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Mathematical Aspects in 'O' and 'M' Chanting in Psycho-Neurobics Technique

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Abstract: ***Mathematical research in alternative medicinal field is somewhat done to some extent and yet more is expected. Psychoneurobics, an alternative medicine, consists of aerobics along with activation of neurons through psychological commands. The aim is to study the Mathematical aspects of Psychoneurobical 'O' and 'M' chanting along with some yogic exercises. Research on OM chanting is beneficial for the biological world. To some extent, unhealthy person can be cured and healthy one can stay fit just by OM chanting. Recent research in Psychoneurobics proved that OM chanting done along with Psychoneurobics results in better and faster improvement in health sector.***

Keywords: Psychoneurobics, Chanting, Mathematics

1. Introduction

Frankly speaking, let me first explain the need and existing system of alternative medicine named Psychoneurobics. Later we will discuss about mathematical background. Everyone on the earth wish to live a long life. But due to various constraints, the person is unable to do so. For the same, (s)he starts refreshing his daily life routine whenever needed. e.g. the newly born infant baby is supposed to be a pure soul. But the real issues start after consumption of food. Many years ago, there was no use of urea or other pesticides during farming and cultivation of crops, due to which the lifespan of a person was more as compared to as of today. Day-by-day a human being is becoming health conscious. The person usually consults doctor if feel unhealthy. For the same, the person wants to change on-going lifestyle. Listening to others, watching on the social media and suggestions received from the doctor, in limited cases, the person shifts the mind towards alternative medicine. Now-a-days Happy Thoughts, Yogic Exercises (physical and mental), Meditation (one or more existing), Occult Sciences (Astrology, Numerology, Wrist watch analysis, Vastu, etc.) and many more are some of the existing ways of alternative medicines. One of them is Psychoneurobics in which continuous research work is being done.

Psychoneurobics is one of the healing therapies consisting of a set of exercises depending on concepts of Psychology, Neuroscience and Aerobics.
Psychoneurobics includes.

-**Psycho**: Psychological status of an individual
-**Neuro**: Related to neurons i.e. the fundamental unit of information in nerve cells
-**Aerobics**: It comes from Aerobics means exercises.

Thus, Psychoneurobics are physical activities being done in human body i.e. biological structure.

These psychoneurobics done with some chants like OM results in faster improvements in the patients.

2. Literature Review

[1] *Mishra, A.* in the research mentioned that OM is a healing practice having divine sound enhancing cosmic consciousness and chakra activation. [2] *Gangadhar, P.-et-al* in their research stated that OM holds a strong and high vibration which can be felt as it seems to be the sound of Universe. [3] *Kar, A.-et-al* concluded in their research that the depression, anxiety and stress levels of undergraduate engineering college students is remarkably and effectively reduced by OM chanting stimulation. [4] The work of *Wani, L. K.-et-al* is specially highlighted on scientific and spectral analysis of sacred sound OM and its effect on important body organs like heart and overall health. [5] *Madhukar Krishnamurthy* used OM and Vedic chants for meditation, convert them to time series with the frequency of 44100 Hertz and concluded that meditation songs are Lyapunov and asymptotically stable, hence are perfect for meditation. [6] *Falake, P.* used classifiers to explore the effect of OM chanting on human brain. [7] *Harne, B.-et-al* examined effect of Om meditation on the brain using a discrete wavelet transform based feature extraction method and concluded that Om meditation as a daily routine could work wonders for stressful people. [8] *Ghaligi, S-et-al* studied the effect of Vedic chanting and concluding in the enhancement on memory and sustained attention. [9] Using Analysis of Variance and Pearson correlation, *Gupta, A.* found significant increase in psychological well-being and improved trajectory of different domains of psychological well-being where psycho-neurobic treatment yielded greater effectiveness. The author suggested psycho-neurobics as an effective intervention to integrate with school curriculum in Indian subpopulation. [10] *Ajay Anil Gurjar -et-al* found that chanting OM Mantra removes the entire psychological pressure and worldly thoughts. Algorithm analysis carried out for the divine sound OM serves as brain stabilizer and an energy medicine for stressed human beings. [11] *Ajay Anil Gurjar-et-al* studied wavelet transforms, time-frequency analysis of chanting OM and concluded steadiness, calmness and peace in mind of human being.

All of these and other researches too clearly indicate the benefit of OM chanting done with (or without) any healthy

intentions. Now the following literature discusses about the mathematical aspects involved in phonetics, acoustics aerodynamics.

[12] *Gill, M. V.* stated that vowel is sound with open vocal tract whereas consonant is a sound created with partial or complete closure of vocal tract. [13] *Scully, C.* in her thesis studied on speech production modelling. [14] *Fariborz Alipour-et-al* critically studied the various mathematical models on human phonation process based on geometry, boundary conditions and material properties. [15] *Cveticanin, L.* reviewed mathematical and mechanical models on vocal cord. [16] *Dedouch, K.-et-al* studied mathematical models on male vocal tract. [17] *Dr. Mrs. Sarita Mane* in her presentation details about phonetics. [18] This text explains the organs of speech. [19] Fernando Trujillo detailed about the production of speech sounds. [20] The coves a lecture on brief overview of speech production. [21] *Gina Jiang* discussed about chaos in vocal coed vibration. [22] *Alasaad, E.-et-al* studied on mathematical representation for speech signals using polynomial equations where they concluded that proposed algorithm with degree of polynomial 20 and segment length 25 had the best sound representation.

3. Discussion

Speech Production Process:

[19] Fernando Trujillo referred to Psycholinguistics and mentioned that speech had two steps:

1) Speech starts in the brain in the form of message and the lexico-grammatical structure
2) Physical production of sound
   a) **Initiation:**
      Air is expelled from the lungs to trachea.
   b) **Phonation:**
      While passing the air through trachea, the larynx has two horizontal folds of muscles called vocal folds. The gap between these vocal folds, called Glottis.
      - **Open Glottis:** Voiceless sound
      - **Closed Glottis**: Voiced sound
      - **Narrowed Glottis:** Whisper sound
      - **Vibrating Glottis**: Voiced sound
   c) **Oro-nasal process:** Velum let the air to pass either through oral or nasal cavity.
   d) **Articulation:** It occurs in mouth differentiating vowel and cosonants.

[17] Dr. Mrs. Sarita Mane detailed about the organs of speech in the flow-chart given below:

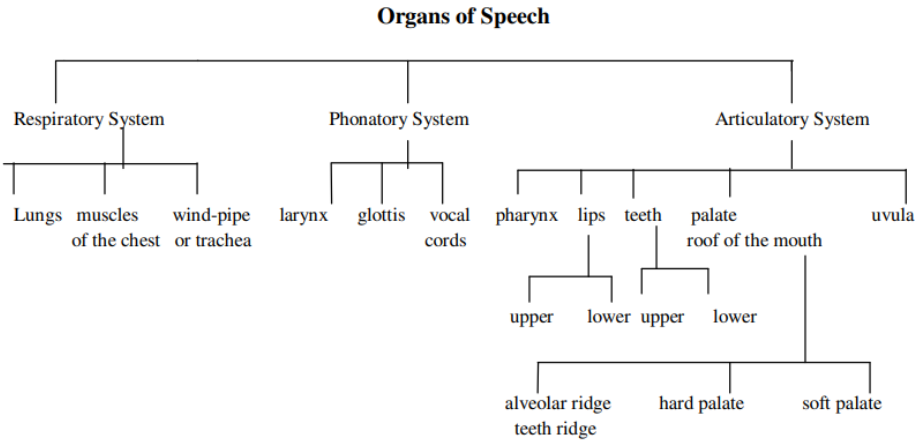

Figure 1: Organs of Speech (Source: [17])

Chanting pattern:

Chanting OM means repeatedly uttering sacred and universal sound OM. In some researches, it is suggested as A-U-M. This indicates that either OM or A-U-M has a great impact on the health of a human being and its daily and consistent use shows the significant change in the results.

The chanting can be done in the following ways:

1) Ooooooooooooom:
   The method says that in one cycle of respiration while inhaling chant O (long duration) and while exhaling chant M (short duration)

Chanting O:

The person is asked to sit in comfortable position with straight back-bone, close the eyes, deep inhale and exhale (two cycles each). Next making round shape of mouth, one is asked to make a sound of O. In this process, the vibrations of the throat make some wave patterns.

2) Ommmmmmmmm:
   The method says that in one cycle of respiration while inhaling chant O (short duration) and while exhaling chant M (long duration)
3) Ooooooooommmmm:
   The method says that in one cycle of respiration while inhaling chant O and while exhaling chant M (both for about equal duration)

In Psychoneurobics, this chanting is done as O and M separately with some process.

Chanting M:

The person is asked to sit in comfortable position with straight back-bone, close the eyes, deep inhale and exhale (two cycles each). Next keeping the mouth shut, one is asked to touch the tip of tongue to the palate (roof of a mouth) and make a humming sound of M. In this process, the vibrations of the throat make some wave patterns.

Glottis in Vibration:

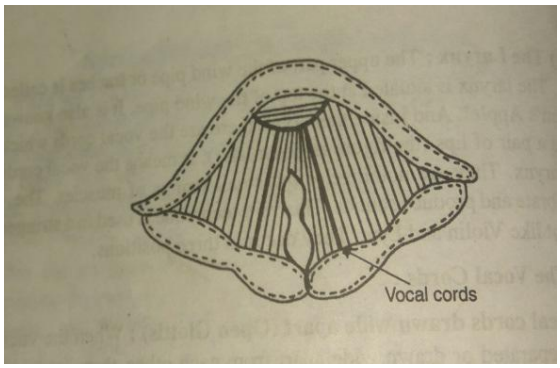

Figure 2: Glottis (i.e. the gap between the vocal folds) in vibration (Source: [17])

The force of the pulmonic air – stream flowing through the glottis makes the vocal cords to contact and blow apart. The faster process creates vibration in vocal cords producing voiced sounds.

Chanting O and M, as discussed above, creates vibration at vocal cord. Vibration creates sound waves. Sound waves can mathematically be expressed as:

Fluid-Solid-Acoustic interactions:

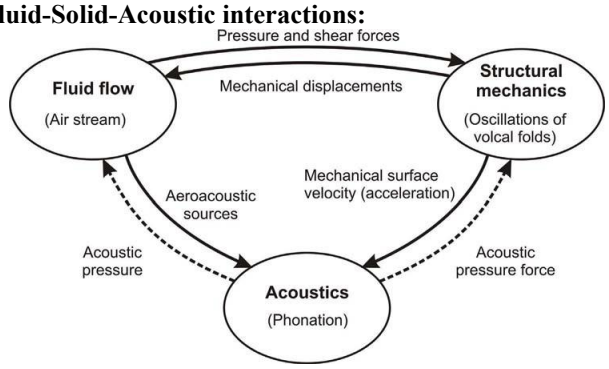

Figure 3: Fluid-Solid-Acoustic interactions (Source: [14])

As displayed in Fig. (**3**), fluid forces making vocal folds to deform influencing the velocity of the adhering fluid particles. This solid deformation makes the change in fluid domain and has to be adapted. These fluid-acoustics interactions can be described by aeroacoustics (flow induced sound) and the solid-acoustics coupling by claiming coincident surface velocity (acceleration) [14].

Mathematical Aspects Parameters of sound:

The appearance of sound to a human ear is characterized by three parameters

a) **Pitch** (*related to frequency*): sensation by which one can differentiate between voice of various living beings on the earth
b) **Loudness** (*related to intensity*): correlated with sound level measured in decibles (dB)
c) **Quality** (*related to waveform*): related to number of frequency components. Different frequency components have different amplitudes whereas superposition of them results in the actual waveform.

The sound level is given by:

$$\beta = \log_{10}\left(\frac{I}{I_0}\right)$$

where, β = sound level, I = Intensity of sound, I_0 = constant reference intensity i.e. the minimum intensity that is just audible at intermediate frequency (10^{-12} w/m^2).

Vocal Folds:

[15] The One-Degree-of-Freedom One-Mass Model of the Vocal Fold:

The basic idea of Fulcher et al. model was that energy derived from flow of air through the glottis oscillates of vocal folds and maintains their motion. Negative Coulomb damping energize vocal cords by the acting aerodynamic forces. This force adds energy to the oscillator instead of removing it. A viscous force is added to include the effects of the tissue damping. Adding a viscous damping term makes steady-state motion possible. The mathematical model is

$$m\ddot{x} + r\dot{x} + kx = F_0, x \geq 0$$
$$m\ddot{x} + r\dot{x} + kx = -\frac{F_0}{2}, x < 0$$

where,
$F_0 = PA$, the negative Coulomb force
$P =$ Lung pressure
$A =$ medial surface of the glottis

[15] Two-Degrees-of-Freedom One-Mass Model of the Vocal Fold

The mathematical model of oscillating system of vocal cord given by Adachi and Yu considered the vibration of vocal cord parallel and perpendicular to the air flow.

$$\frac{1}{2}m\frac{d^2z}{dt^2} + \frac{1}{2}r\frac{dz}{dt} = f_{Bz}(t) + f_{\Delta pz}(t) + f_{Cz}(t) + f_{Rz}(t)$$

Where, $r = \sqrt{mk}/q$ = resistant coefficient with quality factor q
$f_{Bz}(t) = f_{Bz}(p_g)$
$f_{\Delta pz}(t) = l(p - p_0)(w - i\bar{z})$
$f_{Cz}(t) = -iky$
$f_{Rz}(t) = -\frac{1}{2}k\left(\Delta x(1 + \eta\Delta x^2) + i\Delta y(1 + \eta\Delta y^2)\right)$

where p_g =pressure in the glottis, p_0 = subglottal pressure, p = pressure at theentrance of the vocal tract, $\bar{z}$ = complex conjugate function to z, η = coefficient representing the nonlinear elastic property.

It is modified as:

$$\ddot{x} + r\dot{x} + k_x\Delta x + k_c((\Delta x)^2 + y^2)\Delta x - k_{xy}y + k_s x^{-s}(1 - r_S\dot{x}) = E_p$$
$$\ddot{y} + r\dot{y} + k_y y + k_c((\Delta x)^2 + y^2)y - k_{xy}\Delta x = E_p$$

where change of the air pressure p satisfies

$$\dot{p} = Q - \begin{cases}(x-1)p^{1/2} & for\ x > 1\\ 0 & for\ x \leq 1\end{cases}$$

where r = damping coefficient of the vocal cord, r_S = coefficient of the additional damping, k_x and k_y are a horizontal and vertical stiffness coefficient of the vocal cord, k_{xy} is a stiffness of the coupling between the two directions of motion, k_c is the coefficient of the cubic stiffness term, k_s

is a hyperbolic type stiffness, x_0 is the unloaded equilibrium position $(Q = 0)$, E is the average pressure, and Q is air flow and $\Delta x = x - x_0$.

Wavelet Study:

[7] The main two studies based on EEG (Electroencephalograph) on loud Om mantra meditation:

1) Time domain analysis of the EEG signal before and after Om chanting.
2) Power spectral density (PSD) analysis which employed a fast Fourier transform (FFT) to examine oscillatory changes in the standard frequency bands (delta, theta, alpha, and beta) after OM chanting.

Wavelet and FFT are two tools of spectral analysis. Wavelets are localized in both time and frequency whereas the standard FFT is only localized in frequency. Continuous (CWT) and discrete (DWT) are the two types of wavelet transform. DWT is a time-frequency analysis technique suitable for analysing non-stationary signals and EEG signals contain non-stationary characteristics, hence DWT is the well-suited technique for analysing EEG.

The power spectral density (PSD) of

1) delta (0.3–4 Hz),
2) theta (4.1–8.0Hz),
3) alpha (8.1–16.0 Hz), and
4) beta (16.1–32.0 Hz) and
5) gamma (36.1-64.0) frequency band can be obtained using Welch technique, Hanning windowing function.

The resulting values can be normalized into a relative power as follows:

$$\text{relative power} = \frac{\int_{f_L}^{f_H} S_b(f)df}{\int_0^{f_{max}} S_T(f)df} \times 100$$

where, f_L = lower frequency of particular band, f_H = higher frequency of particular band, $f_{max} = 50\,Hz$, $S_b(f)$ = EEG signal of particular band, $S_T(f)$ = EEG signal of particular band.

4. Summary

1) O and M chanting has benefits in terms of health and wellness.
2) Study of Chanting connects to sound generating system in human body.
3) Brain to vocal system becomes the part of the process.
4) Sound waves generated impacts the organs of the body.
5) Repetition of O and M acts as hammer to activate and balance the glands (*Chakras*).
6) Mathematically the acoustic process is studied but psychonuerobical chanting of O and M has further scope in terms of mathematical aspects.
7) The mathematical models of vocal cord vibrations describe the phenomenon qualitatively in a better form.

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