Journal Of Harmonized Research (JOHR)

Journal Of Harmonized Research in Engineering
2(1), 2014, 235-238

ISSN 2347 – 7393

Original Research Article

A STUDY ON ACOUSTIC BEHAVIOUR OF ASSAMESE NASAL PHONEMES

Mausmita Devi, Laba Kr. Thakuria, Purnendu Bikash Acharjee, Pranhari Talukdar

Department of Instrumentation and USIC
Gauhati University

Abstract
Nasal voice in any language, are the only class of sounds which dominant speech output is from nasal cavity as compared to the oral cavity [1]. In nasal sounds resonance occurs through the nose. So, nasals have some special features like presence of zeros in the spectrum, and concentration of energy at lower frequency level etc. In this paper we discuss on acoustic characteristics of Assamese nasal phonemes and their properties. The paper further discusses about the classification of acoustical behaviour between nasal and semi vowel sounds present in Assamese language. It is found from the experiment that Assamese nasal sounds have their spectral properties prominent at around the range of 2 to 4.5 kHz. From the proposed study it is reported that concentration of energy lies in the lower frequency region. Because, the first formant present at around 2.5 kHz and then another formant may present at around 4.5-5 kHz.

Key words: nasal phonemes, nasal murmur, formants, acoustic.

1. INTRODUCTION

Nasal sounds are caused by the resulting the abstraction of the vocal tract and the lowering of the velum. This results in air flow out through the nasal cavity than the oral cavity **[4].** In other words we can say that nasality is a condition for resonance. Nasal consonants and nasalised vowels are well-known difficulties of most speech synthesisers **[6].** It is very important to quantify the acoustic characteristics of nasal sounds to incorporate them in an Automated Speech Recognition (**ASR**) system. This work represents an attempt to evaluate the contribution of extractible acoustic measurements to the detection of Assamese nasals voice. It is the aim of the proposed paper to study the phonetic variations of Assamese nasal sound and to develop an acoustic variation study of them.

For Correspondence:
thakurialabaATgmail.com
Received on: March 2014
Accepted after revision: March 2014

1.1 Back ground of the study

Assamese is an Indo-Aryan language spoken by the Assamese people in general. The mixed Aryan culture and the mongoloid culture gave birth to a new culture. So, every community from this region always exhibits their indigenous culture with diversity. It is the link language for the people living in Assam and adjoining states of Arunachal Pradesh, Meghalaya, and Nagaland etc. This language has
come from Sanskrit as its offshoot, through different stages of development.

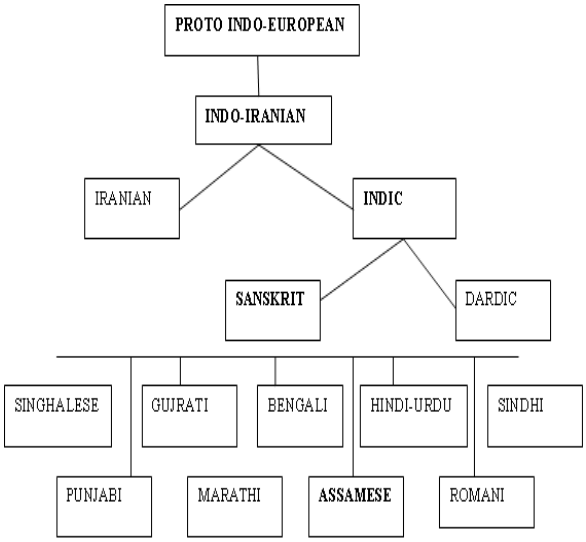

Fig-1: Proto Indo-European Family Tree

The ASSAMESE phonemic structure consists of eight vowels, ten diphthongs, twenty-one consonants and two semi vowels **[7].** The ASSAMESE vowels and consonants are shown in the tables below.

Table 1: Vowels in ASSAMESE.

	Front	**Central**	**Back**
Close	i		u û
Half-close	e ê		o ô
Half-open	ɛ		ɔ
Open		A	

Nasals (/m/, /n/ and / ŋ / for Assamese language) are produced when the velum lowers to allow coupling to the nasal cavity and a complete closure is formed in the oral cavity. The nasal consonants are lower in intensity than vowel.

Table 2: Consonants in ASSAMESE

Nature of Articulation	**Bi-labial**	**Alveolar**	**Palatal**	**Velar**	**Glottal**
Plosive	p b	T d		K g	
	ph $b^ɦ$	t^h $d^ɦ$		k^h $g^ɦ$	
Fricative		s z		X	ɦ
Nasal	M	n		ŋ	
Lateral		l			
Rolled		r l			
Semi Vowel	w		J		

2. Experimental Procedure

2.1 Data Collection

For this study all the words are on the format either on (CVN or NVC) format. Where C represents oral consonant, N stood for nasal consonant /m, n, ŋ / and V referred to the vowels. All the words considered are of single syllable or mono syllabic. Because, single syllabic word avoids the effect of co articulation across syllable boundaries [8]. The words are first recorded and then analyse their nasality effects in nasal context viz CVN and NVC. In CVN context the vowels followed the nasal consonant /m, n, ŋ /. In the second nasal context i.e. NVC, the vowels are preceding the nasal consonant. So, in both the context regressive and progressive nasalization are studied.

2.2 Subjects

In this study, male subjects are selected. Because, the study needs the participants with the low fundamental frequency. So that the harmonics showing nasality effects could be traced in spectrum accurately **[8].** Five speakers are used to record the Assamese words. All the speakers from the same dialect. All subjects use

Assamese language in their daily life. The age of subjects are ranged from 25-30 years.

3. Result and Analysis

The nasal sounds are analyzed by studying the spectrum. A proper acoustic study for nasal sound is very important for any pattern recognition especially in automated speech recognition. Nasal resembles with vowels sometimes as they referred as voiced frictionless constituents. In other hand nasal murmur or nasal consonant characterised by a closure phase. Fig **2** and Fig **3** represents the spectrogram of nasal sound of the context CVN and NVC respectively.

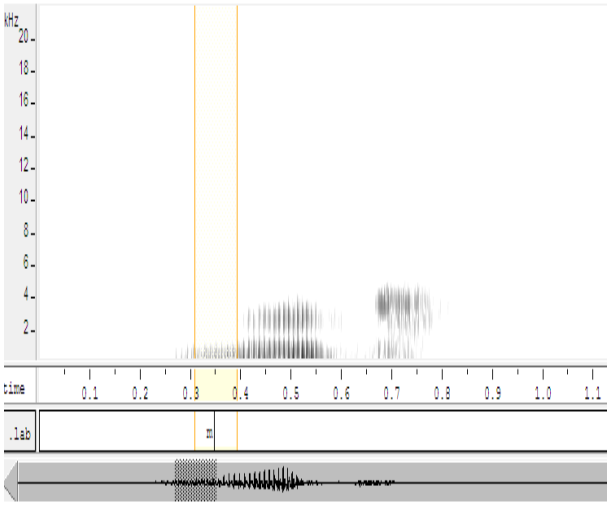

Fig 2:-Spectrogram of the word “MUKH” of context NVC

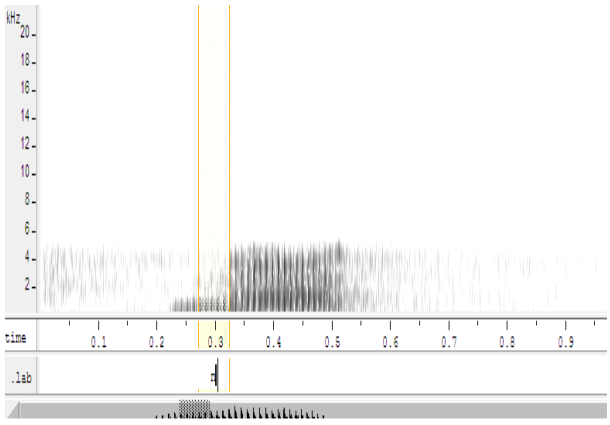

Fig 3:-Spectrogram of the word “NAAK” of context NVC

Except / ŋ / all the nasal consonant occur initially, medially and finally. / ŋ / does not occur initially **[7].**

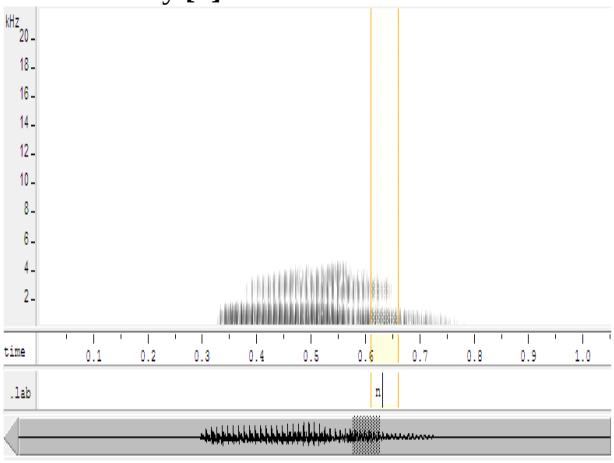

Fig 4:-Spectrogram of the word “PAN” of context CVN

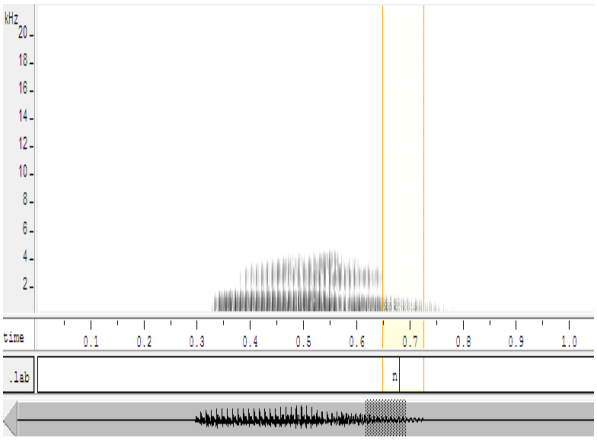

Fig 4:-Spectrogram of the word “RAN” of context CVN

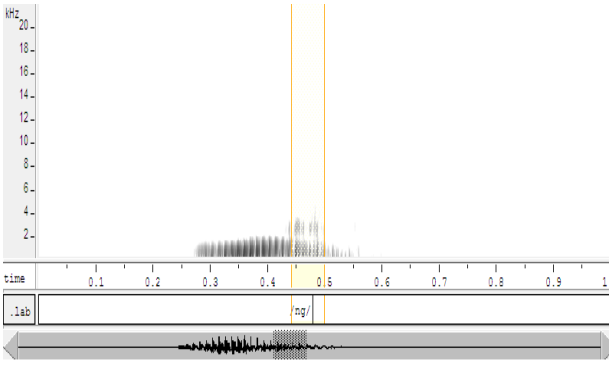

Fig 4:-Spectrogram of the word “RANG” of context CVN

So from the study of above spectrogram it is seen that the all nasal have a very low value for

the energy ratio because of the presence of energy at frequency above 3 kHz in nasal murmur. Also it is also prominent that the nasal / ŋ / has a tendency to have a lot more energy at high frequencies (4kHz) as compared to /m/ and /n/ which is around 2.5-3 kHz respectively. The reason for this could be that the first anti resonance of / ŋ / occur at a frequency above 3 kHz. It can be seen from the above spectrogram that nasals in general have low energy than the semi vowels.

The concentration of energy at the lower level of frequency is another major acoustic characteristic possessed by all nasal phonemes. The existence of a very low first formant in the region of 2.5-4 kHz is common for all the nasal sounds irrespective to their nature of context. Acoustically they are characterised by a spectrum in which the second formant is weak or absent; a spectrum at approximately 2.5kHz dominates the spectrum.

4. Acknowledgement

Firstly, we would like to express my sincere gratitude and heartfelt thanks to my guide Prof. Pran Hari Talukdar, Professor, Department of Instrumentation and USIC, Gauhati University. We would not have been able to complete the research work and shape it in the form of the research paper without his consistent advice, and never ending enthusiasm, positivity, encouragement, support and understanding. We are very fortunate for having an opportunity to work with him from which I benefited enormously.

5. References

1. Douglas O'Shaughnessy, Speech Communication Human and Machine. IEEE Press, 1987.
2. Sami Lemmetty (`1999), *Review of Speech Synthesis Technology, MPhil Thesis, submitted to* Department of Electrical and Communications Engineering, Helsinki University of Technology.
3. Lawrence Rabiner,Biing-Hwang Juang and B.Yegnanarayana, Fundamentals of Speech recognition. Pearson Education, 2009.
4. Pran Hari Talukdar. Speech Production, Analysis and coding Pno-18
5. Rabiner, L. R. (1995) Proc. Natl. Acad. Sci. USA 92, 9911-9913
6. O. Fujimura, "Syllable as a unit of speech recognition," in IEEE Trans. Acoust., Speech, Signal Processing, vol. 23, February 1975, pp. 82–87
7. Upendra nath Goswami . An Introduction to Assamese. P no-31
8. Elenius and G. Takács "Phoneme Recognition with an Artificial Neural Network" Banikanta Kakati. Assamese, its formation and development, 3rd Ed 1972