

# A Study on the Process of Supra segmental Preservation of IE Language and Computational Data Analysis of Acoustic Phonetics

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**Abstract:** Languages are being lost at rates exceeding the global loss of biodiversity. With the disappearance of a language we lose unique dimensions of culture and as well as the human history and the evolution of linguistic diversity that was provided by the language. When biologists set conservation goals, they give higher priority to species those mostly go extinct. On integrating about the details of the bio-structure of species, some formal techniques are applied to prioritize the preservations for those few close relatives. With the help of constructive language trees we can use these methods to develop language preservation priorities that reduce the loss of linguistic multiplicity. The emergence of evolution in other ways some universal metrics are used to save the endanger species and these in turn keep the originality of the species and avoid its extinction. This paper unleashes some aspects of Acoustic Phonetics of IE Language and their process of Supra segmental Preservation. In this discussion, it tries to find out the possibility of the course of the new research, also look into the facets to see the relation between modern acoustic phonetic system and ancient Indian articulatory system. Although there are some relations between acoustic and articulatory patterns are well known. The present position, in regard to the relationships between articulation and sound spectrograms is given by M. Joos and H.K. Dunn in their research on phonetics (M. Joos and H.K. Dunn: “The calculations of vowel resonances, and an electrical vocal tract”, pp. 22, 740-753, Journal of the Acoustical Society of America, 1950. P. Delattre: “The physiological interpretation of sound spectrogram”, published by Modern Language Association, 66, 864-875, 1951). But this discussion deals with the modern techniques and theories and also the early speculations of tuning and intonation to relate them from an acoustic point of view.

**IndexTerms** - Supra, phonetic, acoustic.

## 1. INTRODUCTION:

There is at present a renewed interest in the contributions to linguistic science which can come from acoustic studies. This due in part to new instruments, developed during and after the way, which enable us to deal with the acoustic aspects of speech with a new facility. Development of new instruments make possible to see more clearly the acoustic patterns that correspond to the various linguistic units and to determine some of the relations between articulatory movements and sound.

In general, speech can be analyzed from the two points of view: the phonetic reality and the articulatory behaviour of the speaker. The first one is most readily accessible as the acoustic speech wave. Still it is equally present in the articulatory behaviour of the speaker and the perceptual analysis of the auditory signal by the listener and the discrete mental representation which serves as the set of instructions from which the phonetic signal is built by the speaker. Again the supra-segmental features of speech are associated with stretches that are larger than the segment in particular pitch, stress and duration. Amongst these three pillars of supra-segmental structure, pitch is the perceptual concept. It highly depends on the intension of the speaker and the meaning which the speaker wants to make by the pitch sounded word. As the main characteristic of pitch is the rate of vocal cord vibration, so the articulator study of linguistics can correlate with it. Again the repetition of nearly the same pattern of vibration which can lead to measure the periodicity in the speech signal is the correlated part of acoustic phonetics.

According to Indian tradition the three accents are pronounced. They are *Udatta* in a high tone, *Svarita* in a middle tone and *Anudatta* in a low tone. According to the ancient Indian Linguists productions of the distinct tones was intimately connected to the production of air and breathe control. Ancient philologist and grammarian Ubaṭa clearly stated the characteristics of these three types of toning signals. To him, *Udatta svara* is pronounced through the upward force of wind. *Anudatta svara* is pronounced through the downward force of wind. And *Svarita* is pronounced through the cross ward force of wind.<sup>1</sup> This primitive idea of intonation and components throws the light to the idea of acoustic phonetics as this deal with the verbal communication and accent is an integral part of verbal communication.

<sup>1</sup> Ubaṭa, Commentary on Ṛigveda Prāṭiśākhya: “*āyāmo nāmo bāyunimittam ūrdhagamanam | viśrambhonāmo adhogamanam gātrānām bāyunimittam | ākṣepanāmo tīrjaggamanam gātrānām bāyunimittam*”- 1<sup>st</sup> Pāṭala, p. 21.

## 2. ASPECTS OF SUPRA-SEGMENTAL:

Regarding the matter of supra-segmental feature of a language the former researchers like Selkirk, Nespor, Vogel and Hayes and Pierrehumbert and Beckman and Ladd showed in their researches that the prosodic hierarchy and the tonal structure are the common structural components to all languages. In 1976 Goldsmith discussed that the tonal structure can be thought of as a string of tones arranged in parallel to the segmental structure provided by the string of consonant and vowels, that is, as an auto-segmental tier (J. Goldsmith, "Autosegmental Phonology", Doctoral dissertation, MIT). It varies greatly across languages. According to this researcher, there are two ways in which a typology can be set up,

- i) A morpho-syntactic one. It comprehends how do tones signal what words, phrases or clause types are used.
- ii) A phonological one. It comprehends where tones located are and how many contrasting tones are there.

Coming to the concluding words, Indian traditional dealing with the accentuation is worth to be mentioned. It can be observed that there was an approach for preserving the accentuated words and the rules had been made for that. This traditional approach can be seen sometimes as a form of commentary or sometimes as the basic grammatical rule. The segmental or supra-segmental process of preserving the phonology in ancient period was deeply related to the tone and to be considered as the basic cause of syntactical and morphological variation.

Still there is a question arisen about the impact of morpho-syntactical and phonological signal to the listener. This research paper would like to analyse this signalling process in an analytical and post- facto method. In this method the upper mentioned two ways of typology will be observed to determine the legacy of supra- segmental in acoustic phonetics.

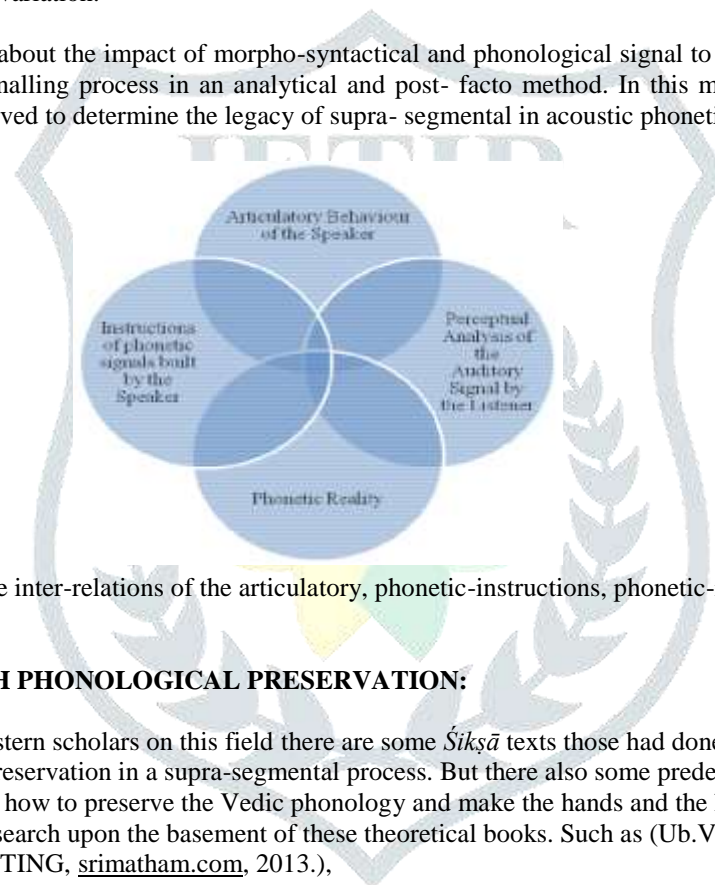


Figure 1: The figure depicts the inter-relationships of the articulatory, phonetic-instructions, phonetic-reality and perceptual analysis of the auditory signals.

## 3. ŚIKṢĀ-S DEALING WITH PHONOLOGICAL PRESERVATION:

Apart from the eastern and western scholars on this field there are some Śikṣā texts those had done a thorough study and made theories on the phonological preservation in a supra-segmental process. But there also some predecessors are available who showed the first glimpse about how to preserve the Vedic phonology and make the hands and the head into a symbol of accent. The scholars had done their research upon the basement of these theoretical books. Such as (Ub.Ve Sri Rama Ramanuja Achari, Introduction to VEDIC CHANTING, [srimatham.com](http://srimatham.com), 2013.),

1. *udātta* - right hand to shoulder  
*anudātta* - hand to knee  
*svarita* - hand should be moved to 45 degree angle to the body
2. *udātta* - head up  
*anudātta* - head down  
*svarita* - head would be turned slightly to the side
3. *udātta* - palm turned up  
*anudātta* - palm down  
*svarita* - hand should be moved horizontally to the right
4. *udātta* - thumb on index finger  
*anudātta* - thumb on little finger  
*svarita* - thumb on ring finger

Now there must be a question arrived that what the relation is between accentuation, supra-segmental feature and acoustic phonetics? Again what is the significance of the theories of phonological preservation? Here is diagram showed which will show the interlinked relation between these phrases of language in a hierarchy way.

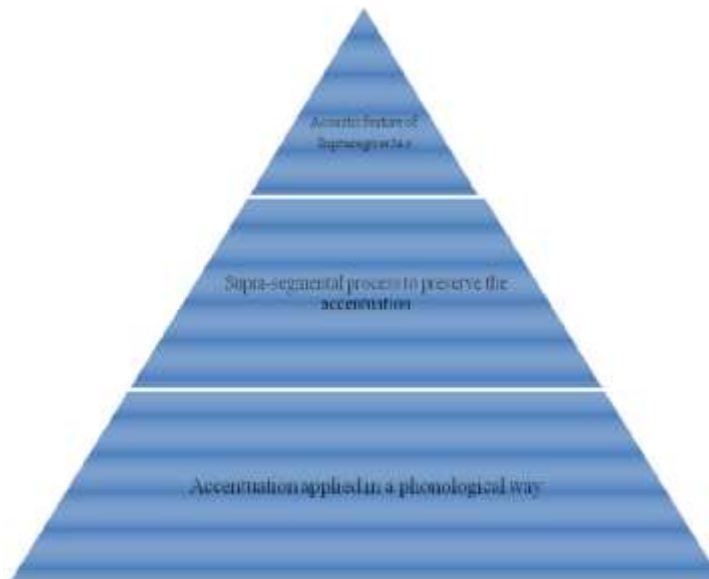


Figure 2: The figure depicts the development of the phonological preservation

This particular paper has the main intension to establish this fact that this pyramid structure is the basic concept of acoustic phonetics. Again it is well dealt in Sanskrit grammar and *Śikṣā* texts. Sanskrit is one of the languages where the stressed accents carried the value to change the morphological structure too. This language is an example by itself where it can be proved that stressed syllables also have different pitch characteristics from unstressed syllables. To determine the pitch characteristics in stressed and unstressed syllables Sanskrit language gives emphasise to the “*mora*” which determine the syllable weight. There is a deep history in Sanskrit prosody and metrics to consider moraic weight as compared to use straight syllables. These syllables are divided into two parts “*loghu*” (light) and “*deergha*” or “*guru*” (heavy) feet which are based on number of “*moras*” that can be isolated per word. It was the first attempt to the technique of accusation of a language from articulated syllables.

#### 4. SIGNIFICANCE OF PHONOLOGICAL PRESERVATION:

As per the linguistic view there is thin line discrimination between “speaking” and “language”( Anca Sirbu: “THE SIGNIFICANCE OF LANGUAGE AS A TOOL OF COMMUNICATION”, “Mircea cel Batran” Naval Academy Scientific Bulletin, Volume 18, 2015, Issue 2). According to them “speaking” is a specific process of communication and so its implementation is concrete. Again “language” is a system of any concrete form of communication. It is a general, abstract aspect in itself and a sum of organisations and skills. Coming to the point of significance of Phonological Preservation, one first takes the language grammar in grant as the basic written form of language preservation techniques. But on the other hand, India has a longstanding verbal tradition which emphasized pronunciation and rhythm. So the marking of accents in *devanāgarī* script was considered for exact meaningful pronunciation. In fact, concerns for the purity and correctness of Sanskrit gave rise to a sophisticated science of grammar and phonetics. Hence some scholars found that, its alphabetical system seemed to be superior to the Roman system. There were majorly two kinds of preservation we can experience throughout the Vedic chanting system and the ancient grammar. The first one was the various forms of recitation which ensured not to borrow any other word in the poem or hymn. Thus the seers made various forms of continuous or crooked recitation theories. Here we can see the more practice of head and hand movements. The second one of preservation was completely depends on acoustic and auditory relation between the speaker and the listener. This was later on written down grammatically which might be till the date most primitive and copious language preservation procedure.

#### 5. RELATION BETWEEN SANSKRIT AND OTHER IE LANGUAGES:

It is a well established fact that Sanskrit is one of the language families of IE language group. Then it is obvious to have some similarities amongst these languages. Still this very paper would try to find out whether there is any similarity between them on the basis of phonetic reality. Here phonetic reality stands for the meaning of intonation and delivery format of pitch and stressed syllables.

It is fact that all languages have vowels and consonants. Vowels and consonants are parts of words which can occur in their own. Now it is quite irrational to think that speaker of same language family would utter same vowel- consonant formatting and the intention or meaning of the words with vowel –consonant format would be same. But it could be possible for a same family group of language, to be interlinked in the pitch intonation formula which can change the word meaning by its intonation weight. According to western scholars, Sanskrit hymns contains pitch tone rather than stress syllables. On the other hand, in other IE languages which came later than Sanskrit also have pitch tone, i.e., English, African, German etc. In English it is noticeable that stress syllables get more importance than pitch. But the way of using pitch intonation and syllable weight is quite similar with Sanskrit language. In this regard it could be stated that Sanskrit is the foremost language which have written and most applicable

grammar that can show a way of a general acoustic phonetic pattern of any language.

### 5.1. CONCEPT OF MARKER IN SANSKRIT:

Like any other IE group of languages Sanskrit has marker and basic word, combination of whom a word is formulated. In Sanskrit it is called “*prakṛti*” and “*pratyaya*” Grammaerian Pāṇini said, “*prakṛti*” or “*prātipadika*” is the crude or elementary form of a word or base or root or an uninflected word. According to Pāṇini, “*arthvadadhāturapratyayah prātipadikam.*”(Pāṇini, Aṣṭādhyāyī, sūtra no. 1.2.45)

Again “*pratyaya*” is a marker. Pāṇini said in Aṣṭādhyāyī, “*pratyayah paraśca.*”(Pāṇini, Aṣṭādhyāyī, sūtra no. 3.1.1. and 3.1.2.) For example, Rāmaḥ is word, which contains “Rāma” as *prakṛti* and “ḥ” as *pratyaya* or marker. Both of them combined to make a single word which defines a name in a noun form.

Again “Parting” is a word contains “Part” as *prakṛti* and “ing” as *pratyaya* or marker. Both of them combined to make a single word which defines a name in a noun form.

In this basic way we can define roughly all the existing languages in basic two form. They are,

Language that has markers, i.e. Agglutinative Language. Example, Sanskrit, Hindi, Arbi, Bask, Hibru languages. Languages that don't have markers i.e. positional or isolating Language. Example, Chinese, Sudani, Tibatian, Barmese languages etc. But this is very limited and a rough sketch of morphological classification of languages. We are talking about phonological acceptance in a language family which also shows the antiquity of language. With this connection marker is regard as not only the preserving process of sound but also a basic articulatory behaviour of speaker that ensures the listener in doing the perceptual analysis of that auditory signal. Sanskrit being a prime and mother of IE languages shows the way in which the whole language can be systematically uttered and analysed through some grammatical and phonetic procedures. It could also be essential for a language like Sanskrit who had surpassed a long journey from spoken to written history.

### 5.2. PITCH INTONATION AND MARKER:

The basic aspect of vocal tuning is the proper pronunciation of the phonemes with the proper accents. Speech creates vibration during the time of pronunciation which human beings can control as per their own wish by modulation of the speech. This realization leads the primitive men to preserve Vedic textual recitation in a methodical way to relate each accent with the movement of them. Here it should be mentioned that, the exact nature of Vedic accent is a debatable issue. Some hold that it is a pitch accent keeping resemblance to its sister language Greek and Latin. Other holds that it is a stress accent as it pronounced today by the Vedic Pandits (Suniti Kumar Chatterjee: “The Origin and Development of the Bengali Language”, Introduction, pp. 36-37). Vedic meaning gives prime importance to the accent and directly labels them as the means of interpretation of Vedic texts. Thus Vedic poets were very strict to preserve these accents in this supra-segmental level. This is the primitive idea of accentuation of pitch tone where speaker can module its tune as per the importance of the meaning of the word. Such as, in English, this rising and falling tone mainly are used simultaneously in asking question, making a list and giving a statement, command, exclamation and specially used at the end of the sentence. Again in some stressed syllables they have been used to make a particular meaning. The word, “wonderful” has rising pitch or *Udātta* in “W” and falling pitch or *Anudātta* in “d”. Thus the sound of this word would be Won- derful (d̄ is falling tone). Here lies the uniqueness of Sanskrit where scarcity of modern technique made the speaker of this language in the primitive age to make the human organism symbol of intonation to preserve the language in a supra-segmental level and gave birth of *Śikṣā* literature, the phonetic analysis of the language.

### 6. CAUSE AND PATTERN OF SYMBOLIZING THE BODY PART TO UTTER THE PITCH TONE.

Accent being a phonological supra-segmental feature is very much helpful to understand the meaning intended by the speaker. So the ancient oral tradition was focused to preserve the accentuation too. As previous mentions of phonetic preservation, *padapāṭha* and *kramapāṭha* are some names of preservation methods of phonetics in a segmental way. They could be applied and shown neutrally from the verbal application. The supra-segmental way of preservation was totally dependent on verbal application. The reaction of human external organs, especially hand and head had been used in a methodical way to relate each accent with the movement of them. Thus the movements of head and hand were given a meaning. In other words they stood for representing the three Vedic accents and their varieties.

### 7. HUMAN PSYCHOLOGIES AND SUPRA- SEGMENTAL PROCESS OF PRESERVATION OF THE PHONETICS.

The perfect order displayed in human psychology and throughout the universe is based on Laws of Nature that have been studied by modern science since more than 150 years. The profound insights into the ancient Vedic Literature brought to light by Maharshi Mahesh Yogi over the past 40 years. He guided the discovery that the laws that construct the human mind and body are as same as the structure of the syllables, verses, chapters, and treatises in the Vedic Literature (Tonny Nader- Ram: “Human Psychology: Expression of Veda and the Vedic Literature”, pp. 80-81).

*Śikṣā* literature of Sanskrit language is represented by the structure that computes and expresses the internal aspects of psychology, such as, its biochemical constitution, temperature, pressure etc. (the expression of autonomic nervous system). These expressions are channelled via autonomic ganglia. In the branches of *Śikṣā*, there are 36 componenets on each side of the spinal cord. ( Tonny Nader- Ram: “Human Psychology: Expression of Veda and the Vedic Literature”, pp. 80-81).

### 7.1. DIAGRAM OF HUMAN PSYCHOLOGY:

The very next page is showing the diagram about the human psychology which is corresponding to be related to the 36 *Śikṣā* texts.

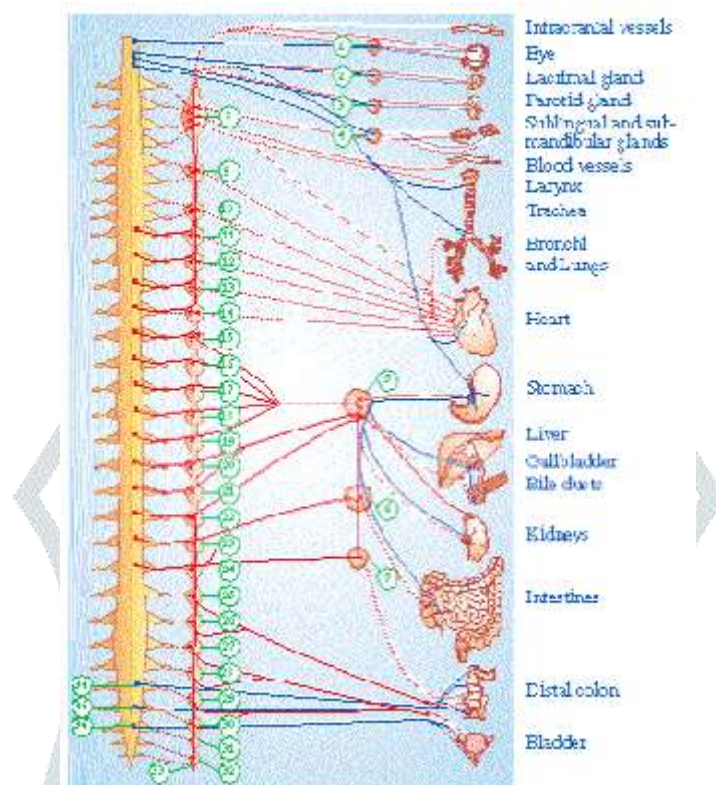


Figure 3: 36 Autonomic Ganglia with some of the tissues and organs to which they connect.

### 8. TENTATIVE STEPS TO BE TAKEN FOR.

All these previous discussion were done to understand the acoustic phonetics system in modern era and the theories adopted by the ancient Indian grammarians whom used to be called “the head and hand movement process” to preserve the accentuation in a supra-segmental way. There can be few tentative steps to correlate these two phrases of linguistics. The following algorithm serves the purpose:

#### ALGORITHM:

Steps:

- i) Define the infrastructure of spectrograph and telephone theory on which they are functioning.
- ii) Audio Recording: The principal data in any study of the phonetic structures of a language are the audio recordings. In this regard, the best way of making such recordings is on a Digital Audio Tape (DAT machine). Many recordings of endangered languages have to be made in noisy surroundings. The best way of dealing with this situation is to use a close-talking noise-cancelling microphone, held by a head mount a few centimetres to the side of a speaker's lips.
- iii) Relate the vocal tube system defined by the authors of *Śikṣā* texts and the modern techniques adopted in laboratories with the help of the machineries: In addition to varying in quality and length, vowels can differ in tone (pitch). Chinese, Cantonese are well known examples. Most languages use pitch tone in this common way. But there are so many tone languages other than languages like English and Italian those do not have sufficient tones. Some languages also have vowels that differ in the quality of the voice (vocal fold action). They may distinguish a regular voice, a creaky voice and a breathy voice. Many sounds are fairly common but do not occur in the most widely spoken languages. Ejectives sounds are those in which the closed glottis rises and pushes out air. They occur in about 20% of all languages, implosives sounds are those in which the glottis descends and they occur in about 10% of all languages (Peter Ladefoged: “Preserving the sounds of disappearing languages”, p. 5).
- iv) Citing out the importance of “*mora*” or syllable weight in acoustic and tonal structure of a language.
- v) Identify the features by going through the elements of the *Śikṣā* literature.

## 9. CONCLUSIONS:

From this comprehensive study, it enlightens several aspects of phonetics and some important matters are discovered. These would be considered as the future prospect of this very project and will usher the future research in this field of study. They are Ancient supra-segmental process to preserve the accentuation is a primary attempt to tuning the vocal cord vibration. *Mora* is the basic phonological tone structure to understand the accusation of phonemes. Converting human physiology into technical organs for proper pronunciation the accentuated words by the Vedic seers was the first attempt towards the question of acoustic phonetic system. Languages are being lost at rates exceeding the global loss of biodiversity. In the evolution of linguistic diversity, human history and languages played an important role as a result it becomes very essential to conserve the languages from its extinction. The extinction of any language leads to lose dimensions of culture and the insight it provides on human history in such a way that it cannot be reverted. To set the important parameters for conserving languages, biologists set priorities for species which are likely to extinct. In this process, some technical methods are used to accumulate the details of the evolutionary species and find the relations for finding the priorities for conservation. On constructing the language trees, advance techniques help to set the priorities for conserving and as a result, linguistic diversity can successfully be minimized. To preserve the originality of the species and its likelihood of extinction, there are some metrics used that are universally tested for the conservation of the endangered biological characteristics in the purpose of evolution. Last but not least is the matter that how the human body does react with the utterance of a sound and how much effective of this reaction to the speaker as well as the listener. This primary finding gave birth before at least 700 years ago the process of head and hand movements which is equally followed to the modern yogic practice and the posture of classical dance form. But majorly it is an initial step to understand the intension of phonetic sound that linked both speaker and listener. Thus it would be considered as the basic pragmatic structure of phonetic preservation.

## Reference:

1. Achari, Rama Ramanuja. Introduction to Vedic Chanting. srimatham.com. 2013. Pdf.
2. Balasubhramayam, M.D. An Accentual note on Vikaṭa in Pāṇini and the Veda. Delhi: Indian Linguistics. Vol. 26. 1965. Print.
3. Chatterjee, Suniti Kumar. The Origin and Development of the Bengali Language. New Delhi: Rupa Publication India Pvt. Ltd. 2011 (4th Impression of 1st ed. 1926). Print.
4. Dunn, H.K. and Joos, M. The calculations of vowel resonances, and an electrical vocal tract. America: The Journal of the Acoustical Society of America Publication. 1951. Pdf.
5. Delattre, P. The physiological interpretation of sound spectrogram. America: Modern Language Association Publication. 1951. Pdf.
6. Ghosh, Batakrihna. Linguistic Introduction to Sanskrit. New Delhi: Cosmo Publication. 2006 (1st Publication). Print.
7. Goldsmith, John A. Autosegmental Phonology. America: Massachusetts Institute of Technology. Dept. of Foreign Literatures and Linguistic. Doctoral Dissertation. 1976. Pdf.
8. Gray, J. E. B. "An Analysis of R̥gvedic Recitation". London: Bulletin of the School of Oriental and African Studies. Vol. 22. Issue. 1. 1959.
9. Kulkarni, Nirmala R. Vedic Studies. Delhi: Bharatiya Kala Prakashan. 2006 (1st edn.). Print.
10. Ladefoged, Peter. Preserving the sounds of disappearing languages. California: Linguistics Department, University of California. 2009 (Posted in Website ). Pdf.
11. Misra, Vidhata. A Critical Study of Sanskrit Phonetics. Varanasi: Chaukhamba Sanskrit Pratishthan. 1972 (1st edn.). Print.
12. Nader- Ram, Tonny. Human Psychology: Expression of Veda and the Vedic Literature. USA: Maharshi University of Management. 2010 (4th ed. of 1st edn. 2001). Pdf.
13. Pāṇini. Aṣṭādhyāyī. Ed. Satya Prakash Dube and Sambhu Dayal Pandey. Pāṇinīya Śikṣā. Rajasthan: Rajasthani Granthagara. 2004 (1st edn.).
14. Renou, L. Etude de grammaire Sanskrite Première Série. Paris: Adiren Missonneuve. 1936. Pdf.
15. Sirbu, Anca. The Significance of Language as a Tool of Communication. Romania: Naval Academy Scientific Bulletin. Volume 18, Issue 2. 2015. Pdf.
16. Staal, J.F. Room at the Top in Sanskrit. Hague: Indo-Iranian Journal. Vol. 9. 1966. Pdf.
17. Steiner, Rudolf. The Magic of Tone. Voice and Sonorous Yogi Practices. Vox Mundi Project: www.voxmundiproject.com. 1999.
18. Ubaṭa. Commentary on R̥gveda Prātiśākhya. Ed. Mangal Dev Sastri. London: Oxford University Press. Vol. 1. 1932. Pdf.