variables referring to the personal and geographical information of the event. The data used correspond to the annual report of criminality, published by the technical investigation body (CTI) of the national prosecutor's office of Colombia in 2017. The dataset contains 6202 observations and 20 variables. First, we reviewed scientific literature associated with machine learning models used for the modelling of social phenomena, identifying the most used techniques in these studies. Per second, the dataset was debugged in order to proceed with a relational analysis of the variables. Third, three models of supervised learning are implemented, Decision Trees, Nearest K-neighbors and Random Forest. The results show a high level of accuracy in predicting the future status of missing persons. The highest level of accuracy and sensitivity was obtained with the classifier based on the Random Forest technique, with results of 85% and 80% respectively. These findings are interesting for the future development of information systems for the management of social and crime phenomena.

**Keywords**—classification, machine learning, missing people, random forest, supervised learning

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# Three and Two Dimensional Slope Stability Analysis of Ultimate Walls of Sungun Mine for Determination of Factor of Safety

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## Abstract

The Sungun copper deposit is located in the East Azerbaijan province, Iran. The development of the Sungun mine leads the extension of the mine area and also withdrawal of its walls. So, a slope stability analysis of mine is of prime importance. In this research, Two and three-dimensional slope stability analyses of the ultimate slope for Sungun copper mine is investigated using the distinct element code. Therefore, UDEC and 3DEC software were used. The extended Mohr–Coulomb failure criterion applied for the analysis. Laboratory tests and field surveying were conducted in order to obtain the input data for analysis. These analyses were repeated in three positions (dry-drained- wet) for four walls of the mine including eastern, northern, western and southern walls. The results indicate that the factors of safety obtained from 2D analysis are not necessarily more conservative than 3D analyses. Monitoring of the slope displacements after lowering of groundwater level by horizontal drains leads to the higher factor of safety in both 2D and 3D analysis. The differences in factors of safety for 2D and 3D slope stability analyses is more considerable for lower groundwater levels than in higher groundwater levels. The results illustrated for routine slope designs, using the 3D analysis leads to lower factor of safety and reduces the cost of operation.

**Keywords:** Three & two dimensional, slope stability, factor of safety, Sungun copper mine.

## 1. Introduction

Stability analysis is commonly used for safe and functional design of an excavated slope (e.g. open pit mining, road cuts, etc.), and the equilibrium conditions of a natural slope. The analysis technique chosen depends on both site conditions and the potential mode of failure, with careful consideration being given to the varying strengths, weaknesses and limitations inherent in each methodology. The first step in any rock slope stability analysis must be a detailed evaluation of the lithology and rock mass structure. From this follows the necessity to determine if the orientation of the existing discontinuity sets could lead to block instability. This assessment may be carried out by means of stereographic techniques and kinematic analysis [1].

Three-dimensional (3D) slope stability analysis is still not routinely used by geotechnical engineers even though most slope stability problems are three-dimensional. This is due to several reasons. First, it is commonly believed that two-dimensional (2D) slope stability analysis provides a more conservative estimate of the 3D slope stability problem (e.g., [2–4]). Second, a 3D slope stability analysis is more elaborate to conduct as compared with a 2D slope stability analysis. Third, it is more difficult to input data and visualise the output of a 3D slope stability analysis. However, rapid progress in computation and visualisation is making 3D slope stability analysis more accessible to geotechnical engineers [5].

This paper examines available 3D slope stability software, 3DEC [6] to analysis of the ultimate slope for Sungun copper mine in Iran. The development of this mine lead to the extension of the mine area and also withdrawal of its walls. So, a slope stability analysis of mine is essential. Three-dimensional slope stability analyses are performed to analyse the final wall for Sungun mine . For comparison, 2D slope stability analyses are also performed.

## 2. Discontinuum Modeling

Discontinuum methods consider the rock slope as a discontinuous rock mass by considering it as an assemblage of rigid or deformable blocks. The analysis includes sliding along and opening/closure of rock discontinuities controlled principally by the joint normal and joint shear stiffness. Discontinuum modeling constitutes the most commonly applied numerical approach to rock slope analysis, the most popular method being the distinct-element method [6]. Distinct-element codes such as UDEC and 3DEC [7] use a force-displacement law specifying interaction between the deformable joint bounded blocks and Newton's second law of motion, providing displacements induced within the rock slope. UDEC and 3DEC are particularly well suited to problems involving jointed media and have been used extensively in the investigation of both landslides and surface mine slopes. The influence of external factors such as underground mining, earthquakes and groundwater pressure on block sliding and deformation can also be simulated.

## 3. Case description

The Sungun copper deposit is positioned in the Varzaghan area in East Azerbaijan province, Iran. Ore in Sungun is fungi-form with 350×400 m dimensions and its upper part consists of oxide-zone (malachite and azurite mineral) and supergene-zone (mostly culcosite). The location of the mine is indicated in Fig. 1.

This deposit is located 85 km NW of the Varzaghan porphyry copper deposit. Preliminary mineral exploration was carried out in 1967 – 1970 by Parjam and Metallgesellschaft [12]. So far, more than 50 diamond drill holes with a maximum depth of 1013 m proved the existence of the considerable porphyry copper mineralization at the Sungun deposit. The orebody contains 170 million tons of ore, with an average grade of 0.86% Cu, 0.007% Mo, 82 ppb Au and 1.8 ppm Ag. Supergene enrichment blankets average approximately 50 m thickness and comprise the primary source of Cu ore [13].



Fig. 1. Location of Sungun copper mine.

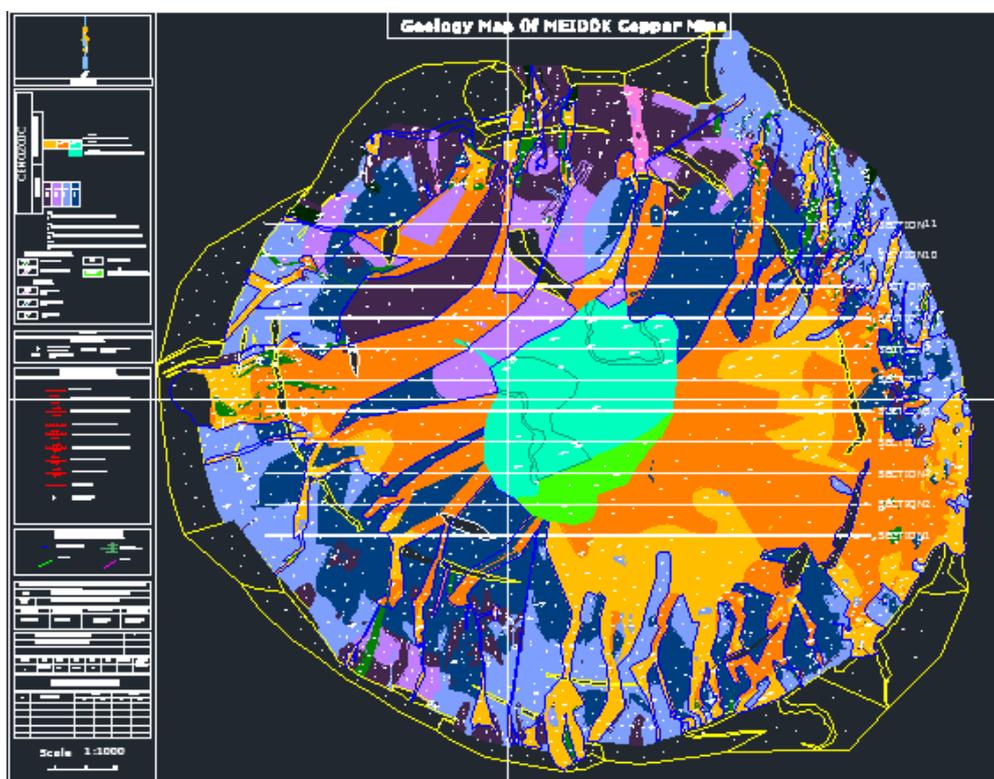


Fig. 2. Geological map of Sungun Copper mine.

In the course of the study, geotechnical mapping was carried out to determine the critical orientation of geological discontinuities. Physico-mechanical properties of the rock materials were obtained by laboratory tests conducted on samples cored from exploration drilling and rock blocks taken directly from the mine.

Three major joint sets have been recognized at Sungun, which are related to the regional tectonic history. They have an important influence on slope stability in the open pit, notably in terms of planar and wedge failures. Detailed geological and

geotechnical data is an unknown factor in the design and operation of an open pit, the lack of which may causes a significant risk to the mining venture. As data are accumulated and used effectively, so the risk of unpredicted conditions is reduced, and accordingly safety and productivity will increased. Usually, the geotechnical work undertaken at an open pit mine is in connection with improving slope stability [14]. At Sungun open pit, geological and geotechnical data have been obtained by face mapping, scan line surveys, exploration drill holes and laboratory tests. Fig. 2 shows Geological map of Sungun Copper mine.

#### 4. Geomechanical properties of the different division

Discontinuities play a major role in the design and maintenance of opencast pits, their presence affecting the mechanical and hydrogeological properties of the rock masses. Scanline surveys were carried out in selected areas of the open pit at Sungun either where failure had occurred or where the potential for failure existed [8]. Numerous parameters were measured for each discontinuity such as roughness, dip and dip direction, spacing, continuity, joint aperture, and the presence of gouge. Joint profile readings were taken [9] with a carpenters comb and compared with the joint roughness profiles of [10]. Detailed structural mapping was also undertaken of each face, the data collected including the lithology, dominant joint sets, critical joint spacing, veins and any faults.

Geomechanical properties and also effective joint sets in the stability of different division are presented in the tables 1 and 2, respectively. Dip and dip direction of all the joint sets for different parts of the mine are given in the table 2.

Table. 1. Rock mass's geomechanical properties of different division of the mine.

Parameters	Eastern wall	Western wall	Northern wall	Southern wall	Comment
Lithology	Light-grey Granodiorit	Grey Granodiorit	Light-grey Granodiorit	Light Granodiorit	-
Deformation modules (MPa)	2818	2818	3638	2818	$E_m = 100000 \left[ \frac{1 - \frac{D}{2}}{1 + (e^{\frac{(75 + 25D - GST)}{11}})} \right]$
Poisson ratio	0.21	0.21	0.22	0.21	UCS test
Uniaxial compressive strength (MPa)	2.60	3	5.60	2.60	Rock Lab software
Shear strength (MPa)	0.06	0.07	0.10	0.06	Rock Lab software
Friction angle (Deg)	35	36	40	36	Rock Lab software
Cohesion (MPa)	2.20	2.30	2.94	2.15	Rock Lab software
Mean density	2.51	2.52	2.46	2.41	Mean

Table. 2. Effective joint sets in stability of different division of the mine.

Wall	JS1				JS2				JS3			
	W	E	N	S	W	E	N	S	W	E	N	S
Dip	83	88	89	79	76	81	80	90	78	53	-	82
Dip Direction	277	281	352	000	005	070	277	275	312	032	-	080
Spacing (m)	0.5	1	0.5	1	0.8	0.5	1	0.8	1	0.6	0.8	0.6
Continuity (m)	1-20	5-50	1-20	5-50	1-30	5-40	5-40	5-50	1-30	5-40	5-40	1-20
Joint roughness	planar	rough	planar	rough	planar	planar	rough	rough	planar	rough	planar	planar
Joint thickness (mm)	2-50	5-30	2-40	5-30	2-30	5-40	5-40	2-30	2-30	5-50	2-30	2-20

#### 5. Slope Stability analyses

In wall stability analysis for the final slope, jointing system in the mine area is one of the critical factors and has a significant importance. In this research, joint study was done by 13 scan line (each with 20 meters length). For every joint, its dip and dip direction were determined.

The DIPS software program was used to generate the stereonets from the obtained scanline survey data. For each region a contoured pole data stereonet with joint set windows was constructed. The stereonets then were analysed according to procedures given in for assessing potential modes of failure, thereby allowing potential failure zones to be identified[11]. The Dips software was used to depict and analyze jointing systems in the mine area. Rose diagram and contour poles of all the surveyed joints in the mine area are shown in the figures 3.

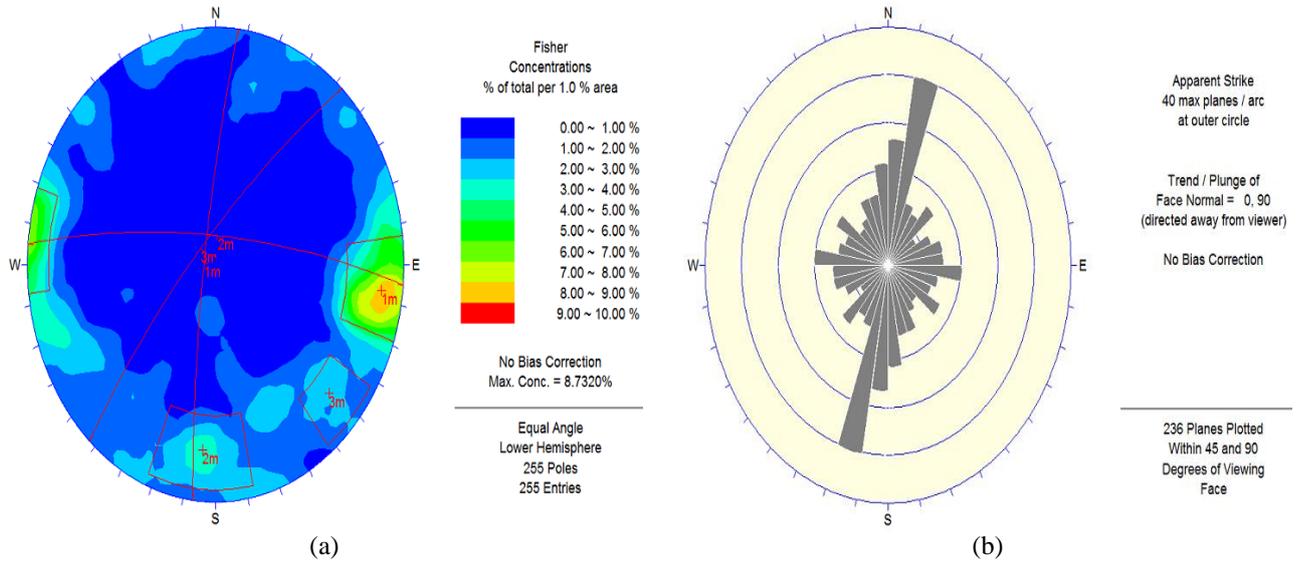


Fig. 3. a) Country curve, b) Rose diagram for all the surveyed joints in the mine area and their related joint sets.

In the first step, the topography of the mine before its opening was modeled and its in-situ stresses were calculated. Then to test the accuracy, the model was changed to the current available pit.

This analysis was repeated in the following three positions:

- Assumed that underground water is not available.
- There is not any drainage network and also water level in the elevation 2540 on the walls.
- There is a drainage plan to dry the walls to the level of 2540.

These analysis steps were done for four walls of the mine; including east wall, north wall, west wall and south wall.

## 6. Results

Results of the numerical analysis for all the walls are given in Table 3. Figures 4-6 show some of these analysis using UDEC (2D) and 3DEC (3D) code.

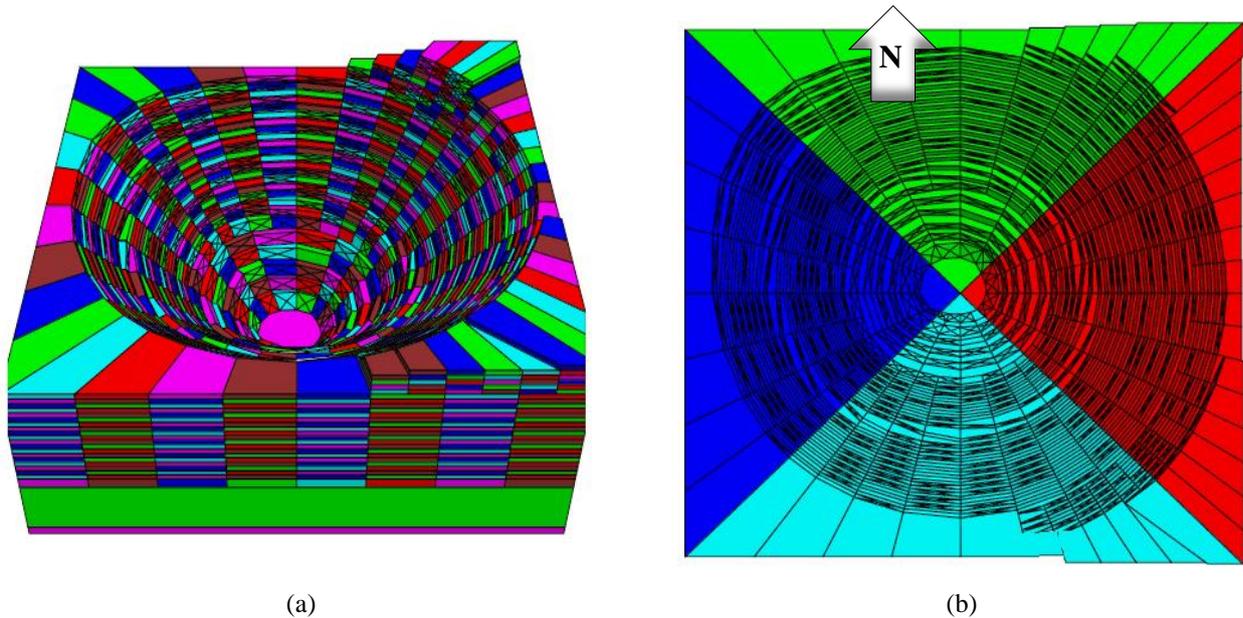
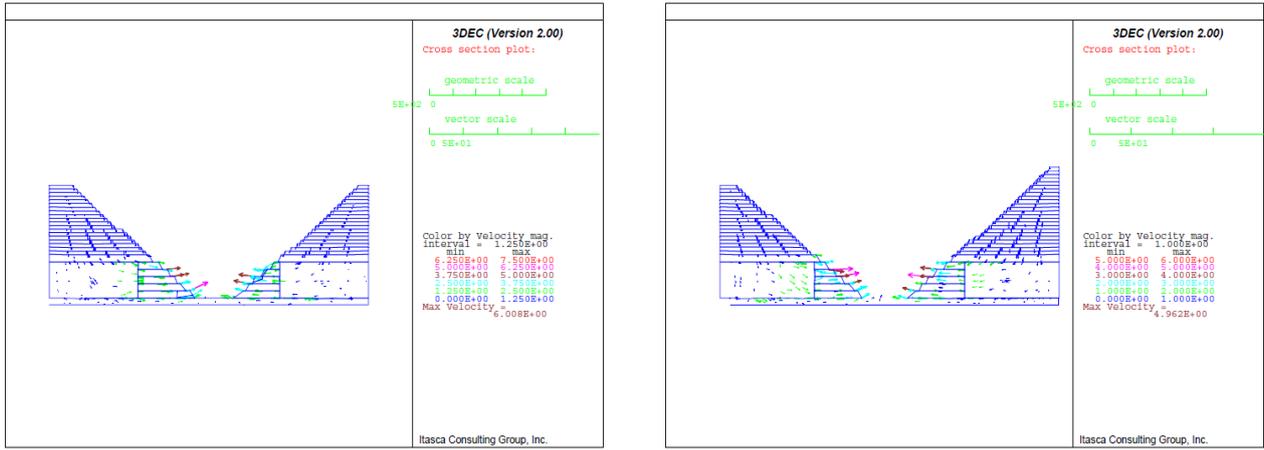


Fig. 4. a) Constructed model of final pit of Sungun mine. b) Division of the mine into 4 areas for final slope analysis.



a b

Fig. 5. a) tendency vectors of movement toward the inside of the pit. a) Southern-Northern masses, b) Western-Eastern masses.

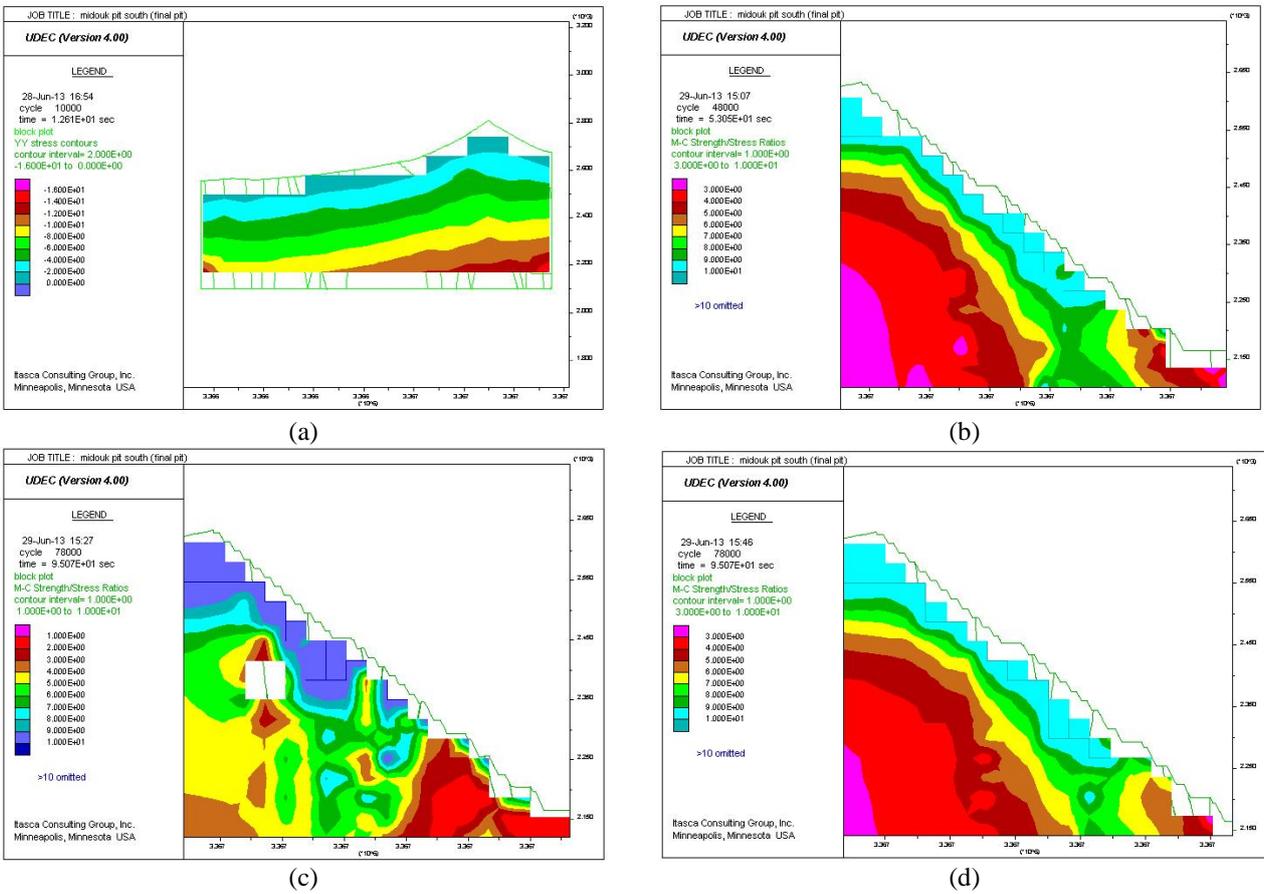


Fig. 6. a) In-situ vertical stresses before mining, b) Mohr-Coulomb safety factor in dry situation, c) & d) Mohr-Coulomb safety factor with water level of 2540 and 2250, respectively. (Southern wall of final pit)

Table 3. Two-dimensional and three-dimensional slope stability analyses of Sungun final pit.

		UDECC				3DEC			
		east	north	west	south	east	north	west	south
Dry	Factor of safety	1.80	1.56	2.04	1.44	1.47	1.47	1.94	1.40
	Maximum X-displacement (cm)	1.5	1	3	1	2	1	2.7	0.8
	Maximum major stress (MPa)	10	10	11	7	10	8	10	6
Drained	Factor of safety	1.60	1.46	1.85	1.32	1.42	1.42	1.67	1.21
	Maximum X-displacement (cm)	2	1	2	3	1.8	1.2	2.2	3.3
	Maximum major stress (MPa)	10	11	10	7.5	12	12	10	7
Wet	Factor of safety	1.30	1.15	1.54	1.03	1.04	1.04	1.36	0.93
	Maximum X-displacement (cm)	120	170	150	85	140	180	150	100
	Maximum major stress (MPa)	25	25	25	30	22	22	25	28

Fig. 7 shows the difference in factors of safety between the 2D and 3D slope stability analyses in different positions.

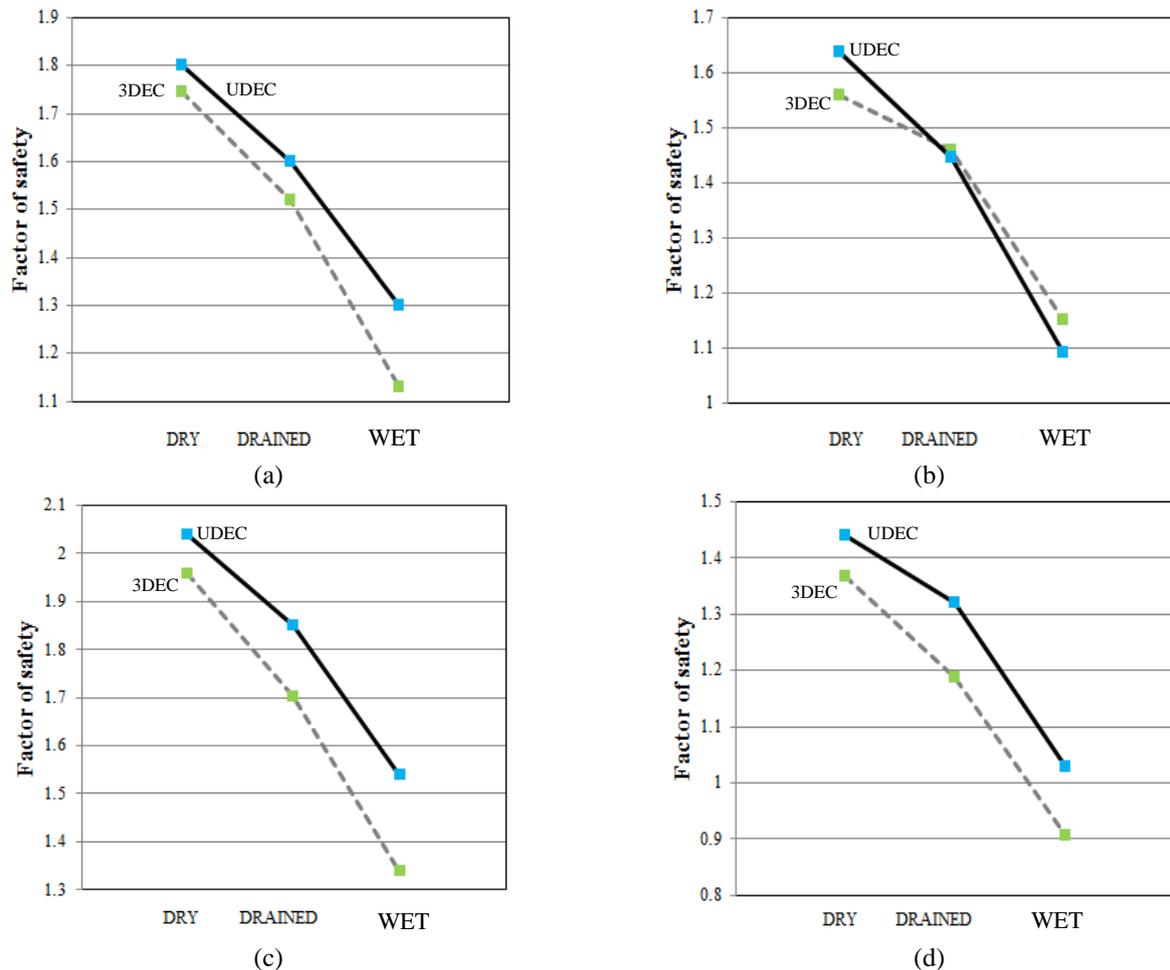


Fig. 7. Factor of safety for final wall with different situations. a) Eastern wall, b) Northern wall, c) western wall, d) southern wall.

## 7. Conclusion

In this research, the stability of Sungun copper mine walls were carried out using distinct element code (UDEC&3DEC). Both 2D and 3D slope stability analyses were performed to establish the representative shear strength parameters to be used in the analyses and to examine the differences in the results. The extended Mohr–Coulomb failure criterion was used for analyses. The rock mass was assumed to be permeable and also by the obtained data from surveying, laboratory tests and field observations. The results are as follows:

- Water and pore pressure in the faults and main joints were the most important instability factors in these analyses.
- If the pore pressure removed by a drainage system for the long life of the mine, there will be stable wall for this period.
- The factor of safety after the drainage improved (27–34)% and (20–28)% based on the 3D and 2D slope stability analyses, respectively.
- The difference in factors of safety between the 2D and 3D slope stability analyses for the deeper groundwater table (water level in the elevation 2540 on the walls) is less than 7%.
- According to the mechanical properties of wall rocks and dip direction of faults and main joints and with a drainage system, mining operation with optimized slope can be done.
- The results illustrated that using the 3D analysis leads to lower factor of safety and reduces the cost of operation.

## References

- [1] Doug Stead, Erik Eberhardt, John Coggan, Boris Benko. "Advanced Numerical Techniques In Rock Slope Stability Analysis – Applications And Limitations". LANDSLIDES – Causes, Impacts And Countermeasures, 17-21 June 2001, Davos, Switzerland, pp. 615-624.
- [2] Li AJ, Merifield RS, Lyamin AV. Limit analysis solutions for three dimensional undrained slopes. *Comput Geotech* 2009;36:1330–51.
- [3] Li AJ, Merifield RS, Lyamin AV. Three-dimensional stability charts for slopes based on limit analysis methods. *Can Geotech J* 2010; 47:1316–34.
- [4] Michalowski RL. Limit analysis and stability charts for 3D slope failures. *J Geotech Geoenviron Eng* 2010; 136(4):583–93.
- [5] E.C. Leong, H. Rahardjo. Two and three-dimensional slope stability reanalyses of Bukit Batok slope. *Computers and Geotechnics* 42 (2012) 81–88.
- [6] Itasca (2001). *Itasca Software Products - FLAC, FLAC3D, UDEC, 3DEC, PFC*. Itasca Consulting Group Inc.: Minneapolis.

- [7] Hart, RD (1993). An introduction to distinct element modeling for rock engineering. In *Comprehensive Rock Engineering: Principles, Practice & Projects*. Pergamon Press: Oxford, 245-261.
- [8] Sen Z, Kazi A. Discontinuity spacing and RQD estimates from finite length scanlines. *International Journal Rock Mechanics Mining Science and Geomechanical Abstracts* 1984;21:203–12.
- [9] Stimpson B. A rapid field method for recording joint roughness profiles. *International Journal Rock Mechanics Mining Science and Geomechanical Abstracts* 1982;19:345–6.
- [10] Barton N. The shear strength of rock and rock joints. *International Journal Rock Mechanics Mining Science and Geomechanical Abstracts* 1976;13:255–79.
- [11] Hoek E, Bray JW. *Rock slope engineering*, 3rd ed.. London: Institution Mining and Metallurgy, 1981.
- [12] Hassanzadeh, J. (1993): *Metallogenic and tectono-magmatic events in SE sector of the Cenozoic active continental margin of Central Iran (Shahr-Babak, Kerman Province)* (PhD Thesis). University of California, Los Angeles, 201p.
- [13] Taghipour, N., Aftabi, A. and Mathur, R. (2008): *Geology and Re-Os Geochronology of Mineralization of the Sungun Porphyry Copper Deposit, Iran*. *Resource Geology* 58 (2): 143 – 160.
- [14] A.R. Bye, F.G. Bell. "Stability assessment and slope design at Sandsloot open pit, South Africa". *International Journal of Rock Mechanics & Mining Sciences* 38 (2001) 449–466.

# Strengthening of Reinforced Concrete Coupling Beams Using Fiber Reinforced Polymers Materials

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## Abstract

The strengthening of civil engineering infrastructures is often required due to extreme and excessive loads, advanced design codes, human or environmental effects. Several researches recommend the use of reinforcement technique by FRP (Fiber Reinforced Polymers) bonding. In tall building, RC coupling beam, constitute the critical structural element because of the high shear demand of the coupling beams due to shear deformation. The objective of this work is to propose a reliable modeling for the determination of the cyclic response of these structural elements and to identify the possible contributions of reinforcement by bonding FRP used carbon fiber materials. where shear mode failure is dominated and characterized by diagonal cracks. The assessment of the contribution of the FRP is based on changes in ductility gains ,resistance and energy absorption. The exploitation of the results leads to interesting conclusions concerning the wrapping configurations and the amount of composite materials.

## Strengthening strategy and adopted configuration

The specimen of the experimental program of Paulay [1] was chosen in this study. The geometry of the specimen is illustrated in Fig. 1. Set-up and specimens are extensively described in Paulay [1]. The strengthening strategies were considered using unidirectional carbon fibers. Two configurations have been tested Fig. 2. The failure occurs when the compressive stress exceeds the average compressive strength in the concrete strut. The FRP composite contribute to transfer part of these forces. The adopted configurations based on bonding of the coupling beam with bands of composites are shown in Fig. 2.

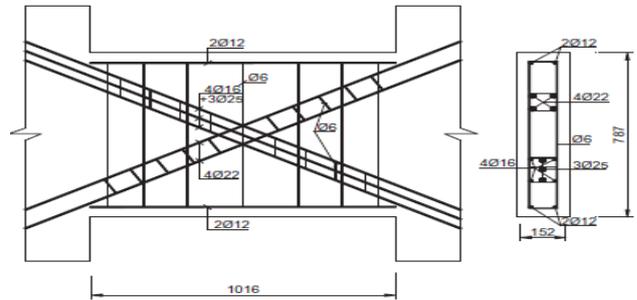


Fig.1 Geometry of test specimens (mm) (Paulay, 1969)

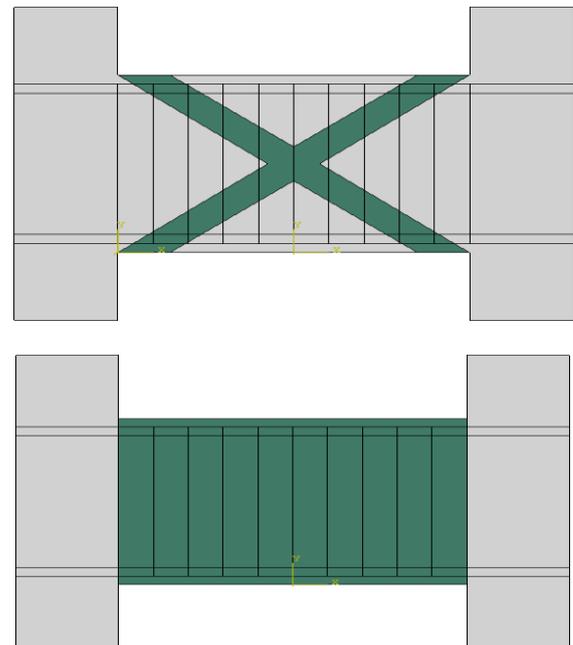
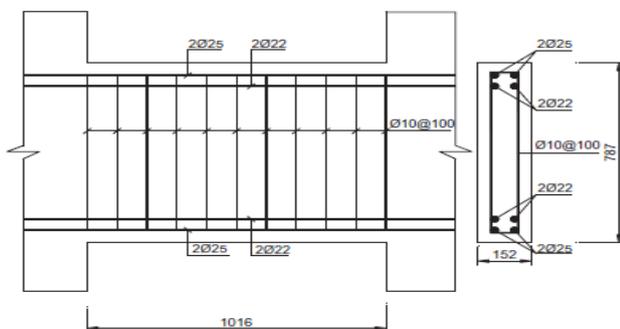


Fig.2 Adopted configuration of bonding by FRP composite.



## Numerical modeling strategy

In the present study, a nonlinear 3D analysis is used. The coupling beam is modeled with solid elements (C3D8R). The reinforcements are modeled with truss elements (T2D3). The composite material is modeled with two-dimensional elements (R4S). Concerning the contact between the concrete elements and those of the composite, the use of interface elements is avoided and the detachment is directly simulated by the modeling of the cracking of the concrete adjacent to the layer of composite. The steel material is modeled using an elastoplastic model with isotropic hardening based on the Von Mises criterion. The composite material considered to be transverse isotropic in the plane perpendicular to the fibers, and the model (Concrete Damaged Plasticity) is used to describe the mechanical behavior of concrete.

### Results and Evaluation of load gains and ductility

Fig. 3. Global Load displacement curves. Fig. 4 shows the failure mode of a classical RC coupling beam. It can be seen the diagonal cracks pattern conducting to failure. The ultimate strength achieved with FRP composite for both specimens was higher than for the specimens without bonding.

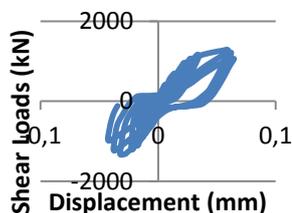


Fig.3 The Load Displacement curve

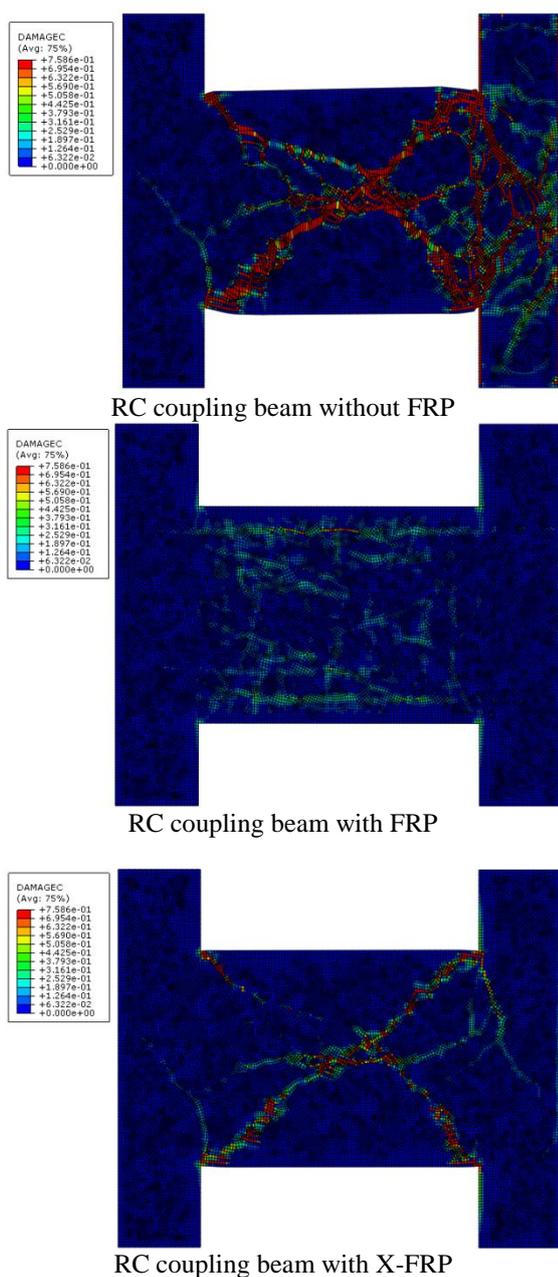


Fig.4 Compressive damage in concrete.

### Conclusion

An accurate numerical model describing the behavior of RC coupled shear walls has been developed in this paper. The various simulations carried out with the addition of bands of composites have been highlighted. The effects of the external reinforcement by FRP composite prove effectiveness in many aspects (resistance, ductility, damage, energy absorption...).

### References

[1] Paulay T. The coupling of shear walls. Ph.D. University of Canterbury, Christchurch, New Zealand; 1969.

# Building Design Mapping and Improvement

Harrison Wara Che

**Abstract**—Building design refers to the broadly based architectural, engineering and technical applications to the design of buildings. All building projects require the services of a building designer, typically a licensed architect or structural engineer. Smaller, less complicated projects often do not require a licensed professional, and the design of such projects is often undertaken by building designers, draftspersons, interior designers (for interior fit-outs or renovations), or contractors. Larger, more complex building projects require the services of many professionals trained in specialist disciplines, usually coordinated by an architect.

**Keywords**—building, architecture, design, mapping

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# Deciphering Gendered Politics of Environmental Movements: A Study of Save Ganga Movement in India

Anjali Dalal

**Abstract**—In the study of environmental movements, feminist scholars have added a new vision and understanding, by exploring the entrenched symbiotic relationship between women and environment. Insights from feminist political ecologists nearly draw conclusions that success and failure of environmental movements are not merely reflections of intensity, size and awareness of protests, but women participation as the core of the ecological movements. However, due to patriarchal structure of society, most ecological movements keep women's participation at bay, resulting in disconnection between women-nature and protest movements, leading to superficial, non-sustainable policies and strategies of environmental protection. This research paper focus on the theoretical perspective of Feminist political ecology, that examines the place of gender in ecological and political relations through special focus on environment movements in general and Save Ganga Movement in particular. The paper examines the role of women in three environmental movements- Chipko (Garhwal, India), Plachimada (Kerala, India) and Green Belt (Kenya, India), in order to investigate similar trends of women participation in Save Ganga Movement (India). The latter shows differed participatory base of women, while studying three protest site, i.e, Garhwal, Kanpur and Varanasi (the three main regions around river flow). In the conclusion it was identified that the parameters as developed by Feminist Political ecologists are seen in the mountainous region (i.e., Garhwal) where women participation has questioned the access to forest resource and management, contributed local experiences in decision making process, engendering grassroots activism, but in Kanpur and Varanasi the movement lacks women participation as the core of the struggle. It was here that active rights of women over water resource and local techniques and experience of water management is undermined by the scientific 'modern knowledge' of urban economy that not only lead to domination of patriarchal values in institutional way but also 'ecological othering' of women. Therefore, the paper outlines, the gender sensitive inclusive measures in environment movement in general and Save Ganga Movement in particular, as a prerequisite for success of movement and elimination of patriarchal decision making institutions.

**Keywords**—gendered environmental politics, Ganga Movement, ecological othering, feminist political ecology

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# Shopping Tourism for Emerging Markets: Examining Shopping Tourism in the UK as an Attraction Tool for Wealthy Tourists

Ali Abdallah, Shaima Al Mohannadi

**Abstract**—This study explores shopping tourism in the UK and examines it as an attraction tool for wealthy tourists to the UK's capital city London. The study aims to identify the scope of shopping tourism used by countries such as the UK as a tool for attracting wealthy tourists. This study adopts the quantitative research approach through surveys in attaining the results required. Results demonstrate how the UK tourism market is an experience-based market and has recently become an attraction for luxurious brand shoppers. The term Tremain is introduced as a new form of tourism generated by the Brexit. If addressed appropriately the Tremain can assist in any negative economic retaliations of the Brexit. The study concludes that shopping tourism is yet to further incline in years to come, however, government support and cooperative planning with the retail industry is required as a means of further strengthening this developing sector.

**Keywords**—Brexit tourism, luxury shopping, UK tourism, wealthy tourists

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# Assessment of Response after Chemoradiotherapy for Non-Metastatic Head and Neck Tumors by Positron-Emission Computed Tomography Scan

Joao Moreira-Pinto, Joao Gagean, Joao Dias, Andre Soares, Claudia Vieira, Isabel Azevedo, Hugo Duarte, Jose Dinis

**Abstract**—Introduction: In recent years, non-metastatic node positive head and neck cancer (HNC) is usually treated with chemoradiotherapy (CRT) with increasing good outcomes, although a significant proportion of patients (pts) still relapse within the first 3 years. Response evaluation after CRT remains a matter of debate, with a recent focus on positron-emission computed tomography (PET-CT) high negative predictive value (NPV) 12 weeks after CRT. We analyzed the NPV of PET-CT in our institution after CRT for HNC. Methods: Retrospective study including pts with a histologically confirmed diagnosis in our institution of squamous-cell carcinoma of the oral cavity, oropharynx, hypopharynx or unknown primary site of the head and neck, from 2010 to 2017, with no metastatic disease. All pts were treated with CRT with curative intent and had a response evaluation by PET-CT scan intended 12 weeks after CRT. Complete response (CR) was defined as no enlarged lymph nodes in the neck and no FDG uptake on PET-CT scan. Confirmation test was image control (PET-CT, CT or MRI) or pathologic confirmed persistent disease in the first 3 months after the 12 weeks PET-CT. Pts with PET-CT scan before 12 or after 14 weeks were excluded. Results: Thirty-four eligible pts, 32 male (94.1%), median age 56 yo. All pts were treated with CRT, 29 with Cisplatin (median 2 cycles, range 2-3), 4 with Carboplatin (median 6 cycles) and 1 with Cetuximab (7 cycles). Radiotherapy was performed with VMAT technique in 25 pts (74%) and IMRT in 9 pts (26%), total dose 70 Gy in 35 fractions. PET-CT was performed median 13 weeks after CRT (range 12 to 14). Among 34 pts, 21 had a CR in PET-CT (61.8%), 12 pts partial response (35.3%) and 1 pt no response (13%) after CRT. Thirty-nine percent of all pts with incomplete response on initial PET-CT scan had persistent disease after 3 months versus 0% of pts with initial complete response ( $p=0.005$ ). NPV PET-CT for CR at 12 weeks was 100% with a positive predictive value of 38.5%. Sensitivity was 100% and specificity 72.4%. Conclusion: PET-CT 12 weeks after CRT has a high negative predictive value for complete response.

**Keywords**—chemoradiotherapy, head and neck cancer, locally advanced, PET-CT scan

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# Adaptation and Impact of Climate Change in Kabul Region: A Case Study

Mohammad Rahim Rahimi, Yuji Hoshino

**Abstract**—The aim of this paper is to study the behavior or influence of climate change in Kabul Metropolitan Area (KMA). The Kabul Metropolitan Area (KMA) in Afghanistan includes Kabul existing city and Kabul New City (KNC). KMA will with hold a large population within its boundaries. KMA admitted the challenges due to climate change; such as, variation of climate change, social transformations, city landscape, economic and political issues etc. The main problems competed Afghanistan were the temperature changes over the years, especially Hindukush and Central Highland of Afghanistan from 1950 up to 2010, 1°C and 1.71°C raised respectively. Moreover the cause of temperature increase, it has affected precipitation in spring season and melting of glacier, snow and early melting in compressed time. Furthermore, decline of water table in existing Kabul city due to the immoderate use of water from underground resources and pollution. In addition, Afghanistan has dry and extreme climate thus water is the main source income of huge population hence it's directly related to the capacity of precipitation. Finally, the temperature increased and precipitation declined in spring period have effect on spread of dissertation, migration to the cities and other challenges that we will discuss in this paper.

**Keywords**—Climate change, Climate Adaption, Adaptation in Kabul Metropolitan Area, manage KMA

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# Role of Glutamine-Rich Region of *Candida albicans* Tec1p in Mediating Morphological Transition, Invasive Growth and Shock Resistance

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**Abstract**—Hyphal growth and the transcriptional regulation to the host environment are key issues during the pathogenesis of *C. albicans*. Tec1p is the *C. albicans* homolog of a TEA transcription factor family, which share a conserved DNA-binding TEA domain in their N-terminal. In order to define a structure-function relationship of the *C. albicans* Tec1p protein, we constructed several mutations on the N terminal, C terminal or in the TEA binding domain itself by homologous recombination technology. The modifications in the open reading frame of TEC1 were tested for reconstitution of the morphogenetic development of the *tec1/tec1* mutant strain CaAS12. Mutation in the TEA consensus sequence did not confer transition to hyphae whereas the reconstitution of the full-length Tec1p has reconstituted hyphal development. A deletion in one of glutamine-rich regions either in the Tec1p N-terminal or the C-terminal in regions of 53-212 or 637-744 aa, respectively, did not restore morphological development in mutant CaAS12 strain. Whereas, the reconstitution with Tec1p mutants other than the glutamate-rich region has restored the morphogenetic switch. Additionally, the deletion of glutamine-rich region has attenuated the invasive growth and the heat shock resistance of *C. albicans*. In conclusion, we show that a glutamine-rich region of Tec1p is essential for the hyphal development and mediating adaptation to the host environment of *C. albicans*.

**Keywords**—*Candida albicans*, morphogenetic development, TEA domain, hyphal formation, TEC1

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# A Review of Current Knowledge on Assessment of Precast Structures Using Fragility Curves

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**Abstract**—Precast reinforced concrete structures are favorable alternatives for construction world all over the globe, thanks to their rapid erection phase, ease mounting process, better quality and reasonable prices. Such structures are rather popular for industrial buildings. For the sake of economic importance of such industrial buildings as well as significance of safety, like every other type of structures, performance assessment and structural risk analysis are important. Fragility curves are powerful tools for damage projection and assessment for any sort of buildings as well as precast structures. In this study, a comparative review of current knowledge on fragility analysis of industrial precast reinforced concrete structures were presented and findings in previous studies were compiled. Effects of different structural variables, parameters and building geometries as well as soil conditions on fragility analysis of precast structures are reviewed. It was aimed to briefly present the information in the literature about the procedure of damage probability prediction including fragility curves for such industrial facilities. It is found that the determination of key structural parameters and analysis procedure are critically important for damage prediction of precast reinforced concrete structures using fragility curves.

**Keywords**—Damage prediction, Fragility curve, Industrial buildings, Precast reinforced concrete structures.

## I. INTRODUCTION

**P**RECAST technology was emerged as a result of the industrialization of construction practice. Precast reinforced concrete structures are favorable choice of construction alternative because of their fast erection phase, ease mounting process, better quality and reasonable prices. The rapid construction characteristic and low cost of maintenance as well as other aforementioned advantages turn precast reinforced concrete structures into a popular option for industrial facilities. On the other hand, such structures have several drawbacks i.e. weakness due to beam to column connections, incapability of rigid diaphragm establishment, inadequate strength and stiffness. These disadvantages may result in severe losses in earthquakes. [1], [2]. Reconnaissance reports in literature have exposed problems and failures due to poor construction and improper detailing in precast structures similar to other types of structures [3]-[8].

Earthquakes occurred particularly in last three decades in all over the globe arise the need for detailed investigation and assessment of existing structures. Although engineers have

several methods for structural assessment, fragility curves are powerful tools for probabilistic safety assessment and provide a wide-range projection for seismic performance evaluation [9], [10]. With the aid of fragility curves, damage probability estimation can be done for a given intensity of seismic excitation. Achieving this, it is highly important to establish measures of damage which can be done by using damage indices or discrete damage states or direct tracking of member/structure response [11]. Fig. 1, adopted from the illustration (A-2) in FEMA 445 [11], summarizes the structural performance assessment process with using fragility curves. Besides, it can be used for performance based design of a new structure with an appropriate preliminary design.

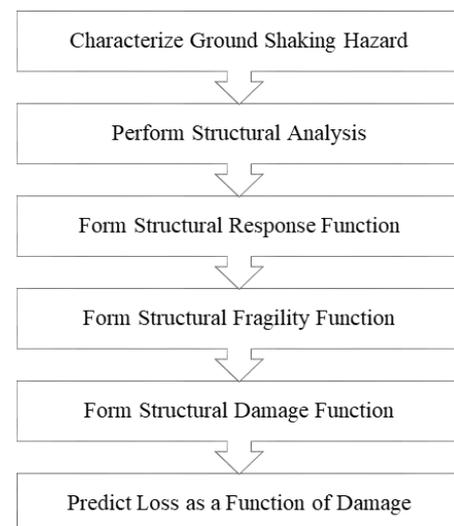


Fig. 1 Structural performance assessment process (adopted from FEMA 445 [11])

Although most of the studies about fragility analysis deals with reinforced concrete structures and masonry structures in literature [12]-[15], there are several studies on performance assessment of precast reinforced concrete structures by using fragility curves. In some of these studies, the effects of various structural parameters, soil conditions, connection details, existence of non-structural members on level of structural damage and probability of collapse have been investigated by using damage limits in different codes and specifications. Some other studies have evaluated the accuracy of the fragility curves.

This paper aims at reviewing the studies in literature on fragility analysis of precast reinforced concrete structures. The basic information about the fragility analysis is given in the following section. It is decided that to not flood the whole theory, equation and statistical background about the fragility curves and analysis in here since the paper focuses on the application of the method on particular precast

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structures which is a quite new effort date back to mid-2000. Detailed information and fundamentals of the method can be found in [11], [16] and etc.. After that main outcomes of existing studies in literature are presented and finally a summary is given at the last section.

II. BASIC KNOWLEDGE ABOUT THE FRAGILITY ANALYSIS

Fragility functions are expressions of a probability that a structural member or overall system will experience a certain level of damage, respect to a certain level of response of the member or structure which is measured by the demand [11]. There exist several methods to develop the fragility functions for the vulnerability and risk assessment. They can be categorized as (a) expert opinion-based approach which highly relies on the knowledge of the expert and accepted as a subjective methodology, (b) empirical approach which depends on the damage distribution in structures obtained after seismic events and (c) analytical approach that is the outcome of structural analyses and which needs to be outcome of a big data cluster. Besides there exist hybrid approaches that combine any two of aforementioned three methods [10]. After establishing the function, it generally turns into a curve which has a better representation. Fragility curve, which is fundamentally a mathematical model based on probability theory, graphically represents the probability of exceedance of a certain damage limit for a given earthquake intensity. It can be written in a closed form as shown in (1).

$$Pr = P[R \geq r | I] \tag{1}$$

R and r represent the structural response and limiting structural response for a given damage level respectively whereas I states for the selected ground motion intensity in (1) [19]. Fig. 2 shows the flowchart that is used to construct the fragility curve by using the analytical methodology [17]. Generally, structural analysis perform on a representative model of a group of which individuals are similar structural characteristics to each other [21]. Classification should be done with the findings of site surveys and inventory studies. Nonlinear analysis procedures, any type of pushover analysis or time history response analysis, should be used to obtain results as close to outcome of real structural behavior. After obtaining the capacity curve of the member or structure, dynamic analyses are carried on to acquire demand of the given ground motions which are specific to the site. As it is mentioned before, one of the most critical step for the overall procedure is defining the damage or structural response limitations. Such limitations of which exceedance probability are investigated for a given excitation can be selected as interstory drift ratios, residual deformations, predetermined damage states defined in codes and acknowledged reports etc..

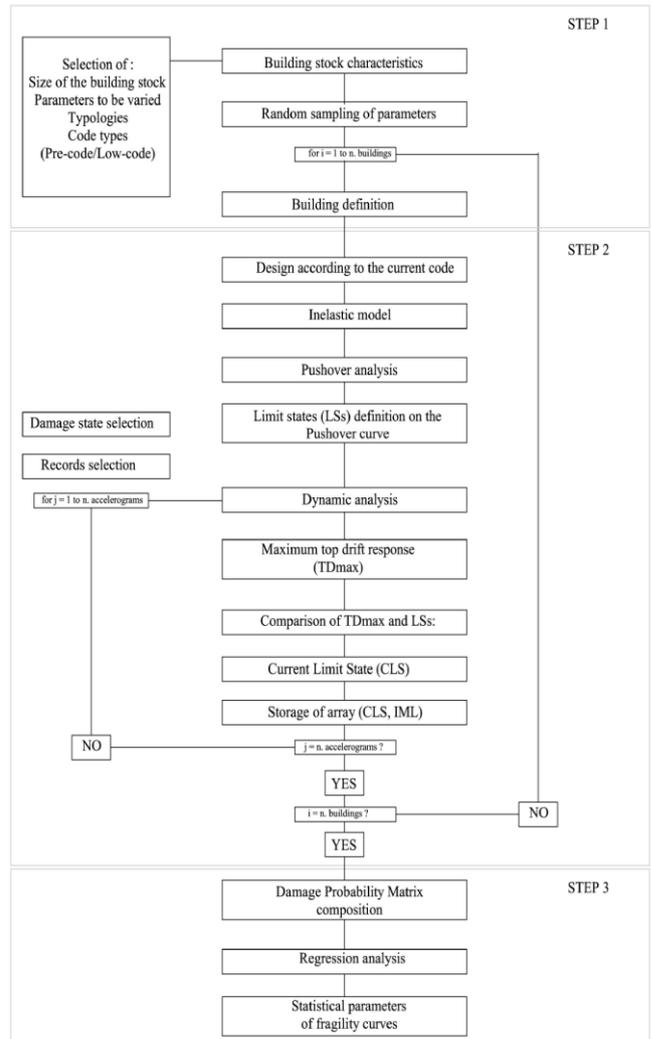


Fig. 2 Flowchart of the proposed analytical method by Casotto et al. to derive fragility curves [17]

After all, exceedance probability of chosen damage or response limiting function is determined with using capacity curve and various demands. One of the example fragility curve represent the probability of different damage states respect to interstory drift ratio is given in Fig. 3 [10]. It should be noted that such graphics can contain either multiple damage levels as can be seen in Fig. 3 or single, specific damage level. Using the fragility curves, one can end-up with the damage or loss estimation for a given type of structure built in specific area.

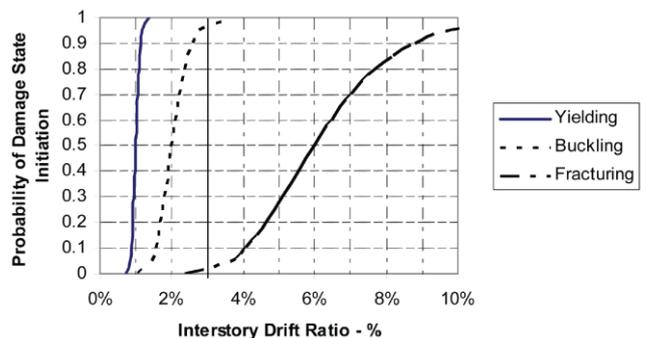


Fig. 3 Example of fragility curve [10]

### III. STUDIES IN LITERATURE ON ASSESSMENT OF PRECAST STRUCTURES USING FRAGILITY CURVES

In this section, some outcomes of the past studies with respect to different aspect of structural assessment of precast reinforced structures with using the fragility curves presented. Literature survey mainly focuses on fragility analysis on single-story, pin-connected precast industrial structures.

Although there exist many investigations on the subject of fragility analysis on residential buildings, there are few studies on structural assessment using fragility curves of precast industrial structures. Those attempts dates back to mid-2000 and available studies are summarized in this section.

*A. Bolognini et. al. 2008 [21]*

Bolognini et. al. performed vulnerability analyses on traditional Italian precast reinforced concrete structures using simplified pushover procedure. Investigated building stock was categorized in four distinct typology which are presented in Fig 4. Rigid diaphragm assumption were applied and design code differences were accounted i.e. material strength, base shear to weight ratio, connection type. Displacement capacity limits

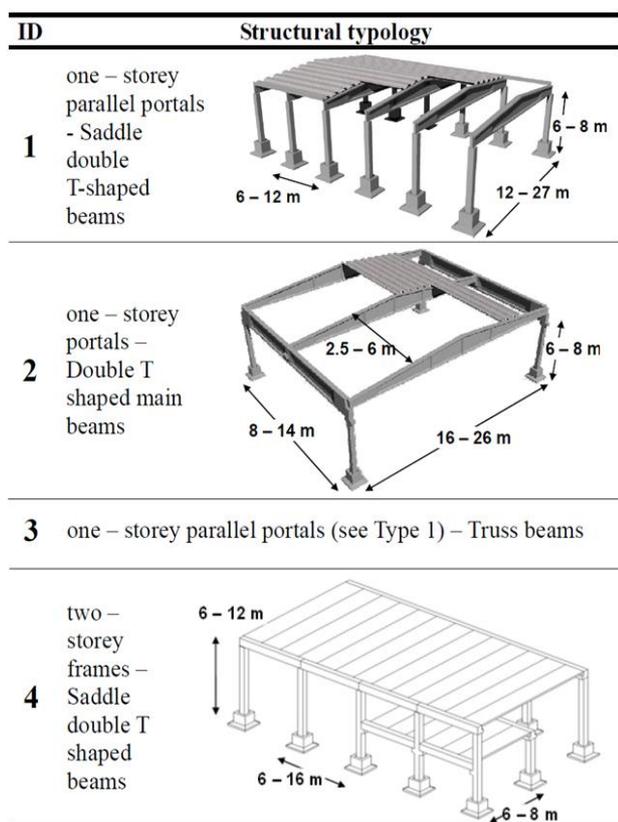


Fig. 4 Four different structural typology used in [21]

were chosen as limiting response states and peak ground acceleration was specified as ground motion parameter. However, response spectrum was used instead of dynamic analysis for obtaining the displacement demand. It was claimed that using response spectrum for obtaining demand parameter led to less computational effort. Fig. 5 shows fragility curves that they constructed. LS1 and LS3 represent the light damage and collapse limit states,

respectively. It was noted and confirmed that connections are one of the weak points for such structures.

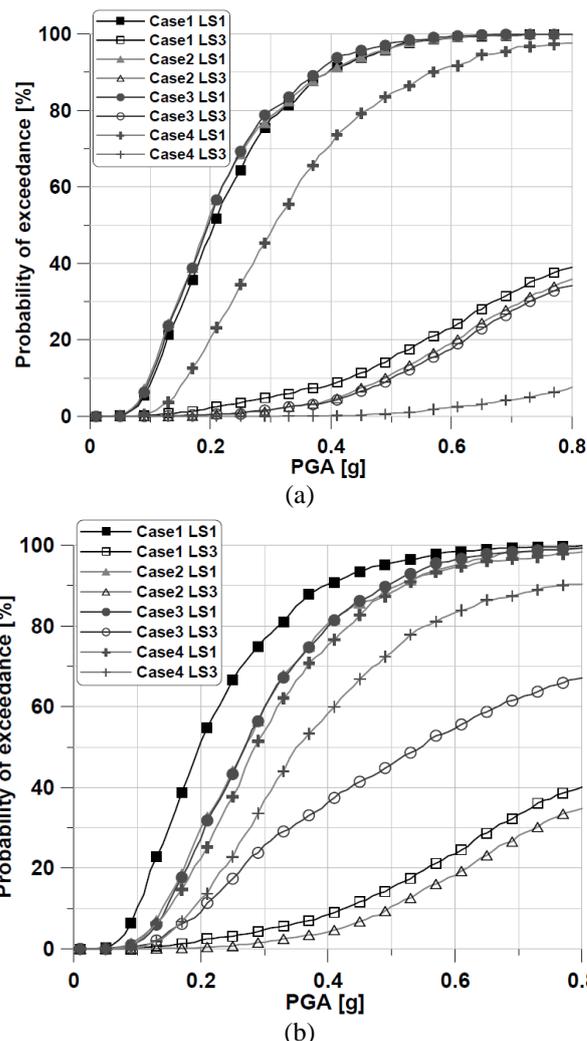


Fig. 5 Fragility curves constructed in [21]  
 (a) Lateral force ratio (F/W) %4,  
 (b) Lateral force ratio (F/W) %10

*B. Senel and Kayhan 2010 [19]*

Senel and Kayhan performed damage assessment using fragility curves on 65 single-story, precast reinforced concrete structures located at Denizli, Turkey. It was highlighted that most of them have slender columns with inadequate confinement and built before the modern Turkish seismic code issued. Investigated building stock was categorized in twelve distinct group according to their structural properties i.e. strength, stiffness and ductility. It was noted that efficiency of these structural properties on behavior of such structures were studied by comparison of fragility curves. Damage states were determined by using strain based displacement limits. Two dimensional models were used to obtain capacity curves (Fig. 6). Nonlinear time history response analyses with 360 earthquake data were used to calculate demands. Fragility curves were constructed based on peak ground velocity parameter.

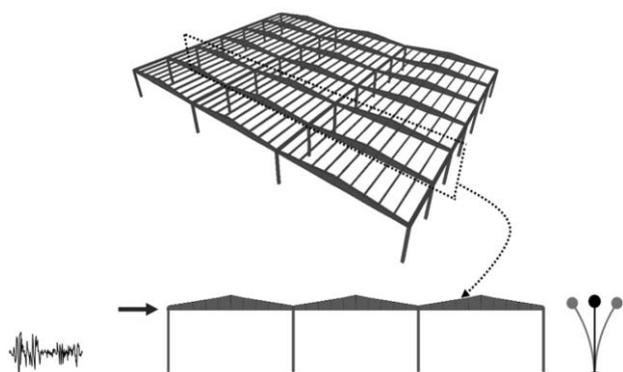
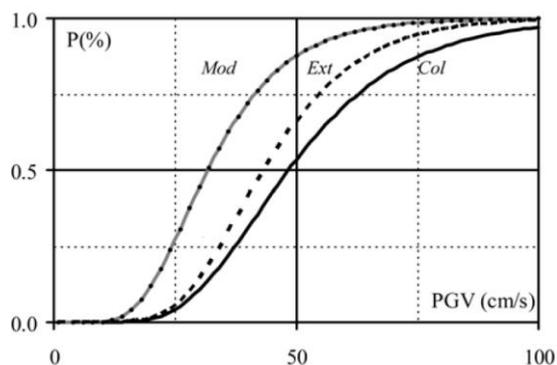
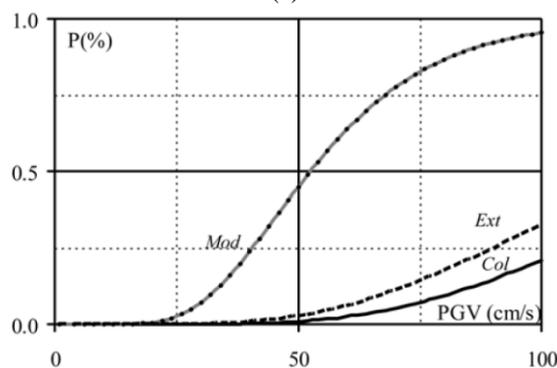


Fig. 6 Representation of structural model [19]



(a)



(b)

Fig. 7 Fragility curves constructed in [19]

- (a) B350-T0.4-L1,
- (b) B450-T1.0-L2

Fig. 7 shows fragility curves that they constructed. In the figure, B represents the cross-sectional dimension of square column, T and L stand for transverse and longitudinal reinforcement ratios, respectively. It was reported that most effective structural parameters control damage probability of such structures were ductility and stiffness.

*C. Casotto et. al. 2015 [17]*

Casotto et. al. performed fragility analyses on precast reinforced concrete structures. It was stated that the aim of the study was presentation a fragility model for prefabricated industrial structures constructed in Italy. It was reported that building stock was categorized in two distinct typology which are presented in Fig 8. It was also noted that 650 site survey were done which was used to determine the geometric properties of the modeled structures and 70 earthquake records were used to perform nonlinear dynamic analysis. Damage limit states were determined by using the parameters of yielding of the longitudinal bars,

interstory drift and connection resistance. Fragility curves were constructed based on peak ground velocity parameter. Besides, the power-law function with three spectral quantity ( $IM_{pw}$ ) was used as can be seen in Fig. 9.

Structural configuration	Code level	Design lateral load*	Id code
Type 1	Pre-code	2%	T1-PC-2
	Low-code	4%	T1-LC-4
		7%	T1-LC-7
		10%	T1-LC-10
Type 2	Pre-code	2%	T2-PC-2
	Low-code	4%	T2-LC-4
		7%	T2-LC-7
		10%	T2-LC-10

Fig. 8 Two different structural typology used in [17]

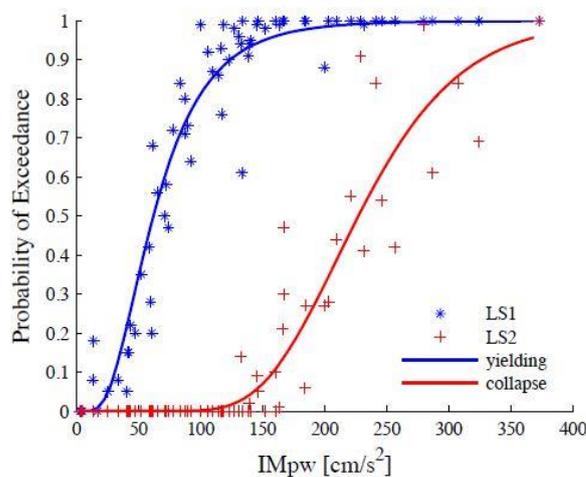


Fig. 9 Fragility curves constructed in [17]

It was reported that higher fragility obtained while the three component of the earthquake record considered. It was also noted that connection failure should be including the assessment carefully. Besides, it was concluded that results from the analysis and from the site survey are compatible in the study.

In addition, same authors published another research paper with the similar context [18]. Both papers are based on same study and structural database of 650 site survey. It was stated in [18] that choosing a simplified analysis methods without considering vertical acceleration could not able to represent the connection failure in precast structures.

*D.Babic and Dolsek 2016 [2]*

Babic and Dolsek performed vulnerability analysis on twelve distinct industrial precast structure classes which were subclasses of two main types (Fig.10). Structure classes were single story and representative of 100 individual building, as well as typical for Italian practice. It was mainly investigated that the effect of non-structural components i.e. vertical panels, horizontal panels and masonry infill walls on vulnerability for such structures (Fig. 11). Therefore, dislocation of non-structural elements besides structural collapse, were chosen as damage state for

the analyses. Connection property between such non-structural and structural members as well as applied code to design were also included. Three dimensional and detailed structural models were used for analyses including hysteretic behavior for both beam to column connection and fasteners linking non-structural components to load-bearing system. Demands were obtained using both response spectrum and time history procedures.

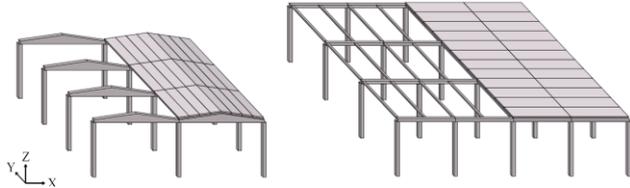


Fig. 10 Two main structural typology used in [2]

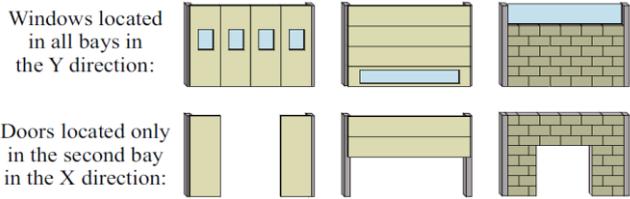


Fig. 11 Non-structural components with openings used in [2]

It was concluded that horizontal panel were most vulnerable whereas vertical panels were less vulnerable in the study. It was also concluded that masonry infill-walls affected the probability of collapse in terms of reducing the median peak ground acceleration whereas horizontal panels affected the probability of collapse in terms of scattering of the data in collapse fragility curve.

*E. Palanci et. al. 2016 [22]*

Palanci et. al. performed seismic assessment of 98 precast industrial structures in Denizli, Turkey using fragility curves. All the structures were single-story and they classified as three groups according to their ductility and strength capacities. More than 300 earthquake records were used to perform nonlinear time history analyses. PGV was the parameter for seismic intensity in the study and those records of seismic excitations were classified into three main groups which were low, medium and high intensity levels.

Damage state were chosen according to Turkish seismic code 2007 which were categorized as yielding state, immediate occupancy state, life safety state and finally collapse prevention state. Representation of the damage states and typical capacity curves regarding to them is shown in Fig. 12. Fragility curves constructed in the study for precast industrial structures are given in Fig. 13, according to three classified structure groups.

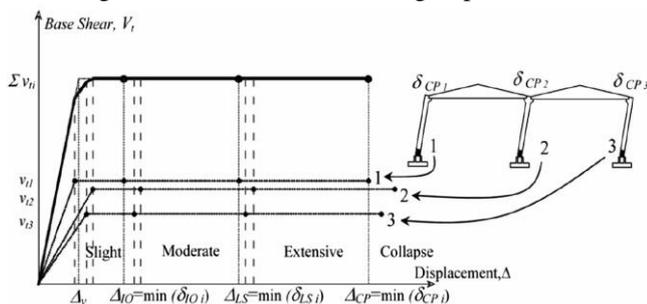


Fig. 12 Capacity curve and damage region representation in [22]

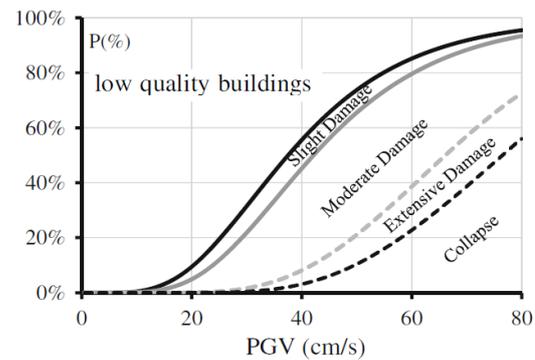
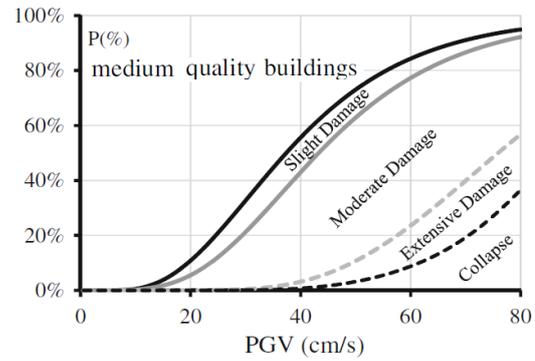
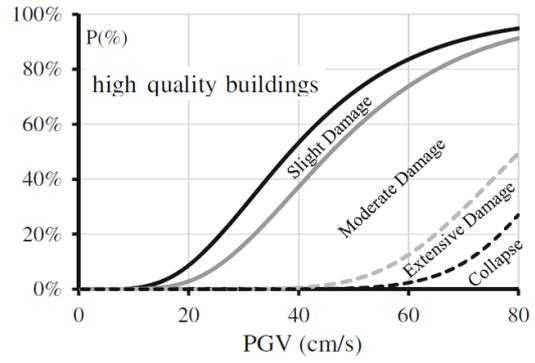


Fig. 13 Damage region representation on the analytical fragility curves [22]

It was noted that ductility and strength of the structure are effective parameters on fragility curves of single story structures especially regarding to higher damage levels. It was said that average fragility curves regarding to structural classification according to ductility and strength, presented clearly distinct results and concluded that such probabilistic method could be an effective way of the preliminary assessment method of precast industrial structures.

Authors of [22], M. Palanci, S. M. Senel and A. Kalkan have published similar research papers on the subject eith using same structural database which was precast industrial structures located in Denizli, Turkey. They have studied the effect of same structural parameters, strength, ductility and stiffness as well as other variables on vulnerability analysis with different aspects [23]-[25].

*F. Buratti et. al. 2017 [9]*

Buratti et. al. performed fragility analyses precast industrial structures using empirical method including damage occurrence in more than 1800 structures. It is noted that two types of models were adopted i.e. fragility model with exceedance of certain amount of damage and ordinal model which was aimed to overcome the overlapping effect of

fragility curves.

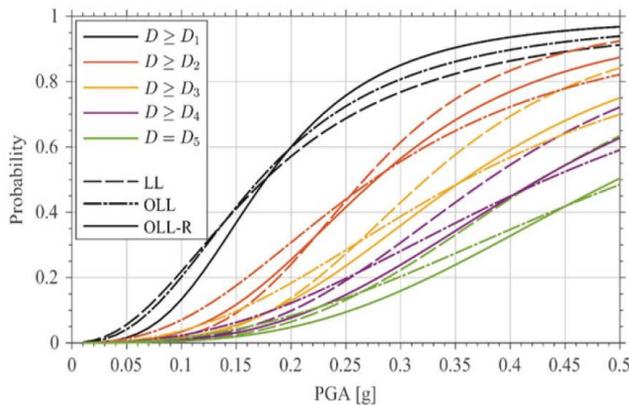


Fig. 12 Different types of fragility curves according to various model obtained in [9]

The damage matrices were evaluated according the gathered data and after that fragility curves were fitted. Damage states were determined using EMS-98 (European Macroseismic Scale 1998) as a six-level scale system (D0 to D5). The database investigated according to cadastral data and intensity of ground motion was obtained from shake maps generated for Italy. Peak ground acceleration value was selected the earthquake intensity. It was concluded that precast structures were significantly more vulnerable in comparison to reinforced concrete frame structures with regard to fragility curves. It was also noted that the investigated damage states in structures was due to Emilia earthquake of which peak ground acceleration was less than 0.35 g and stronger earthquakes should be considered carefully with respect to outcomes of the study.

*G.Ercolino et. al. 2018 [26]*

Ercolino et. al. performed vulnerability analyses on forty, single story, precast reinforced concrete structures which were designed according to current Italian code. Four different geometrical configurations were adopted. Main variables were dimensions of members, reinforcement details and soil types. Incremental N2 method used to obtain the responses. Damage limit state were selected as only collapse limit (Demand/Capacity>1) whereas demands were obtained using response spectrum.

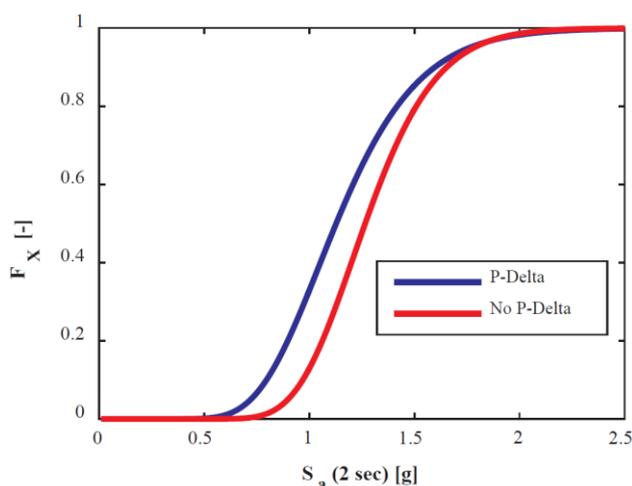


Fig. 13 Elastic model of precast structure used in [26]

It was concluded that the detailing according to recent Italian code achieved as safe design against the collapse probability because of the appropriate seismic details and structural overstrength. It was also noted that cracking has negligible effect on collapse assessment. On the other hand geometrical nonlinearity has a significant effect on response (Fig13).

#### IV. CONCLUSION

Fragility analysis can be accounted as sophisticated and advanced method of performance assessment. Significant number of fragility analysis studies on residential buildings can be found in the literature. However, there are few studies on fragility assessment of precast reinforced concrete structures. Such studies dates back to mid-2000. Outcomes of studies on fragility analysis of single-story, pin-connected precast industrial structures are presented in this study. It is aimed that to gather the information and to present the trend on the subject.

Past studies shows that accuracy of connection modeling, inclusion of the claddings as well as infill walls and considering the vertical component of the seismic excitation are significantly important parameters for fragility analysis of precast reinforced concrete structures. It is concluded that there should be a consensus on the damage limits since the damage states cannot be directly comparable among the outcomes of the available studies.

In addition, it is obvious that there is a need for performing more detailed studies with using more parameters either structural or non-structural. Finally, since new and broaden studies require huge amount of effort, conducting a joint research group to work on the subject systematically would be a good way to reach more sensitive and reliable outcomes.

#### REFERENCES

- [1] FIB, "Seismic design of precast concrete building structures", Bulletin no. 27, State of the art report, 2004.
- [2] A. Babic and M. Dolsek, "Seismic fragility functions of industrial precast building classes", *Engineering Structures* 118 (2016) 357-370
- [3] S Ozden, E Akpınar, H Atalay, "Reconnaissance report on Van earthquake of October 2011", Research Report, Kocaeli University, 2011.
- [4] S. Ozden, E. Akpınar, H. Erdogan, H Atalay, "Performance of precast concrete structures in October 2011 Van earthquake, Turkey", *Magazine of Concrete Research*, 2014.
- [5] M. Saatcioglu, D. Mitchell, R. Tinawi, N. J. Gardner, A. G. Gillies, A. Ghorbarah, D. L. Anderson, and D. Lau, "The August 17, 1999, Kocaeli (Turkey) earthquake — damage to structures", *Can. J. Civ. Eng.* Vol. 28, pp. 715–737, 2001.
- [6] I. Ioannou, R. Borg, V. Novelli, J. Melo, D. Alexander, I. Kongar, E. Verrucci, B. Cahill and T. Rossetto, "The 29th May 2012 Emilia Romagna Earthquake", EPICentre Field Observation Report, No. EPI-FO-290512, 2012.
- [7] I. Ioannou, R. Borg, V. Novelli, J. Melo, D. Alexander, I. Kongar, E. Verrucci, B. Cahill and T. Rossetto, "The 29th May 2012 Emilia Romagna Earthquake", EPICentre Field Observation Report, No. EPI-FO-290512, 2012.
- [8] A. Belleri, E. Brunesi, R. Nascimbene, M. Pagani, P. Riva, "Seismic performance of precast industrial facilities following major earthquakes in the Italian territory", *J. Perf. of Const. Fac.*, Vol. 29 Issue 5, 2015.
- [9] N Buratti, F. Minghini, E. Ongaretto, M. Savoia and N. Tullini, "Empirical seismic fragility for the precast RC industrial buildings damaged by the 2012 Emilia (Italy) earthquakes", *Earthquake Engng Struct. Dyn.* 2017.
- [10] G.M. Calvi, R. Pinho, G. Magenes, J.J. Bommer, L.F. Restrepo-Vélez and H. Crowley, "Development Of Seismic Vulnerability Assessment

- Methodologies Over The Past 30 Years”, ISET Journal of Earthquake Technology, Paper No. 472, Vol. 43, No. 3, September, pp. 75-104, 2006.
- [11] FEMA-445 “Next Generation of Performance-based Seismic Design Guidelines. Program Plan for New and Existing Buildings”, Federal Emergency Management Agency (FEMA), Washington DC, USA, 2006.
- [12] G. M. Verderame, M. Polese, E. Cosenza, G. Manfredi, “Vulnerability analysis of a pre-seismic code R.C. building in Catania, in Seismic behavior of GLD R.C. buildings”, (E. Cosenza Ed.), CNR – GNDT, Rome, Italy, 2002.
- [13] K Karimi. and A. Bakhshi, "Development of Fragility Curves for Unreinforced Masonry Buildings Before and After Upgrading Using Analytical Method", First European Conference on Earthquake Engineering and Seismology, Geneva, Switzerland, 3-8 Sep.2006.
- [14] M. Polese , G. M. Verderame , C. Mariniello, I. Iervolino and G. Manfredi, “Vulnerability Analysis for Gravity Load Designed RC Buildings in Naples – Italy”, Journal Journal of Earthquake Engineering, Vol 12 , pp. 234-245, 2008.
- [15] T. Karantoni., F. Lyrantzaki, G. Tsionis, and M. N. Fardis, “Analytical fragility functions for masonry buildings and building aggregates - UPAT methodology”, Internal Report, Syner-G Project, 2011.
- [16] K. Porter, “A Beginner’s Guide to Fragility, Vulnerability, and Risk”, University of Colorado Boulder, 110 pp., 2018. <http://spot.colorado.edu/~porterka/Porter-beginners-guide.pdf>.
- [17] Casotto, C., Silva, V., Crowley, H., Nascimbene, R. and Pinho, R. “Seismic Fragility of Italian RC Precast Industrial Structures”, Engineering Structures, 2015.94, 122-136
- [18] C. Casotto, V. Silva, H. Crowley, R. Nascimbene and R. Pinho, “Seismic Fragility and Collapse Probability of Italian Precast Reinforced Concrete Industrial Structures”, Proceedings of the Twelfth International Conference on Computational Structures Technology, Paper 52, 2014.
- [19] S. M. Senel and A. H. Kayhan. Fragility based damage assesment in existing precast industrial buildings: A case study for Turkey. Structural Engineering and Mechanics, Vol. 34, No. 1 (2010) 39-60
- [20] H. K. DAL, Mevcut Yüksek Katlı Betonarme Binaların Hasar Görebilirliğinin Kırılma Eğrileri Yardımıyla Belirlenmesi, İstanbul Teknik Üniversitesi, Fen Bilimleri Enstitüsü, , Yüksek Lisans Tezi, 2013.
- [21] D. Bolognini, B. Borzi, R. Pinho. Simplified Pushover-Based Vulnerability Analysis of Traditional Italian RC precast structures. In: The 14th World Conference on Earthquake Engineering, October 12-17, 2008, Beijing, China
- [22] M. Palanci, S. M. Senel and A. Kalkan, “Assessment of one story existing precast industrial buildings in Turkey based on fragility curves”, Bull. Earthquake Eng., 2016.
- [23] A. Kalkan, “Mevcut Çok Katlı Ve Mafsallı Prefabrik Binaların Deprem Performansının Araştırılması”, MSc. Dissertation Thesis, Pamukkale Üniversitesi, 2013.
- [24] M. Palanci. “Mevcut Prefabrik Sanayi Yapılarında Deprem Sigortası Risk Primlerinin Olasılıksal Yöntemler İle Tahmini”. PhD. Dissertation Thesis, Pamukkale Üniversitesi, 2014.
- [25] Ş.M. Şenel, M. Palanci, Y. Yılmaz ve A. H. Kayhan. “Yapısal Parametrelerin Tek Katlı Mafsallı Prefabrik Binaların Hasar Görebilirlik Eğrileri Üzerindeki Etkisi”, In: 2. Türkiye Deprem Mühendisliği ve Sismoloji Konferansı, 25-27 Eylül, MKÜ, Hatay, Türkiye 2013.
- [26] M. Ercolino., D. Bellotti, G. Magliulo, R. Nascimbene. Vulnerability analysis of industrial RC precast buildings designed according to modern seismic codes. Engineering Structures 158 (2018) 67-78

# Geographic Information Systems (GIS), a Tool for Water Resource Management in Nigeria: A Case Study of Abuja

Sylvia Usman

**Abstract—**Abstract—In most developing cities, especially in Africa, population growth, urbanization and climate change have caused pressures on basic infrastructure such as potable water supply. The stress on these infrastructures reinforces the poverty cycle and undercuts economic growth. Over the years, conventional methods of obtaining data have been complex and labor intensive. With the advent of GIS, spatial deliveries of numerical data and maps have supported the search for other relevant data, as well as improve data management. The use of GIS applications in most Africa countries is low due to challenges such as, the cost of acquiring and maintaining National Geospatial data infrastructure (NGDI). Abuja as the capital city of Nigeria is one of the fastest growing cities in Africa; faced with certain physical and anthropogenic challenges such as climate change, water scarcity, and over-exploitation of aquifers. The rapid increase in migration and population growth threaten basic infrastructure and amenities. However, limited statistical data about water provides no information about the spatial distribution of water access in Abuja communities. The role of GIS in the spatial aspects of water resource management is enormous. GIS provides governmental and non-governmental agencies access to geo-spatial information for decision making and proper management. Thus, it is essential to embrace GIS technology for its usefulness in national development and economic planning. This paper aims to highlight the importance of adopting GIS technology as a powerful tool for potable water management. It is envisaged that GIS will positively improve water management issues through adequate distribution of potable water and reduce the misuse of public funds through proper planning in Nigeria.

**Keywords—**GIS, potable water, spatial distribution, water access, water resource management

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# Association of Quantitative MRI-Based Radiomic Features with Prognostic Factors and Recurrence in Oropharyngeal Small Cell Carcinoma

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**Abstract**—Background and purpose: Radiomics focuses on extracting a large number of quantitative imaging features correlated with clinical characteristics. We propose a radiomic approach using magnetic resonance imaging (MRI) to decode tumour phenotype and treatment response in oropharyngeal squamous cell carcinoma (OPSCC).

**Materials and methods:** The T1-weighted MRI sequencess of OPSCC patients treated between 2008 and 2016 were retrospectively selected. The extraction of radiomic features was performed using the IBEX software, and hierarchical clustering was applied to reduce features redundancy. The association of each radiomic feature with grading, HPV status and loco-regional recurrence within 2 years, considered as main endpoints, was assessed by univariate analysis and then corrected for multiple testing. Statistical analysis was performed with SAS/STAT® software.

**Results:** Thirty-two eligible cases were identified. For each patient, 1286 radiomic features were extracted, subsequently grouped into 16 clusters. Higher grading (G3 vs. G1/G2) was associated with higher values of GLCM3/0-1MaxProbability and lower values of GLCM25/135-1ClusterShade (p=0.03 and 0.04, respectively). Positive HPV status was associated with higher values of GLCM3/11-4Contrast, GLCM3/6-1ClusterProminence, GLCM25/180-1InformationMeasureCorr2 (p=0.03, 0.02 and 0.04, respectively) and lower values of GLCM3/11-4Correlation and GLCM3/11-7Correlation (p=0.04 and 0.01, respectively). Loco-regional recurrence within 2 years was associated with higher values of GLCM3/4-7Correlation (p=0.04) and lower values of GLCM3/2-1InformationMeasureCorr1 (p=0.04). Results lost statistically significance after correction for multiple testing.

**Conclusion:** MRI-based radiomics in OPSCC for the prediction of tumour phenotype and treatment response is a feasible and promising approach. Larger collaborative studies are warranted in order to increase the statistical power and to obtain robust and validated results.

**Keywords**—Oropharyngeal small cell carcinoma, radiotherapy, radiomics features, hpv , mri.