

Correlations of Acoustic Phonetics with Tamil Metaphysical Theory

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Abstract

Tamil, an ancient, classical and vibrant living language of south India has a unique metaphysical theory with the vowels, consonants and vowel-consonants representing Consciousness, body and Consciousness activating the body respectively. The metaphysical principles of the consonants show some interesting correlations with the acoustic phonetic principles of speech production and processing. Although there are a lot of studies investigating the acoustic phonetic principles of speech production and processing, the correlations between the metaphysical principles and the acoustic phonetic ones have not been sufficiently investigated. This paper explains how the Tamil metaphysical theory principles of the consonants can be correlated with their acoustic characteristics and spectral features. Experiments based on power spectral density analysis of the utterances of a native Tamil-speaker are used to perform the correlation analysis. The results confirm the research hypothesis that the metaphysical significances of vowels and consonants are reflected in their physical manifestation of signals.

1. Introduction

The fundamental research areas of speech production, perception and processing have found wide applications in speech recognition and synthesis systems due to significant insights derived from acoustic phonetics. While the understanding of acoustic phonetics in terms of physiological processes is well established, the study of relationship between the philosophical principles of language grammar and speech signals is a work that requires more exploration. A first question here is, "Are there philosophical principles of language development that govern the acoustic phonetics of language alphabets?". A basic step that can help to answer this question is to investigate the connection between the principles of language philosophy and acoustic phonetics. Language philosophy in general explores the relationship of language and reality by investigating how the meaning of whole is derived from the meaning of its parts and how the language and meaning relates to truth. But this is done at the level of sentences by analyzing different parts of speech and constructing syntax and semantic trees.

Humboldt explains that language is no product (*Ergon*) but an activity (*Energia*). For it is the ever repeated mental labor of making the articulated sound capable of expressing thought (Humboldt, 1987). He says that language is the formative organ of thought, where intellectual activity entirely mental and internal becomes, through sound, externalized in speech and perceptible to the senses. The articulated sound with its intent and capacity to signify, by presentation of a thought differentiates it from animal cry or musical tone. The sounds are ordered according to their affinity and contrast into different classes which determine the completeness and regularity of the sound system that builds the foundation of speech. The Indian language philosophy, follows a metaphysical model for speech called the *Vak* to manifest it through three stages, supreme, subtle and gross (Sir John Woodroffe 2011), (Nallaswami Pillai 1948) and associates significances to different alphabets of the language. Indian languages can be broadly classified into two root languages, the Northern Indo-Aryan and the Southern Dravidian. While major researches on Indian languages are focused on Sanskrit, the root of northern languages, relatively less research is dedicated to Tamil which is the root of southern languages. The Tamil language philosophy has a unique metaphysical theory with sound-significance mapping and exposes the principles of Truth and Consciousness in a simple and direct way, forming the foundation of Tamil grammar.

Though a great deal of insightful metaphysical theory is available in Tamil language philosophy, rare attempts are made to bridge it to the modern science. Recent works by Ulrich Mohrhoff on the interpretation of quantum mechanics (Mohrhoff, 2011; Mohrhoff, 2013) show interesting connections of quantum physics with Indian philosophy. In this paper, to bridge the Tamil metaphysical system to modern science we hypothesize that the metaphysical significances are associated with different sounds of this system, and that they are detectable in their acoustic signals through spectral analysis. We start the investigation with the metaphysical theory as the basis and search for indications of the metaphysical principles in the acoustic characteristics of Tamil vowels and consonants. This paper is organized as follows: The second section takes a quick tour of the Tamil metaphysical theory and the third discusses the method of correlating the language philosophy principles and acoustic phonetics through vowel and consonant spectral analysis. This is followed by experimental results and discussions on how the metaphysical principles reflect in the speech spectral characteristics and conclusions. Relevant related works are discussed in each of the sections.

2. A quick tour of Tamil metaphysical theory

Tamil is a classical language spoken in the southern part of India. It is an ancient language with more than 2000 years of history among Sanskrit, Greek and Latin, and a vibrant living status with rich literature. Its alphabetic system is comprised of 12 vowels, 18 consonants and a compound set of 216 vowel-consonants. The earliest Tamil language

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grammar *Tholkappiam*, written by Tholkappiar (Tholkappiar, 2001; Kamil Zvelebil, 1972) in its phonology section classifies the 12 vowels into two classes as short and long (A,I,U,E,O), (Aa,Ii,Uu,Ee,Ai,Oo,Au), the 18 consonants into three classes as hard, soft and medial (k,c,t,th,p,R), (ng,nch,nt,nth,m,N) and (y,r,l,v,zh,L), where the soft consonants (nt,nth) are pronounced without explicit hard-consonant sound of (t,th) and (R,L,N) are the special consonants. The nomenclature used for vowels, consonants and vowel-consonants in Tamil grammar is unique where the vowels are classified as the art of Consciousness called *Uyir*(Consciousness/soul), the consonants as the art of Consciousness manifesting matter called *Mei* (Truth/body) and the vowel-consonants as Consciousness/soul activating the body *Uyir-Mei* forms the foundation of its metaphysical framework.

2.1 Tamil metaphysical system

The Tamil metaphysical system according to Vallalar, the 19th century mystic Saint-Poet of South-India, is based on the word *Thamizh* itself formed by the concatenation of 3 sounds *Tha+mi+zh* from the 3 classes, the first belong to the hard consonant /th/ and primary vowel /A/, second to the soft consonant /m/ and primary vowel /I/, and the third to the medial consonant /zh/. The system is based on the triune principle of Truth, Consciousness and Bliss where Truth is defined as Being or existence, Consciousness as the self-aware force of existence or “Becoming” reflecting the truth of One becoming Many, and Bliss as the delight of existence. Vallalar explained the meaning of the word “Tamil” based on a self-referential principle of word compositionality, where the word's meaning is interpreted based on the meaning of the composing alphabets. He interpreted its meaning as the natural Truth experience of “Supreme-Perfection-Delight” experienced by the perfected consciousness of being, through supreme-oneness principle. This is achieved by transforming the ignorant nature's darkness into Grace-Light by the evolutionary force (Vallalar,1972; Rajesh K,2015). This natural Truth experience summarized as the process of Involution-Evolution-Delight through the three principles individual, universal and transcendent is elaborated in great detail by Sri Aurobindo, the yogic-mystic philosopher in his magnum opus *The Life Divine* (Sri Aurobindo, 2005; Roy Posner, 2014). Here the process of Truth-Consciousness-Bliss descending through the creative medium of Supermind into cosmic being, mind, life and matter for manifestation is called the involution. The reverse process of heightening the consciousness in the manifested being from matter to life, life to mind, and finally mind to spirit to achieve the final perfection delight is called evolution.

The relationship of this theory to the language alphabetic grammar derives from the mapping of different principles of Truth and Consciousness to the vowels and consonants (Vallalar,1972; Rajesh K,2015; Rajesh K,2018). Broadly, the vowels are classified into primary A,I,U, secondary E,O, AI, AU where A,I,U represents the Truth, Consciousness

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and Bliss. The consonants are classified as hard, soft and medial representing two hemispheres: higher and lower, where the interleaved hard and soft consonants (k,ng,c,nch,t,nt,th,nth) form the lower hemisphere, the medial consonants (y,r,l,v,zh) form the higher hemisphere and the mid-level consonants (p,m) form the connecting link between lower and higher hemispheres as shown in Fig.1 and Table.1. The seventh consonant /th/ stands as the nodus of ignorance involving into the lower hemisphere, the tenth consonant /m/ stands as the nodus of knowledge evolving the involved being out of ignorance towards higher hemisphere and the fifteenth consonant /zh/ stands for the all-integralizing, unitarian harmonic-consciousness and final consummate state establishing a harmonic unity with lower hemisphere, signifying Supreme-Perfection-Delight. The remaining consonants /L/,/R/,/N/ are special consonants with significances comprehending the fifteen consonants. This system of Involution-Evolution-Delight mapped to the vowels and consonants are shown below in Fig.1.

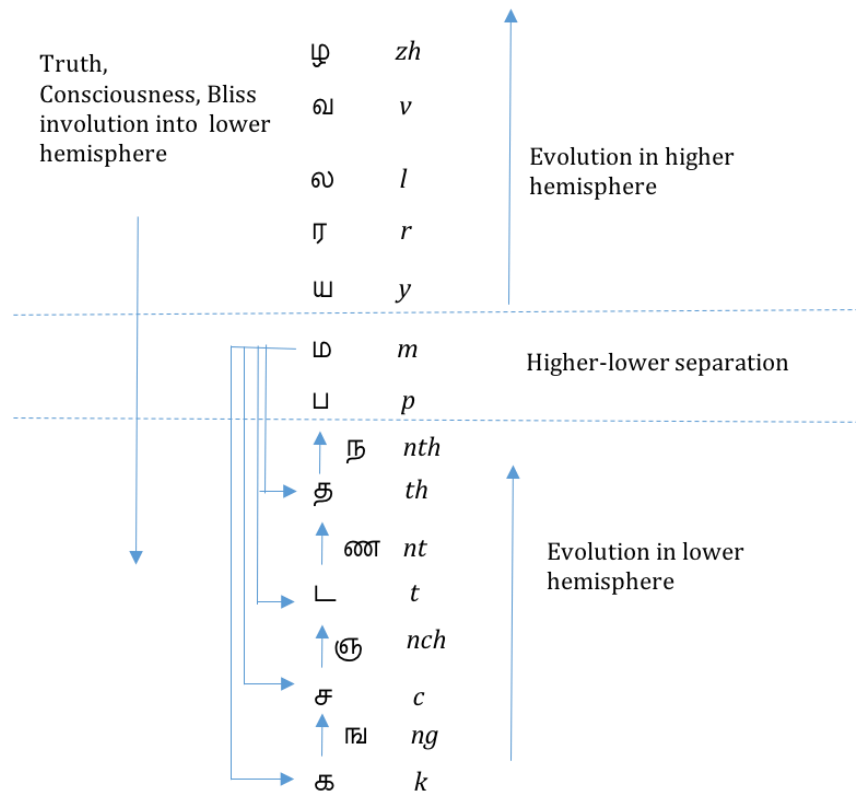


Fig.1: Involution-Evolution-Delight Framework

Vowels/Consonants	Significance
A	Truth, Being
I	Becoming
U	Delight of Existence
zh	Supreme Perfection Delight
y,r,l,v	Supermind
p,m	Overmind
k,c,t,th	Physical, Vital, Mental

Table.1: Significance of Vowels and Consonants

2.2 The double process of Evolution

The whole process of evolution to achieve the final perfection delight is actually a double process as shown in Fig.1, the first is the evolution in ignorance planes of the lower hemisphere(lack of consciousness of oneness), the second is the evolution in knowledge planes of higher hemisphere(consciousness of oneness). Vallalar describes the consonant /m/ as the dissolution sound that dissolves the knots of lower existence to evolve higher and become the base of higher existence beyond the mind principle. Traditionally this formed a seed sound of *OM* (= *AUM*) mantra that is meant to liberate the involved being from the lower planes of existence. The overmind/cosmic consciousness corresponding to the significance of sound /m/ (in Table.1) at once connects and divides the Supreme knowledge and cosmic ignorance. The cosmic consciousness reconciles matter and spirit, not as two poles in opposition but two aspects of the really one and enables One becoming Many (Sri Aurobindo 2005). Simply, the sound /m/ can be thought as the dissolution principle that manifests multiplicity from unity in involution or conversely leads back to unity from multiplicity in evolution.

The dissolution sound /m/ representing the Overmind consciousness stands at the base of supramental consciousness to form the higher hemisphere where the Supermind is Truth-Consciousness that has indivisible knowledge, the Overmind works by union in division and mind by division as the first principle. Sri Aurobindo explains the different poises of Supermind as triple status of Supermind in *The Life Divine* as follows:

“We find that in the principle of Supermind itself it has three such general poises or sessions of its world-founding consciousness. The first founds the inalienable unity of things, the second modifies that unity so as to support the manifestation of the Many in One and One in Many; the third further modifies it so as to support the evolution of a

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diversified individuality which, by the action of Ignorance, becomes in us at a lower level the illusion of the separate ego”. This is tabulated as follows:

Approximants	Plane of Consciousness	Significance
v	Supermind 1 st poise	Infinite One, pure divine ideation and formation in Infinite
l	Supermind 2 nd poise	One to Many
r	Supermind 2 nd poise	Many to One
y	Supermind 3 rd poise	Many in Unity, blissful dualism

Table.2: Approximants significance table

The evolution in higher hemisphere completes in a final state of supramental being, with lower and higher hemisphere united in fulfillment of harmony and signified by sound /zh/. Vallalar interprets /zh/ as the Natural Truth specialty sound representing supreme oneness final perfection delight experience (Vallalar, 1972; Vallalar, 1989; Rajesh K, 2015). Sri Aurobindo explains the supramental being, with a unitarian, intergralising and harmonic consciousness as its foundation, brings out the evolving truth and principle of harmony in the formations of Ignorance in the lower hemisphere. This marks the uniqueness of the sound /zh/ and stands as the consummate state in the metaphysical system of Tamil.

3. Method

In this paper, we propose that by correlating the spectral features of different vowels and consonants to their equivalent significances in the metaphysical theory, we can infer that the gross physical sounds manifest the principles of Tamil metaphysical system. This requires an understanding of the connection between language philosophy and acoustic phonetics, to look for the right acoustic features and correlate with the philosophical significances.

3.1 From Language Philosophy to Acoustic Phonetics

To relate the principles of Tamil language philosophy to acoustic phonetics we can view the metaphysical theory of involution and evolution in lower hemisphere as mental knowledge in the form of thoughts translating into executive actions to achieve a physical effect. Speech is a perfect example, with involution as the process of translating the mental knowledge/thoughts into executive action and resulting in physical speech, and evolution as the reverse process of translating the physical speech vibrations into mental knowledge. As the speech signal connects the physical to mental plane of consciousness,

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it should allow a mental construction of itself through mathematical analysis. The mental formulation of the speech signals without correlation to metaphysical principles is well established in acoustic phonetics as vocal tract modeling of speech and its spectral analysis.

Acoustic speech analysis of the vowels show that the different tongue positions and heights reflect in the first three formants of the spectra (Ladefoged and Disner, 2012; Keith Johnson, 2012). The role of the formant frequencies can be summarized as follows: The first 2 formants F1 and F2 play a dominant role with the formant F1 inversely related to vowel height and formant F2 related to the degree of frontness, hence high vowels have low F1 and vice versa, front vowels have high F2 and low vowels have low F2 (Keith Johnson, 2012). It is established /A/ is low-back vowel, /I/ the high-front vowel and /U/ the high-back vowel. F3 plays a rare role only for the special sound like /zh/. We can correlate the spectral characteristics of vowels (a typical spectra of vowels shown in Fig.2) with its philosophical significances summarized in Table.1 to infer a sound-sense mapping. The significances of the primary vowels, according to the Tamil metaphysical theory, are /A/ represents Truth, absolute existence, /I/ represents Consciousness, One becoming Many or relative existence, /U/ represents Delight, contained or progressive existence. Sri Aurobindo notes that these significances are eternally native to these sounds (Sri Aurobindo, 2016). Correlating these with acoustic phonetics, we see if we assume the vowel /A/ as the fundamental sound behind all vowels, then vowel /I/ is variation of /A/ towards high and frontness resulting in low F1 and high F2 formant frequencies. Similarly, the vowel /U/ is variation of /A/ towards high and lip rounding resulting in low F1 and low F2. So we can see the tendency of introducing high frequency components and becoming a wide-band spectrum reflect the significance of One becoming Many for /I/ and the tendency of becoming a narrow-band spectrum reflects the contained existence for /U/.

Next, acoustic speech analysis of consonants show that the places and manners of articulation determines its classifications. The order of consonants in the Tamil language grammar follows a most natural order in terms of sound articulation as illustrated in Fig.3. The place and manner of articulation for different consonants described concisely in Tamil grammar *Tholkappiam*, *Pirappial* section matches well with modern acoustic phonetics. The sounds of the word *Thamizh*(=Tha+mi+zh) exhibit unique acoustic properties comprehending the entire range of sounds, from hard-consonants to semivowels and bridged by the nasals. As a further motivation, we can see in Fig.3 the successive movement of the place of articulation for hard consonants is achieved by interleaving the soft consonants. Here the nasal sound /m/ plays a critical role in evolving the different hard consonants' place of articulation from lowest (velar) to highest (lips) as shown in Fig.3 and the effect of place of articulation should reflect in their spectra.

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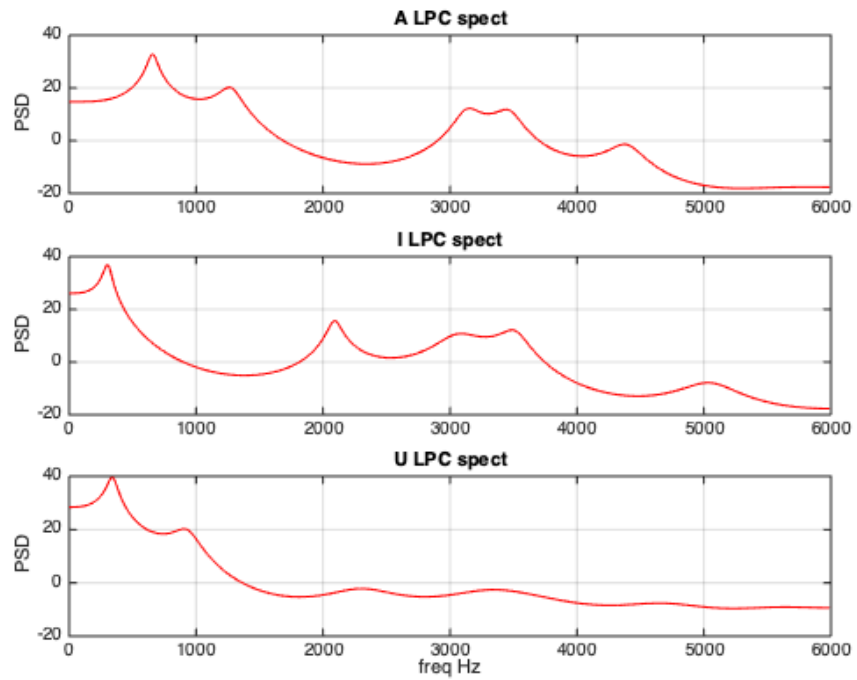


Figure.2: Spectra of vowels A, I, U

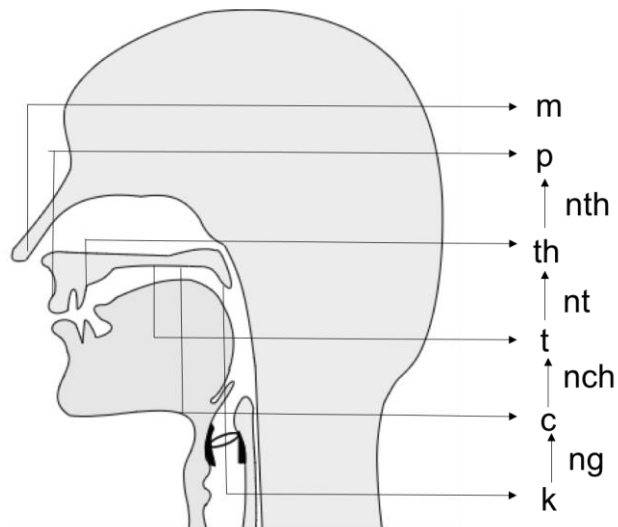


Figure.3: Place of articulation for Tamil consonants

3.2 Correlation of metaphysical significances to consonant spectra

The double process of evolution in the lower and higher hemisphere explained before in subsection 2.2 acoustically relate the hard and soft consonants to stops and nasals and the medial consonants to approximants. Acoustically, we expect the nasal /m/ as the connecting link between stops and nasals, and the approximants to bridge the hard-soft consonants to the vowels through semi-vowels. This natural order of consonants can be seen metaphysically as an ascending series of substance from lower to higher consciousness, and this should reflect in the spectral characteristics of the consonants and spectral analysis should prove it.

3.3 M: The evolutionary nasal sound

The evolution in lower hemisphere characterized by the evolution of hard consonants into soft consonants through the pure nasal consonant /m/ is also supported by the Tamil grammar *Tholkappiam* rule *Punariyal-sutra* 129 (Kamil Zvelebil,1972). According to it, the hard consonants /ka/,/ca/,/tha/ when combined with sound /m/ become the soft consonants /nga/,/ncha/,/na/. Here the name of the rule *Punarchi* means projection of one onto another. In terms of signal processing theory, the projection can be interpreted as the convolution or correlation operation and hence the projection-rule can be seen as the convolution of a signal with linear system. The soft-consonants /ng/,/nch/,/nt/,/nth/ can be considered as generated by convolution of the hard-consonants with a linear system formed by the autoregressive(AR) or linear predictive(LP) model of the nasal sound /m/, henceforth called as the M-model. Conversely, the hard consonants /k/,/ch/,/t/,/th/ are generated by the inverse filtering of the soft-consonants with the M-model. So with respect to the metaphysical framework the forward filtering signifies the evolution towards higher hemisphere and the inverse filtering signifies involution towards lower hemisphere. The power spectral density(PSD) of the soft-consonants $S_y(\omega)$ in terms of the M-model $H_m(\omega)$ with AR coefficients a_q are expressed as

$$\begin{aligned}
 S_y(\omega) &= |H_m(\omega)|^2 S_x(\omega) \quad \text{where } x \in \{k, c, t, th\}, y \in \{ng, nch, nt, nth\} \\
 H_m(\omega) &= \frac{1}{1 - \sum_{q=1}^{M-1} a_q z^{-q}} \\
 S_x(\omega) &= \frac{\sigma_n^2}{\left|1 - \sum_{q=1}^{N-1} a_q z^{-q}\right|^2}
 \end{aligned} \tag{3.1}$$

where the soft-consonants PSD is the product of hard-consonants PSD and the magnitude square of M-model frequency response. Expressed in terms of AR-model of the hard

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consonants and the M-model, this is effectively a cascade of 2 linear-systems driven by the noise of variance σ_n^2 . A typical AR-model based spectrum of the /m/ consonant is shown in Fig.4. As the model for nasal sound production involves a combination of nasal and oral cavities (Rajkishore Prasad, 2007), the oral cavity introduces antiresonant frequencies inversely proportional to its length, with decreasing lengths for /m/, /n/ and /ng/. As a result, the soft-consonants spectra exhibit strong F1 formant caused by the nasal cavity and antiresonances caused by the oral cavity which affect the F2.

A suitable low order AR model of the pure nasal consonant /m/, whose Discrete Fourier Transform (DFT) and LP spectra are shown in Fig.4, can be used to perform the forward and inverse filtering of the hard and soft consonants to produce the corresponding soft and hard consonants and the performance can be analyzed by comparing the M-model filtered signal spectra with the DFT based PSD estimates and computing their correlations.

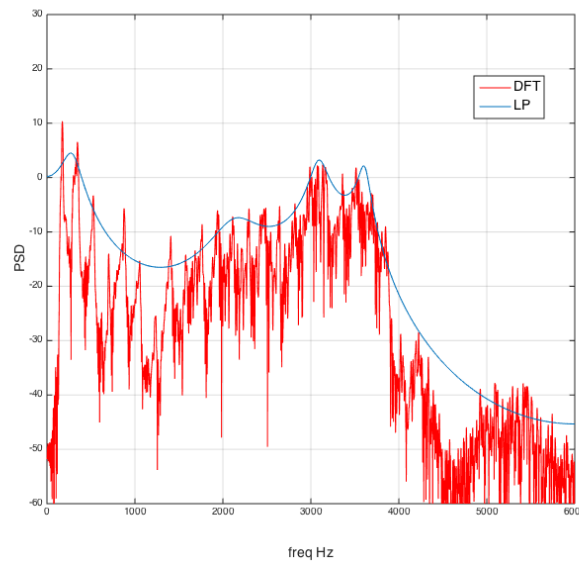


Figure.4: M sound spectrum

3.4 Zh: The consummate approximant sound

The evolution in higher hemisphere is characterized by the evolution of approximants /y/ to /v/ bridged by the rhotic /r/ and lateral /l/ to reach the final retroflex approximant /zh/. To understand this, first we see that the consonants /y/, /r/, /l/, /v/, /zh/ show characteristics different from the hard and soft consonants as it is rightly called in the Tamil grammar as the medials (*Idaiyinam*) because they belong to the higher hemisphere and connect the lower hemisphere hard-soft consonants to the vowels. Next, we see this evolution in

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higher hemisphere to the highest state is bridged by the three poises of Supermind. The primary poise maps to /v/, the secondary poise corresponds to /r/,/l/ and the tertiary poise to the /y/ as shown in the Table.2. This can be expressed in the involution-evolution framework as /v/ descending to /y/ through /l/ as involution in higher hemisphere and /y/ ascending to /v/ through /r/ as evolution in higher hemisphere. This evolution of /y/ to /v/ should show acoustic characteristics with increasing tendency towards the vowel /U/ signifying the contained existence and it could be confirmed by correlation of their spectra.

Tholkappiam states that the sound /zh/ is produced when the tip of the tongue raises and rubs the palette (Tholkappiar, 2001; Kamil Zvelebil, 1972). This manner of articulation for /zh/ sound shows an inherent tendency of producing a hole-tone due its retroflex structure of sound generation. In an attempt of mental formulation of tone nature in frequency domain f , we see the mathematical delta function fits the description of the All-integralizing, Unitarian, Harmonic Consciousness principle, where the delta function expressed as the infinite density bounded and integrated over infinite range becomes unity $\int_{-\infty}^{+\infty} \delta(f)df = 1$. The only signal that approximates this property among practical real world signals is the whistle and this has the unique property of expressing any periodic or aperiodic signal as a sum of scaled harmonic self relations through Fourier transformations. So this sound reflects the unique nature of becoming consummate above the approximants and harmonizing the lower hard-consonants. Again, these could be verified by the spectral analysis of the /zh/ sound and its correlation with the approximants.

3.5 Experimental Setup

The recordings used in this investigation were acquired from a male, native speaker of Tamil language. They were recorded using a MacBook-Pro with built-in microphone and Audacity audio editing software in mono-mode at 48 kHz sampling rate. The Tamil language prime vowels A,I,U and the 15 consonants were recorded for a duration of 10 secs by repeated utterance of each consonant at increments of 1sec and saved as .wav files in the disk. The imported .wav files are extracted in the consonant portion by windowing the first 150ms of each consonant-vowel and used for DFT and LP based spectral analysis in Matlab software. The extracted signals were downsampled to 12 kHz, Hamming windowed and a 8192-pt FFT was used in the spectral analysis. A fifteenth order AR model is used for modeling the consonant spectra and a fifth order for the M-model.

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4 Results and Discussion

Results of three experiments that highlight the key features of Tamil philosophical theory are presented. The first one is the spectral analysis of the hard consonants evolving into soft consonants in lower hemisphere. The second is the spectral analysis of approximants that form the bridge to highest /zh/. The third experiment is to bring out the inherent tone nature of /zh/ and its harmony with lower hemisphere consonants. As part of first experiment, the Fig.4 shows the spectrum of /m/ signal obtained with the 5th order AR-model compared to its DFT spectrum. Next the spectra of the soft-consonants are obtained based on equation (3.1) by convolving the M-model with the AR-model of the hard-consonants. These LP spectral estimates based on the M-model, which we call M-model soft-consonant spectra, are shown in Fig.5 in comparison with the actual LP and DFT based spectra of soft-consonants /k/,/c/,/t/,/th/. The /nch/,/nt/,/nth/ used the fifth order M-model whereas the /nk/ requires an eighth order model to get a better estimate of the soft-consonant spectrum. We can see the main effect of M-model filtering is that the second formant F2 of hard-consonants between 1000-2000Hz is attenuated by the spectral valley of the M-model frequency response in that region. The estimated M-model soft-consonant spectra in Fig.5 show good match upto the third formant frequency less than 3.5 kHz, after which it shows high roll-off due to large attenuation of the M-model in this frequency region. To evaluate the performance we compute correlation between the DFT and the M-model based spectra. As the correlation measure is sensitive to outliers we perform correlation between 0 to 3 kHz covering the first three formants. The correlation coefficients of these spectra shown in Table.3 show good correlation between the spectrum of each soft-consonant and its corresponding M-model soft-consonant spectrum. In Table.3 we can see the spectra of the soft-consonants show best correlation with their respective estimated M-model soft-consonant spectra.

The second experiment on the spectral analysis of approximants matches with the work done by Narayanan et al. (Narayanan Shrikanth, 1999) and shows the evolution of consonant /y/ to /v/ bridged by the presence of liquid consonants /r/ and /l/. Based on spectral analysis results shown in Fig.6 we can see the lateral approximant /l/ bridges the /v/ towards /y/ with its first format F1 low in frequency and formants F3, F4 relatively strong in amplitude and high in frequency, and antiresonances between them. Similarly, the rhotic pre-alveolar /r/ bridges the /y/ towards /v/ with lowered F2 and F3 formant frequencies. The F2, F3 of /l/ are separated by 1 kHz, but for retroflex lateral /L/ and retroflex approximant /zh/, it is separated by less than 500 Hz. The correlation coefficients between the different approximants /y/ to /v/, nasal /m/ and alveolar /th/, are shown in Table.4.

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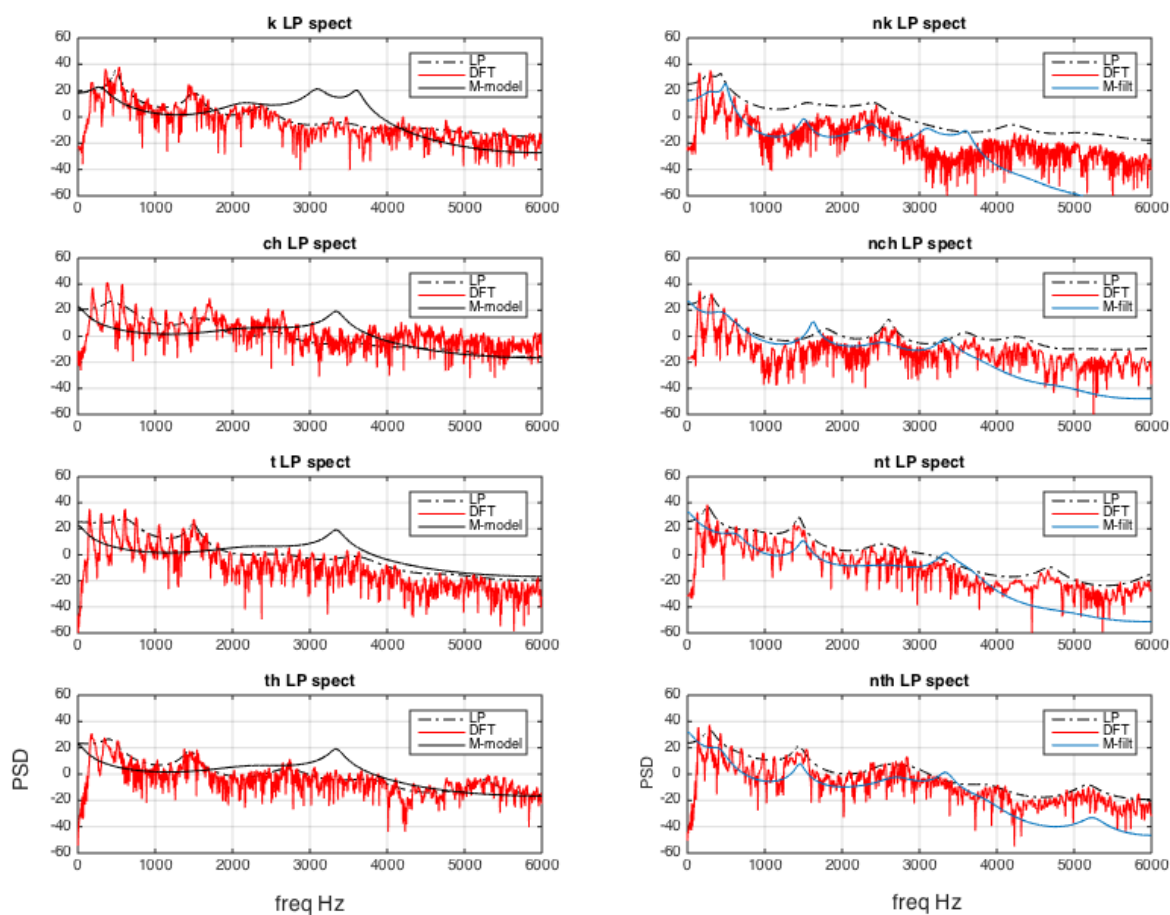


Figure.5: Spectral analysis of Hard and Soft consonants

Soft Cons.	\hat{nk}	\hat{nch}	\hat{nt}	\hat{nth}
nk	0.94	0.92	0.84	0.83
nch	0.85	0.87	0.76	0.86
nt	0.76	0.78	0.90	0.83
nth	0.84	0.83	0.91	0.92

Table 3: Correlation table of soft-consonants

Approx.	y	r	l	v	zh	m	th
y	1.0	0.63	0.81	0.72	0.51	0.51	0.64
r	0.64	1.0	0.82	0.94	0.89	0.6	0.93
l	0.81	0.82	1.0	0.80	0.77	0.65	0.88
v	0.72	0.94	0.80	1.0	0.84	0.56	0.88
zh	0.51	0.89	0.77	0.84	1.0	0.65	0.92
m	0.51	0.59	0.65	0.56	0.65	1.0	0.69
th	0.64	0.93	0.88	0.88	0.92	0.69	1.0

Table 4: Correlation table of Approximants

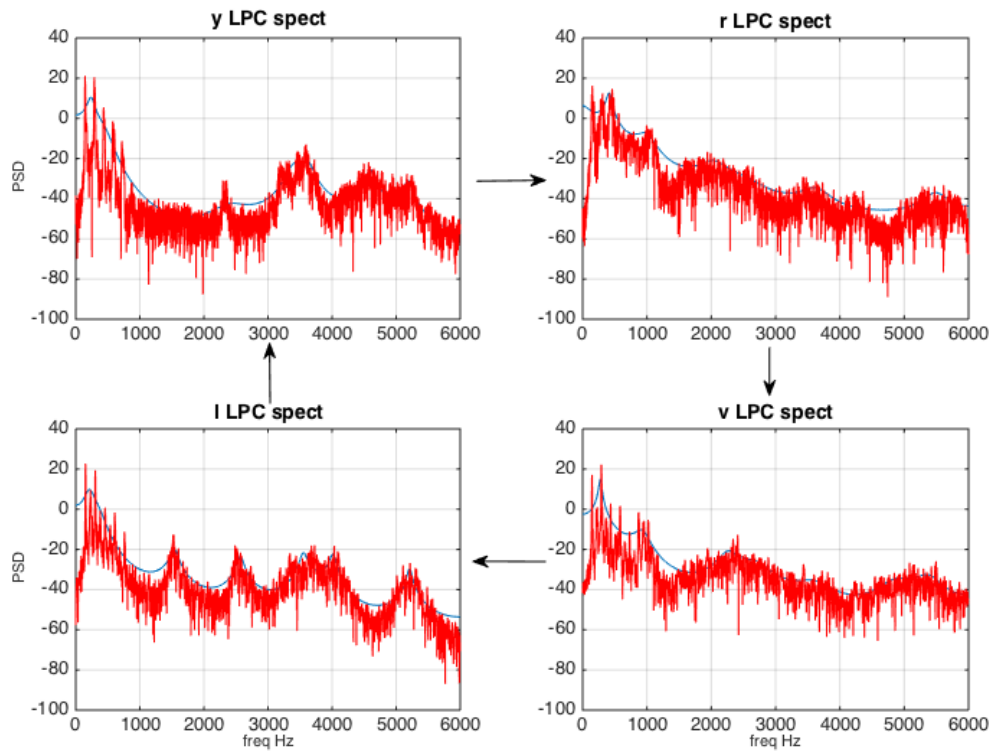


Figure.6: Spectral analysis of Approximants R, L

In the formant transition plot of Fig.7, we can see the formants F1, F2 of /r/ bridges /y/ to /v/ and similarly the F1, F2 of /l/ bridges /v/ to /y/. As the /y/ shows maximum correlation with /l/, the /l/ forms the node of transition from /v/ to /y/. Similarly, as the /v/ shows maximum correlation with /r/, the /r/ forms the node of transition from /y/ to /v/. This bridging between /y/ and /v/ reflects the involution and evolution process in the higher hemisphere. Interestingly the nasal /m/ in Table.4 shows almost uniform correlation with all the approximants and reflects its truth as a base for higher hemisphere consonants.

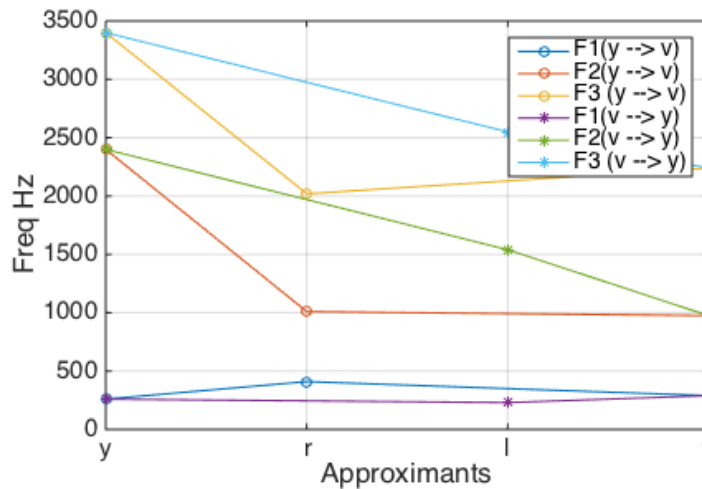


Figure.7: Formant Transitions of Approximants

Narayanan et al. (Narayanan Shrikanth, 1999) studied in detail the characterization of Tamil liquid consonants and their articulatory-acoustic relations. Acoustic spectral analysis of the retroflex approximant /zh/ shows unique spectral characteristics with F2 and F3 close to each other around 1500 and 1800 Hz respectively due to the lowest back and front cavity resonances, a characteristic shared only by the retroflex /l/ and rhotic /r/ sounds. Extending the retroflex /zh/ to a whistled-/zh/ shows interesting characteristics. This is produced by keeping the tongue in the retroflex position of /zh/ and blowing the air resulting in a labial whistle called the hole-tone (Chanaud, 1979; Shosted, 2006) which requires a resonant cavity and two smooth, non-vibrating orifices, where the first orifice formed by raising back of the tongue to the roof of the mouth and the second orifice formed by the lips. The acoustic spectrum of whistled-/zh/ shows a Unitarian behavior near the formant F2 as shown in Fig.9. Here, as the sound /zh/ transitions into a tone, the second formant F2 transforms into a dominant tone peak in the PSD. In addition to the tone-transformation behavior, we can see on comparing the spectrum of /zh/ with the hard consonant /th/ in Fig.8. it brings out the harmony of F2 around 1500 Hz, a spectral peak seen in all the spectra of hard consonants but not in the nasal sound /m/. This is further confirmed by its good correlation coefficient with /th/ as shown in Table.4.

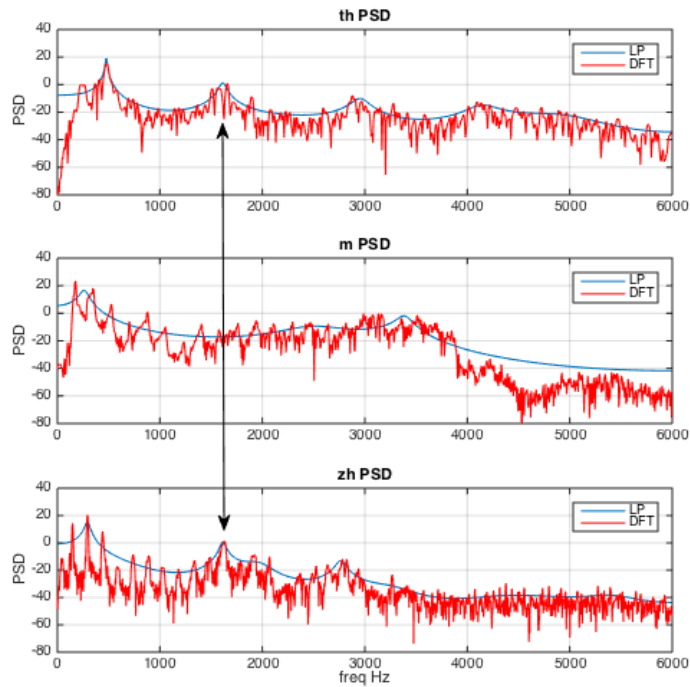


Figure.8: Spectra of /th/, /m/ and /zh/

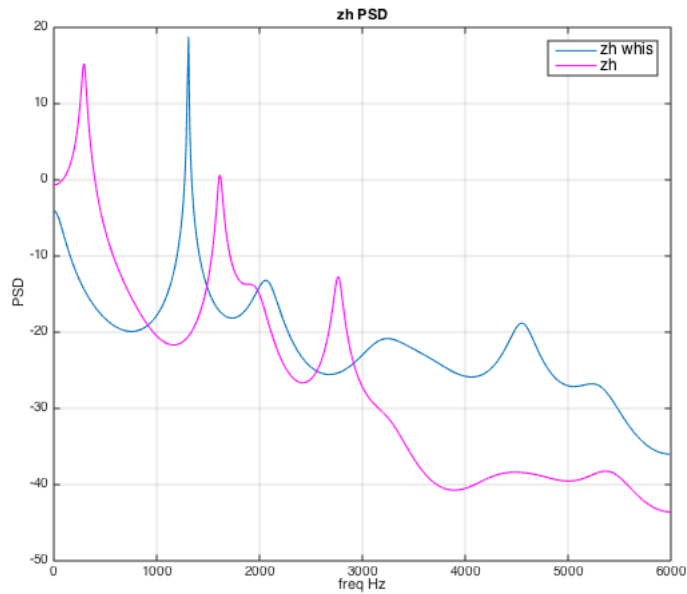


Figure.9: Spectral analysis of /zh/ and whistled-/zh/

5. Conclusions

In this paper, we have investigated possible correlations between the metaphysical significances associated with different sounds and their acoustic characteristics through spectral analysis. We mapped the natural order of Tamil language consonants into lower and higher hemisphere of the involution-evolution process of Tamil metaphysical theory, such that its principles can be correlated to the acoustic characteristics of the consonants. This enabled us to bring the mathematical analysis of source filter theory and spectral analysis to model the involution-evolution process and correlate with their metaphysical significances. Experimental analysis of the consonants show that the natural order of consonants in Tamil language exhibit a spectrally evolutionary form, starting with the hard consonant stops (k,c,t,th) and interleaved by the soft consonant nasals (ng,nch,nt,nth), linked by (p,m) to the medial approximants (y,r,l,v) and culminate in the retroflex approximant (zh). This correlates well with the principles of Tamil metaphysical theory and proves our hypothesis that the metaphysical significances of the sounds are detectable in their physical signals. This approach of correlating Indian language philosophy with acoustic phonetics can lead to cross-fertilization of new ideas from language philosophy and stimulate inter-disciplinary research in the areas of linguistics and speech science. The reported experimental results were based on recordings from one male speaker. Testing this theory with many male and female speakers' speech data, extracting new features of vowels and consonants and applying them for speech processing is a future work.

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