

A Paradigm for Characterization and Checking of a Human Noise Behavior

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Abstract—This paper presents a paradigm for characterization and checking of human noise behavior. The definitions of ‘Noise’ and ‘Noise Behavior’ are devised. The concept of characterization and examining of Noise Behavior is obtained from the proposed paradigm of Psychoacoustics. The measurement of human noise behavior is discussed through definitions of noise sources and noise measurements. The noise sources, noise measurement equations and noise filters are further illustrated through examples. The theory and significance of solar energy acoustics is presented for life and its activities. Human comfort and health are correlated with human brain through physiological responses and noise protection. Examples of heat stress, intense heat, sweating and evaporation are also enumerated.

Keywords—Human brain, noise behavior, noise characterization, noise filters, physiological responses, psychoacoustics.

I. INTRODUCTION

NOISE is defined as a sensation of unwanted intensity of a wave. It is a perception of a pollutant and a type of environmental stressor. An environmental stressor such as noise may have detrimental effects on various aspects of health. The unwanted intensity of a wave is a propagation of noise due to transmission of waves (viz. physical agents) such as light, sound, heat, electricity, fluid and fire [1]. A unified theory for stresses and oscillations is applicable so as to take into effect of all the physical agents as an environmental stressor on a human body [1]-[5]. As per the theory, the stresses acted on a particle due to interaction of many forces are distinguished as fundamental, internal and external stresses. The existence of fundamental stresses is due to presence of electromagnetic and gravitational forces. The internal stresses are acted under the influence of fundamental stresses and are constituted by composition and properties of a particle. The external stresses are acted under the existence of an external source of energy. The omnipresent characteristic of the urban environment is its exposure to environmental noise. The excessive noise is accepted by the public health doctors and professionals as an undesirable feature of the urban environment. Noise is indisputably perceived to be an irritant, interfering into personal privacy, and causing displeasure and diminishing the worth of a person and his health. As health is largely defined to include quality of life and displeasure, therefore noise undoubtedly affects health.

The effects of stress due to noise of physical agents are consideration to contribute to a range of disorders as wide as

impairment of hearing, cancer, heart disease, musculoskeletal conditions, skin disease, gastrointestinal and other disorders. The evidence is strongest for links between certain types of prolonged stress and heart disease, hypertension, and mental illness. Most of the evidence for such links is epidemiological. It is possible that what is bad for the individual employee is also bad for the organization. Organizational worries connected with work related stress include high absenteeism, increased staff turnover, low job satisfaction, low morale, poor organizational commitment, poor performance and productivity, possible increased accident and near miss rates, and, in some cases, an increase in employee and client complaints and litigation.

All such unwanted disturbances of noise caused by a person or deviation from a normal behavior so as to distract attention of a normal person are termed as Noise Behavior. There is always a source of noise and a sink of noise i.e. a person making the noise in the environment and a person affected by such noise in the environment. A person making the noise in the environment is also affected. The occurrences of noise related stress alters the way people think, feel, and behave. Many of the changes that occur are diffident and potentially reversible, although harmful to the person’s value of life at the time. Other changes may be more enduring, and have substantial consequences for health. Behavioral changes include increases in health risk behavior, such as smoking and drinking, and decreases in health positive behavior, such as exercise and relaxation. Many behavioral changes represent attempts to cope with the emotional experience of stress due to noise—for example, by making noise due to presence of physical agents in the environment or because of other person’s noise behavior in the form of polluting the environment. The noise in the environment is associated with poor decision making, impaired concentration, reduced attention span, impaired memory, and confusion. People who report under stress due to noise also admit that not being able to think straight forward. Social behavior and interpersonal relations of the person affected by noise may also be demolished, possibly reflecting these and other psychological changes such as tiredness and increased irritability.

This paper has summarized the concept of characterization and checking of human noise behavior. Definitions with brief description of noise sources, noise measurements, solar energy acoustics, noise filters & their examples, sensors & transducers for a human brain and comfort & health are presented with reference and context with human noise behavior. Appendix has presented contents of the proposed book by the author: *Human Noise Behavior: Paradigm &*

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Therapy in New Dimensions.

II. NOISE CHARACTERIZATION

A. Source and Sink of Noise

The strength of a source is defined as total energy flow per unit time and unit length of line. A line which is drawn hypothetically perpendicular to the plane, from which energy is assumed to flow uniformly in all directions at normal angles to it, is defined as a source. It acts as a point in the usual two-dimensional energy flow diagram. The flow is in imaginary radial lines from the source, the current of energy flow is at a distance r from the source. The current is determined by the strength divided by the energy flow area [6].

B. Psychoacoustics in New Dimensions

The standard sources of noise along with their definitions, their measurement equations and measurement units are presented. A contemporary theory of psychoacoustics is presented for characterization of interference of noise waves due to difference of power of two intensities [7]-[9]. The difference of two intensities of power is due to transmission of heat, fluid, light, electricity, fire and sound into a particle body. The sources of noise are classified according to the type of wave of interference. The various types of noise are defined with factors of speed of wave, areas of energy stored in a wave, due to interference and difference of power between two intensities of wave. Noise filters as per source of noise signals from noise power systems are differentiated for filtering unwanted frequencies from solar power, electric power, light power, sound power, heat power, fluid power and fire power.

The interference of noise arises due to difference of power of two intensities [1]-[5]. The intensity of power for any particle body is a function of development of various stresses. The phenomenon of acoustic resonance arises due to matching of critical stress level with the natural stress level necessary for oscillation of a particle body. The criteria for generation of acoustic resonance include waves propagated with transmission of light, sound, noise, heat, electricity, fluid and fire from a particle body. The psychological feeling of sensation and perception of noise from light, sound, heat, electricity, fluid and fire is a physiological response from the sensory organs of a standard (average) human body.

C. Sources of Noise

The sources of noise are differentiated as per type of wave of interference [1]-[5].

Heat: The sensation of heat is defined as a perception of temperature. The sensation of temperature is a measure of hotness and coldness. The heat is a radiant energy in the wavelength band of electromagnetic radiation from approximately between $0.1 \mu\text{m}$ to $100 \mu\text{m}$. The units of heat are function of sensation of temperature on a scale. Thermal comfort is an evaluation of comfort zone of temperature on the basis of physiological response of a standard (average) human body. The solar radiation spectrum existing in the ultra violet radiation region contributes to sensation of discomfort of the

human body.

Fluid: The sensation of fluid is evaluated by a combined perception of breathing and ventilation evaluated by the amount of fluid passed either internally and externally through a standard (average) human body.

Light: The sensation of light is defined as a visual perception evaluated by an eye with vision in a radiant energy in the wavelength band of electromagnetic radiation from approximately between $380\text{-}765 \text{ nm}$. The physiological response of an average eye makes available information on the units of light. The sensitivity of human eye is not considered to be same in all wavelengths or colors. The visual sensation of daylight is in the visible region of solar energy spectrum.

Electricity: The sensation of electricity is defined as a perception of shock. It is evaluated by skin of an observer due to an electromagnetic energy stored in a conductor due to short-circuiting by a human body either due to pass of direct current or an alternating current.

Fire: The sensation of fire is defined as a perception of burning. It is caused due to combined exposure of skin to radiation energy and fluid acting on a standard (average) human body.

Sound: The sensation of sound is defined as a hearing perception. It is sense of the ear due to fluid pressure energy. The sound is perceived by a human ear in the frequency band in the range of 20 Hz to $20,000 \text{ Hz}$. The units of sound are based on the physiological response of the standard (average) ear. The sensitivity of human ear is not same in the whole frequency band of sound energy.

III. DEFINITIONS

The definitions of noise are based on criteria that areas of energy are stored in a wave due to interference pattern, speed of wave and difference of power between two intensities of composite waves.

Noise of Scattering: This noise occurs due to difference of intensities of power between two fluid power systems. The amplitude of a fluid wave is the power storage per unit area per unit time.

The fluid power is presumed to be stored in a packet of fluid energy wave of a unit cross sectional area and of length s , the speed of fluid.

Noise of Therm: This noise occurs due to difference of intensities of power between two heat power systems. The amplitude of a heat wave is the power storage per unit area per unit time.

The heat power is presumed to be stored in a packet of heat wave of a unit cross sectional area and of length s , the speed of light.

Noise of Sol: This noise occurs due to difference of intensities of power between two solar power systems. The amplitude of a solar energy wave is the power storage per unit area per unit time.

The solar power is presumed to be stored in a packet of solar energy wave of a unit cross sectional area and of length s , the speed of light.

Noise of Electrons: This noise occurs due to difference of

intensities of power between two electrical power systems. The amplitude of an electricity wave is the power storage per unit area per unit time.

The electrical power is presumed to be stored in a packet of an electricity wave of a unit cross sectional area and of length s , the speed of light.

Noise of Photons: This noise occurs due to difference of intensities of power between two lighting power systems. The amplitude of a light beam is the power storage per unit area per unit time.

The light power is presumed to be stored in a packet of light beam of a unit cross sectional area and of length s , the speed of light.

Noise of Scattering and Lightning: The difference of intensities between two fire power systems causes this type of noise. The amplitude of a flash of fire is defined as power storage per unit area per unit time.

The fire power of fluid is presumed to be stored in a packet of flash of fire of a unit cross sectional area and of length s , the speed of fluid.

The fire power of light is presumed to be stored in a packet of flash of fire of a unit cross sectional area and of length s , the speed of light.

Noise of Elasticity: This noise occurs due to difference of intensities of power between two sound power systems. The amplitude of a sound wave is the power storage per unit area per unit time.

The sound power is presumed to be stored in a packet of sound energy wave of a unit cross sectional area and of length s , the speed of sound.

IV. NOISE MEASUREMENTS

The standard measurement equations are derived and adopted from the standard definitions for sources of noise interference as per the following equalities [9]:

Noise of Sol: The solar power intensity I is defined as the product of the speed of light and total power storage capacity for a packet of solar energy wave. The power difference for two solar power intensities is obtained by taking logarithm of two solar power intensities, I_1 and I_2 . It is mathematically expressed as:

$$Sol = \log(I_1)(I_2)^{-1} \quad (1)$$

where, Sol is a dimensionless logarithmic unit for noise of sol. The oncsol (oS) is more convenient for solar power systems. Since an oncsol (oS) is $1/11^{\text{th}}$ unit of a Sol, it is mathematically expressed by the equation:

$$oS = 11 \log(I_1)(I_2)^{-1} \quad (2)$$

Noise of Photons: The power intensity of light I is defined as the product of the speed of light and total power storage capacity for a packet of light energy wave. The packet of light energy wave and solar energy wave, have same energy areas (for same intensity I), therefore their units of noise are same as

Sol.

Noise of Therm: The heat power intensity I is defined as the product of the speed of light and total power storage capacity for a packet of heat energy wave. The packet of heat energy wave and solar energy wave, have same energy areas (for same intensity I), therefore their units of noise are same as Sol.

Noise of Electrons: The electrical power intensity I is defined as the product of the speed of light and total electrical storage capacity for a packet of an electricity wave. The packet of electricity wave and solar energy wave, have same energy areas (for same intensity I), therefore their units of noise are same as Sol.

Noise of Scattering: The fluid power intensity I is defined as the product of the speed of fluid and total power storage capacity for a packet of fluid energy wave. The logarithm of two fluid power intensities, I_1 and I_2 , gives power difference for two fluid power intensities. It is mathematically expressed as:

$$Sip = \log(I_1)(I_2)^{-1} \quad (3)$$

where, Sip is a dimensionless logarithmic unit for noise of scattering. The oncsip (oS) is more convenient for fluid power systems. Since an oncsip (oS) is $1/11^{\text{th}}$ unit of a Sip, it is mathematically expressed by the equation:

$$oS = 11 \log(I_1)(I_2)^{-1} \quad (4)$$

For determining the energy area of a fluid wave, water is the standard fluid used with a specific gravity of 1.0.

Noise of Elasticity: The sound power intensity I is defined as the product of the speed of sound and total power storage capacity for a packet of sound energy wave. The logarithm of two sound power intensities, I_1 and I_2 , gives power difference for two sound power intensities. It is mathematically expressed as:

$$Bel = \log(I_1)(I_2)^{-1} \quad (5)$$

where, Bel is noise of elasticity expressed as a dimensionless logarithmic unit. The oncibel (oB) is more convenient for sound power systems. Since an oncibel (oB) is $1/11^{\text{th}}$ unit of a Bel, it is mathematically expressed by the equation:

$$oB = 11 \log(I_1)(I_2)^{-1} \quad (6)$$

Noise of Scattering and Lightning: The fire power flash of intensity, I with a power of light, is defined as the product of the speed of light and total power storage capacity for a packet of fire wave. The fire power flash of intensity, I with a power of fluid, is the product of the speed of fluid and total power storage capacity for a packet of fire wave.

The combined effect of scattering and lightning for a noise occurring due to flash of fire is to be determined by superimposition principle.

- The flash of fire with power of light and a packet of solar energy wave have same energy areas (for same intensity I), therefore noise units are same as Sol. There may also be power of therm in flash of fire with power of light.
- The flash of fire with power of fluid and a packet of fluid energy wave have same energy areas (for same intensity I), hence their units of noise are same as Sip. In evaluating and determining the areas of energy stored in a wave for the case of fluids other than water, a multiplication factor of a specific gravity of fluid is to be used.

A. Limiting Conditions

The Table I summarizes units of noise and their limiting conditions.

TABLE I
NOISE UNDER LIMITING CONDITIONS

Reference* ($I_2 = \pm 1 \text{ Wm}^{-2}$)	Noise Scales and limiting Conditions		
	Noise of Sol	Noise of Scattering	Noise of Elasticity
Units	Sol	Sip	Bel
$I_1 = 1 \text{ Wm}^{-2}$	No Positive Solar Energy	No Positive Fluid Energy	No Positive Sound Energy
$I_1 = 1 \rightarrow 0 \text{ Wm}^{-2}$	Decreasing Solar Energy	Decreasing Fluid Energy	Decreasing Sound Energy
$I_1 = +ve$	Increasing Solar Energy	Increasing Fluid Energy	Increasing Sound Energy
$I_1 = -1 \text{ Wm}^{-2}$	Negative Solar Energy	Negative Fluid Energy	Negative Sound Energy
	Darkness	Low Pressure	Inaudible range
$I_1 = -ve$	Darkness increasing, distance from point source of light increasing	Low pressure increasing, vacuum approaching	Inaudible range increasing, vacuum approaching
$I_1 = -1 \rightarrow 0 \text{ Wm}^{-2}$	Negative Solar Energy	Negative Fluid Energy	Negative Sound Energy
	Decreasing Darkness	Decreasing Low Pressure	Decreasing inaudible range

*Reference value of $I_2 = \pm 1 \text{ Wm}^{-2}$ signifies the limiting condition with areas of noise interference approaching to zero.

There are three reasons for choosing an *onci* as $1/11^{\text{th}}$ unit of noise: i) Reference value used for I_2 is -1 W m^{-2} on positive scale of noise and 1 W m^{-2} on negative scale of noise. In a power cycle, all types of wave form one positive power cycle and one negative power cycle [2]. Positive scale of noise has 10 positive units and one negative unit. Whereas, negative scale of noise has 1 positive unit and 10 negative units; ii) each unit of sol, sip and bel is divided into 11 parts, 1 part is $1/11^{\text{th}}$ unit of noise; and iii) the base of logarithm used in noise measurement equations is 11.

V. SOLAR ENERGY ACOUSTICS

A. Theory

A theory of acoustics in solar energy was proposed by the author [8], which can be arrived and deduced from definitions of Noise of Sol and Equations (1) and (2).

A brief on the theory of a solar energy absorber is presented here [6]. On the transparent surface of a solar energy absorber, direct rays from the sun are incident. The diffuse rays from the

sky, clouds, and surrounding objects are also incident, which is also partly reflected and partly transmitted from a solar energy absorber. In addition to this, the selective coating on the surface of a solar energy absorber absorbs some part of the radiation. The reflected part of the incident flux is called the reflectance p , the absorbed part of radiation is called the absorptance α , and the transmitted part of radiation is called the transmittance τ . The sum of absorptance, transmittance and reflectance is unity, or:

$$\alpha + \tau + p = 1 \quad (7)$$

There are non-constant distributions of radiations over the directions of incidence and over the wavelength (or frequency) scale on a solar energy absorber. A sample of selective material of a solar energy absorber has radiation properties of transmittance, reflectance and absorptance, which are function of a specific thickness. For a solar energy absorber, the emittance ϵ is defined as the division of the thermal radiant flux emission from a surface to the black body radiant flux emitted at the same temperature [6].

The evaluation of radiation properties from angular dependence point of view is explained through geometry theory of a solid angle formed by all rays joining a point to a closed curve [6]. The solid angle is defined as the ratio of the projected area A on the sphere to the square of length R and radius R. A sphere is considered to be having a solid angle of 4π steradians. For a solar energy absorber, the solar radiation incident on a point at a surface is presumed to be arriving from all the directions through a conical solid angle. For a cone constituting a half angle θ , the solid angle is defined by the circular top and point bottom of that cone [6]:

$$\Omega = 2\pi (1 - \cos \theta) \quad (8)$$

In measuring the transmittance or reflectance, a sample is illuminated over a specified solid angle. The flux is then collected for a given solid angle for measurement of reflectance or transmittance. A conical solid angle is bound through a right circular cone. The source of solar radiation is sunlight.

The radiation properties of sunlight essential for performance analysis of daylighting and lighting are defined as follows [6]:

The luminous flux is directed outward from a source, it ultimately strikes on many surfaces, where it is reflected, transmitted and absorbed. The illuminance is the density of the luminous flux incident on that surface.

The luminance is defined as the intensity of the source or the sink in the direction of an observer divided by the area projected on the source or sink as viewed by an observer.

Luminous intensity is defined as the power due to generation of the luminous flux. A source of sunlight is depicted to be having a luminous intensity in a particular direction. The inverse square law demonstrates that the illuminance incident perpendicular to the line from the point source of sunlight to the surface is directly proportional to the

intensity of the source and inversely proportional to the square of the distance from the source of sunlight to the incident surface [6].

The luminous flux is defined as the rate of flow of light. A receiver surface receives watts of sunlight and it emits luminous flux. The measure of the success rate in converting watts of sunlight to lumens is called efficacy. Quantity of sources is defined as luminous energy and is related to luminous flux, which is luminous power per unit time.

The luminance exitance is defined as the density of luminous flux leaving a surface of a solar energy absorber. The reflectance is defined as the ratio of the luminous flux reflected from a surface to the luminous flux incident on that surface. The transmittance is defined as the ratio of the luminous flux transmitted through a surface to that incident on the same surface.

B. Source and Sink of Solar Energy

The planet earth and its surrounding environment is absorber of solar energy. Examples of solar energy absorbers are civil structures such as green houses, buildings, panels, collectors, thermal power plants, roads, ports, bridges and canals. The earth-atmosphere system is an absorber for a portion of the incident solar energy radiated from the sun. The surface of the earth is also heated by a flux from its interior region from the decay of radioactive isotopes of the earth. The tides on earth occur due to the earth-moon system, result in viscous friction, energy input that affects the surface energy balance of the earth. To the extent that the earth is at a steady state and is not altering, the radiation of heat by earth surface is equal to the input of heat. Radiation of the sun consists of many waves of interference in its spectrum [6]. The absorbed sources of waves of interference of light, sound, heat, electricity, fluid, fire are function of absorptivity for a solar intensity [8]. The sink of solar energy is the earth and its earth-moon system. The temperature of the earth is raised by absorbed solar radiation as incident solar energy is the dominant energy input. The radiation absorbed by the earth is proportional to the earth's cross-sectional area perpendicular to the sun's flux. The earth is acting as a black body radiator with actual power radiated by the earth is determined from the radiative temperature of the earth-atmosphere system [8].

C. Radiation Sources and Life on Earth

Life on the earth is completely dependent upon the energy radiated by the sun. By photosynthesis green plants convert solar energy into chemical energy. All biological processes are either directly or indirectly reliant upon photosynthesis. In addition to the primary role of light in a living economy, a constant environment of radiations from various sources produces other effects, reactions and adaptations [6]. These radiations have receptiveness to influence the life activities. The solar radiation, while passing through the atmosphere is reflected, scattered, and absorbed by gas molecules, ozone, water vapor, clouds and dust. The atmospheric length path traveled by sun rays is obtained by the air mass m , which is the ratio of the mass of atmosphere to the mass which would

exist if the sun was directly overhead at sea level. In this case of overhead earth-sun path, m is equal to 1.0 [6].

The sunlight on the earth is the major source of radiations. The spectrum of sunlight constitutes ultraviolet radiation, visible light, infrared rays and radio waves. The x-rays are originated by solar flares and their ionization due to absorption happens high in the earth's atmosphere. From various celestial sources, x-rays also reach the earth's atmosphere. About 60 per cent of the sunlight energy is in the invisible infrared region's indefinite limit in radiation spectrum. Before radiations of shorter wavelengths reach the surface of earth, they are absorbed in the earth's atmosphere. The artificial radioactive elements are produced by bombardment through high energy particles, examples include helium nuclei. The radioactive emanations consist of three components: i) alpha particles, which are positively charged helium nuclei; ii) gamma rays, which are penetrating radiations of very short wavelength but otherwise like x-rays; and iii) beta particles, which are rapidly moving electrons [6].

D. Greenhouse Gases

The most of ultraviolet solar radiation is absorbed by the ozone in the upper atmosphere. The part of the solar radiation in the shortwave region is scattered by the air molecules. The ozone is formed high above in the atmosphere through ultraviolet radiation absorption by oxygen. The chemical reaction, which is reversible again turns the ozone into oxygen through absorption of longer wavelength ultraviolet rays. The strength of the absorption of solar energy is proportional to the wavelength and absorption bands that are formed at regions of strong absorption. The examples of important atmospheric gases forming part of absorption bands are oxygen (O_2), ozone (O_3), carbon dioxide (CO_2), methane (CH_4), water vapor (H_2O), nitrogen dioxide (NO_2) and chlorofluorocarbons (CFC) [6].

VI. NOISE FILTERS

The noise filters are classified as per source signal of unwanted frequencies from solar power, electric power, light power, sound power, heat power, fluid power and fire power [7]. An acoustic filter is electrical analog circuit of various combinations of RC feedback circuit with an operational amplifier. The acoustic filter is used to filter unwanted frequencies of oscillations from a power system [10], [11]. It is also a network with selective transmission for currents from a power system of varying frequency. The unwanted frequencies generated from a power system are removed by using an operational amplifier with different combination of filter arrangements. An operational amplifier is an integrated circuit that consists of several bipolar transistors, resistors, diodes, and capacitors, interconnected so that amplification can be achieved over a wide range of frequencies.

The action of filtering the frequency from a power system is based on the variation in the reactance of an inductance or a capacitance with change in frequency. The band of frequencies that can be removed from a power system can be at the low frequency end of frequency spectrum, at the high

frequency end, at both ends, or in the middle of the spectrum. The filters to perform each of these operations are known respectively as low-pass filters, high-pass filters, band-pass filters and band-stop filters. There are many configurations of design of filters. The filters are divided into passive and active configurations. The passive filters are less effective simple circuits constructed with resistors, capacitors, and inductors. The active filters are useful in providing an effective filtering action than passive filters. The active filters require a source of operating power.

A. Noise Filter Systems

The criteria for definitions of filters for noise filtering is based on areas of energy stored in a wave due to noise interference, speed of wave and difference of power between two intensities of wave [7]. The filtered noise signals are considered from systems of solar power, electric power, light power, sound power, heat power, fluid power and fire power. The noise filters as per sources of noise are defined as follows:

Filter for noise of sol: This filter is used to filter noise due to difference of power intensities between two solar power systems. Example: window curtain, window blind, wall and sunglasses.

Filter for noise of therm: This filter is used to filter noise due to difference of power intensities between two heat power systems. Example: house, insulation, clothing and furnace.

Filter for noise of photons: This filter is used to filter noise due to difference of power intensities between two light power systems. Example: 3-D vision of any object, electric bulb, television, computer and LCD screen laptop.

Filter for noise of electrons: This filter is used to filter noise due to difference of power intensities between two electrical power systems. Example: AM/FM radio clock with ear phones, telephone instrument with ear phones and CD audio player with ear phones.

Filter for noise of scattering: This filter is used to filter noise due to difference of power intensities between two fluid power systems. Example: electric fan, pump, motor vehicle, river stream, rain fall and tap water.

Filter for noise of scattering and lightning: This filter is used to filter noise due to difference of power intensities between two fire power systems. Example: lighter, matchstick, gas stove, locomotive engine and thunder-bolt.

Filter for noise of elasticity: This filter is used to filter noise due to difference of power intensities between two sound power systems. Example: our vocal chords, organ pipe, thunder-bolt and drum beats.

VII. SOME EXAMPLES OF NOISE FILTERS

Some examples of noise filters are enumerated as under [7].

A. Human Voice Production

The example of phonetics of filtering sound of a human speech is illustrated. The human speech is synthesized due to development of stresses at vocal folds [12], [13]. The smoothening of the sound is function of its amplitude and its shape of oscillations at vocal tract of a human being. The

vocal tract is a resonant cavity wall with sound energy stored in oscillations of its vocal folds. The vocal apparatus showing mechanism of synthesis of human speech is illustrated in Fig. 1.

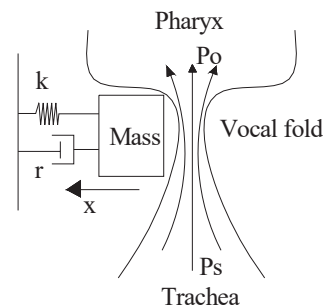


Fig. 1 A human vocal mechanism

B. An Airflow Window with a Photovoltaic Solar Wall

The filtering of solar energy is illustrated through an example of an airflow window attached with a shading device. An airflow window is fixed with a movable roller blind to control the transmission of daylight as well as amount of solar heat. The bottom portion of photovoltaic solar wall is used for controlling the amount of air ventilation along with generation of solar electric power. The example is illustrated in Fig. 2:

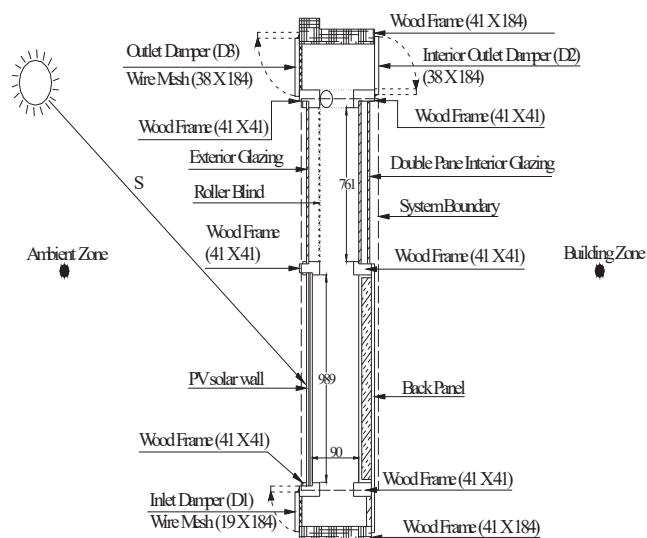


Fig. 2 An Airflow window with a Photovoltaic Solar Wall
 (Dimensions shown are in mm)

C. Psychrometric Air Conditioner

An elementary air conditioner for summer comfort conditioning consists of a cooling coil, a cooling fluid with a filter [14]. The schematic of operation of a psychrometric air conditioner is illustrated in Fig. 3.

D. Telephone Line

The impedance of a telephone line is composed of distributed resistance, capacitance, and inductance [15]. The impedance of telephone line is proportional to the insulation, loop length and whether the wire is buried, aerial or bare

parallel wires strung on telephone pole. A telephone line is usually supplied with a 48 VDC from the telephone exchange. The schematic of operation of a telephone line with telephone instrument is illustrated in Fig. 4.

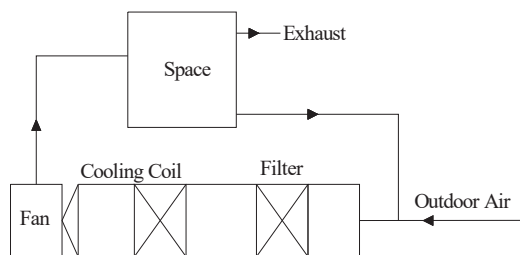


Fig. 3 A psychrometric air conditioner

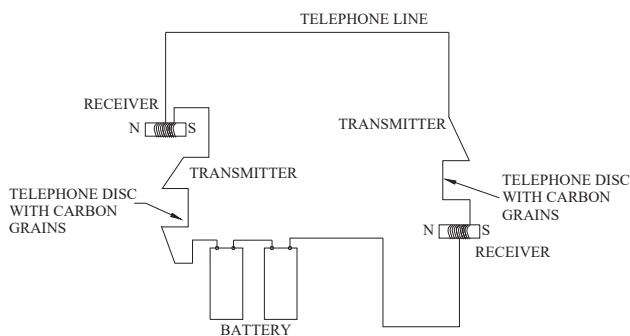


Fig. 4 Operation of a Telephone Line

E. Fire and Smoke Detection System

A fire detection system consists of a control system with interconnected alarms, smoke and heat detectors. A fire detector is a device which is used for presetting an alarm at a particular temperature. A smoke detector is a device which is used for presetting an alarm when a certain percentage of smoke accumulates. The photovoltaic cell activates the smoke alarm only if it senses requisite obscuration of light over a unit area with control from BMS [16]. The schematic of various components for fire detection system is illustrated in Fig. 5.

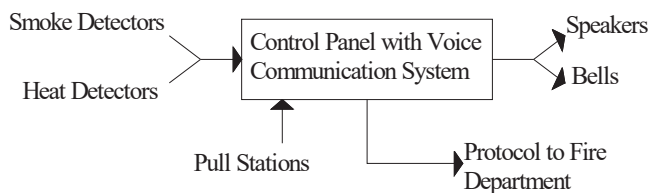


Fig. 5 A fire detection system

VIII. SENSORS AND TRANSDUCERS FOR A HUMAN BRAIN

Our body has feedback systems that regulate the internal environment of our body. The feedback systems make use of storage depots and numerous feedback loops. The monitoring of plasma calcium is a good example of negative feedback. The bones constitute large storage depots for calcium, for the plasma to withdraw these storage supplies in times of need. Our body's homeostatic regulatory systems are represented by feedback loops. The feedback is considered negative, when it

is compensating or negates any change. The negative feedback is essential to stabilize a system.

The gastrointestinal tract, the lungs, the kidneys, and skin of your body make exchange of materials and energy between the internal and the external environments. A steady state is achieved by regulatory mechanisms involving the balance between the inflow and outflow of the internal environment that stabilizes the composition of the internal environment. The tendency to regulate the internal environment so that it is maintained in a steady state is called homeostasis [5].

The coordination of the activities of the various sensory organs within your body is controlled by the secretion of hormones and by transmission of nerve impulses. The nerve impulses travel along axons. The sensory nerve axons carry impulses from different parts of your body to the central nervous system (brain and spinal cord). Although parts of your brain involved in various physiological functions have been located, research attempts to localize complex behavior patterns in sensory areas of your brain have failed. The sensory areas are located for the impulses on the cortex. The motor areas are also located where "command" impulses leave the cortex. The cerebellum receives impulses from sensory receptors and interacts with motor cortex, insuring smooth muscular movements. The reticular formation receives sensory impulses from the environment and sends impulses to the cortex.

A. Heat Stress

When vulnerable to solar radiation, your body acts as a solar energy absorber [6]. This enables your senses for interpretation of our surrounding environment. The amount of heat you lose is dependent on the difference in temperature between the environment and the surface of your body. The heat loss from your body is directly proportional to this difference in temperature. The heat would be released from your body, if the surface temperature of your body is at a higher level in comparison to that of environment. Because of excessive solar heat, the environmental temperature rises above your body temperature; in that case you will gain heat from the environment.

B. Effects of Intense Heat in a Room

Our presence in a room with solar radiation, high room air temperature and conduction do not count in our favor for loss of body heat. In this situation, our body gain heat from the surrounding environment. We have the chance to survive, but only through mechanism of sweating for losing heat. The normal response of our body is resulting in intense heat strains through the body's circulatory system [6]. This happens because the hypothalamus reacts to the heat through expansion of the blood vessels in our skin. As a consequence, it results in decreased resistance to blood flow and our blood pressure falls. The reflexes happen, which prevent large changes in blood pressure, ultimately begin to operate and the decreased resistance to blood flow is compensated through the heart working much harder. The expanded blood vessels create it potential for large amounts of blood to pool in the vessels of

our skin at the price of other organs. We will faint as a result of sufficiently low blood supply to our brain [6].

C. Sweating

Through sweating, a circulatory problem occurs, because of the salt and water loss. A decreased plasma volume occurs because of excessive fluid loss. As a result, the output of blood from the heart is slowed down, which could lead to decreased blood flow to the skin, which ultimately could reduce sweating. If this occurred, your main avenue for heat loss would be shut down. In this case, heat production would continue and your body temperature would rise until your whole body system is collapsed. The body's ability to control heat loss is very limited. A vicious circle may occur as a result of heat not losing rapidly enough to prevent a rise in body temperature. When heat regulation fails, the positive feedback loop occurs into operation in your body (Heat production–metabolism–temperature control); if unchecked it results in heat stroke and death [6].

D. Evaporation

Sweating is an evident method to lose heat by evaporation [6]. Water continuously evaporates from your skin during the process of sweating. When you breathe, there is also a small loss of water from the surface of the lungs. When you breathe or sweat, the amount of water that evaporates is proportional to the humidity of the air. At high humidity of the surrounding air, water evaporates much slowly and therefore contributes less to the cooling process. One of the important methods of losing heat from the surface of your body is through evaporation [6]. There is evaporation of water from your skin after swimming and you feel cool. There should have minimum amount of energy of the water molecules on your body's surface for evaporation to happen. The speeding water molecules on the surface of skin beat the forces holding them in the liquid state. This finally results in evaporation into the air as water vapor molecules. The cooler molecules are left behind in the whole process. As a result, heat pours from the warmer surface of your skin to the cooler water molecules. This heat flow transfers energy to the water, increasing the number of evaporating water molecules. Furthermore, the cooling of your skin also cools any underneath blood which tends to flow through that part of your body [6].

E. Protection through Noise Filters

The keeping of face beard (facial hair) and wearing of a knitted head cloth (*patka*) and a turban (*pag*) on your body has a logical and a scientific significance. The daily self-making folds of hair knots and making round folds of turban over the head of your body with colorful cotton cloths has following historical, medical benefits: i) it indicate, protects and concentrate the disciplinary physical and mental strength of a person; ii) it gives hair tonic to the growth of hairs on your body due to solar energy; iii) the whole system acts as noise filter and provides immunity to your body; and iv) the folded *Patka* with style, folded design of hair knots on top of your head is your identity in time domain, the face beard on your body is a measuring ration and a sign of man, the turban with

style, color, design is your identity in space domain.

IX. COMFORT AND HEALTH

The ASHRAE handbook of fundamentals has provided a detailed discussion of the physiological principles of human thermal comfort [17]. The amount of heat generated and dissipated by your body varies considerably with activity and age as well as with size and gender. The complex regulatory system of your body act to maintain the temperature of your body to about 36.9 °C regardless of the environmental conditions.

The environmental factors that affect thermal balance of your body for influencing thermal comfort are [18]: i) the dry bulb temperature of the surrounding air; ii) the humidity of the surrounding air; iii) the relative velocity of the surrounding air; iv) the temperature of any surfaces that are in direct view to any part of your body and thus exchange radiation. In addition the personal variables that affect the thermal comfort of your body are activity and clothing. The physiological mechanisms that your body uses to control your body temperatures are metabolism, blood circulation, near the surface of the skin termed as cutaneous blood circulation, respiration and sweating. The metabolism rate determines the rate at which energy is converted from chemical to thermal form within your body and blood circulation controls the rate at which the thermal energy is carried forward to the surface of your skin. In respiration, air is taken in at ambient conditions but leaves saturated with moisture and very near the temperature of your body. The sweating has a significant effect on the rate at which energy is carried away from the skin of your body by heat and mass transfer.

The energy generated by metabolism rate of your body varies considerably with the activity of your body. A unit to express the metabolic rate per unit of area of your body is termed as met (1 met = 58.2 W m⁻²), defined as the metabolic rate for your body while seated quite (called sedentary). The variable which affects the comfort of your body is the type and amount of clothing that you are wearing. The insulation of clothing is defined as a single equivalent uniform layer over your whole body. The insulation value for clothing of your body is expressed in terms of clo units (1 clo=0.155 m²CW⁻¹). A heavy business suit with accessories has insulation value of 1 clo, whereas a pair of shorts has 0.05 clo. ASHRAE Standard 55 provides comfort conditions for an acceptable thermal environment [18]. The most comfort studies involve use of the ASHRAE thermal sensation scale. The scale relates words describing thermal sensations to a corresponding number. These are enumerated below:

+3	hot
+2	warm
+1	slightly warm
0	neutral
-1	slightly cool
-2	cool
-3	cold

The operative temperature is the average of the mean radiant and ambient air temperatures, weighted by their

respective heat transfer coefficients. Energy balance equations are developed that use a predicted mean vote (PMV) index. The PMV index predicts the mean response of a large group of persons. The coordinates of the comfort zones are:

Winter: Operative temperature of 20 to 23.5 °C at 18 °C wet bulb temperature; operative temperature of 20.5 to 24.5 °C at 2 °C dew point.

Summer: Operative temperature of 22.5 to 26 °C at 20 °C wet-bulb temperature; operative temperature of 23.5 to 27 °C at 2 °C dew point.

The loss of hearing is a serious occupational hazard. Factory workers, truck drivers and other workers are exposed to noise levels that are harmful. The continuous exposure to harmful noise level results in hearing impairment of your ear. The federal Occupational Safety and Health Administration (OSHA) in the Department of Labor has maintained noise exposure limits. The noise exposure is expressed in daily noise for an 8-hour shift.

APPENDIX

Proposed Book: *Human Noise Behavior: Paradigm and Therapy in New Dimensions*

Contents

1. Introduction
2. Stresses & Oscillations (incl. Physical Agents, Environmental Stressors)
3. Psychoacoustics: Redefining in New Dimensions
4. Noise Sources & Noise Systems
5. Noise Measurements
6. Solar Energy Acoustics (incl. Radiation, Heat Stress etc.)
7. Physiological Responses: Environmental Health & Noise
8. Human Noise Behavior & Cellular Physiology (incl. Neurotransmitters, Serotonin etc.)
9. Noise Sinks: Psychological Effects & Surveys
10. Noise Protection & Immunity (incl. Human Senses, Wellness, Mind & its Control)
11. Noise Monitoring & Instrumentation (incl. A Slide Rule for Noise Measurement; Sensors, transducers and biomedical instrumentation for Noise due to physical agents like heat stress, extreme cold, low pressure, drinking, smoking, breathing, physical activity etc.)
12. Noise Filters & Control (incl. Noise Filter Configurations, Built Environment, Insulation, HVAC, Comfort, Signal Processing, Policies: Noise Control Laws, Legislations, Taxes and Fines etc.)
13. Appendices: Databases of standard/reference noise values of various systems, situations etc.

Target audiences are public health practitioners; environmental health and built environment researchers; medical interest psychoacoustics professionals and law enforcement agencies.

REFERENCES

- [1] H. Dehra, "A unified theory for stresses and oscillations", *Proc. Canadian Acoustical Association (CAA) Montréal 2007 Conf*, Concordia University, Montréal, Québec, Canada, pp. 132-133, 2007.
- [2] H. Dehra, "Power transfer and inductance in a star connected 3-phase

RC circuit amplifier", *Proc. AIChE 2008 Spring Meeting*, New Orleans, LA, USA, session 96a, 2008.

- [3] H. Dehra, "The noise scales and their units", *Proc. Canadian Acoustical Association (CAA) Vancouver 2008 Conf*, Vancouver, B.C., Canada, pp. 78-79, 2008.
- [4] H. Dehra, "A benchmark solution for interference of noise waves", *Proc. AIChE 2009 Spring Meeting*, Tampa, FL, USA, session 67c, 2009.
- [5] H. Dehra, "A guide for signal processing of sensors and transducers", *Proc. AIChE 2009 Spring Meeting*, Tampa, FL, USA, session 6b, 2009.
- [6] H. Dehra, "Solar energy absorbers", chapter 6 in *Solar Collectors and Panels, Theory and Applications*, edited by Reccab Manyala, InTech Publication, pp. 111-134, 2010.
- [7] H. Dehra, "Acoustic filters", chapter 5 in *Ventilation: Types, Standards and Problems* edited by Vincent A. Romano and Allison S. Duval, Nova Publishers, pp. 135-154, 2012.
- [8] H. Dehra, "A theory of acoustics in solar energy", *Natural Resources*, pp. 116-120, 4 (1A), 2013.
- [9] H. Dehra, "A novel theory of psychoacoustics on noise sources, noise measurements and noise filters", *Proc. NoiseCon16*, Providence, Rhode Island, pp. 933-942, 13-15 June, 2016, Publisher: Institute of Noise Control Engineering, USA, 2016.
- [10] V. Del Toro, *Electrical Engineering Fundamentals*, 2nd ed., Prentice-Hall of India, New Delhi, India, 1986.
- [11] Robert H. Randall, *An Introduction to Acoustics*, Dover Publications, USA, 1951.
- [12] Ingo R. Titze, *Principles of Voice Production*, Prentice Hall, Englewood Cliffs, NJ, USA, 1994.
- [13] J. C. Lucero, "Dynamics of the vocal fold oscillation", *TEMA Tend. Mat. Apl. Comput.*, 6, No. 1, pp. 11-20, 2005.
- [14] J.L Threlkeld, *Thermal Environmental Engineering*, Englewood Cliffs, NJ, USA, 1962.
- [15] H. Dehra, "A heat transmission model for a telephone line", *Proc. of 21st CANCAM*, Department of Mechanical and Industrial Engineering, Ryerson University, Toronto, Ontario, Canada, June 3-7, 2007, pp. 356-357, 2007.
- [16] H. Michael Newman. *Direct Digital Control of Building Systems*, John Wiley and Sons, New York, USA, 1994.
- [17] ASHRAE Handbook, *Fundamentals Volume* (1997), American Society for Heating, Refrigerating and Air-Conditioning Engineers, Inc., Atlanta, GA, USA, 1997.
- [18] ANSI/ASHRAE Standard 55-2004. *Thermal environmental conditions for human occupancy*, American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., Atlanta, GA, USA, 2004.