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Cepstral analysis of vowels of esophageal speakers

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Abstract

The aim of this study was to compare normal (NL) and esophageal (ES) speech signals in scope of vowels in order to show differences between signals. A discriminant analysis based on cepstral features extracted from vowels of NL and ES speech was performed. The comparison was made on the basis of the classification function coefficients and the results of the classification for each speech. Vowels recordings were acquired from 10 NL speakers and 10 ES speakers. The discriminant analysis was based on cepstral features extracted from vowel recordings, and was performed separately for NL speech and ES speech. Then a comparison between coefficients of classification functions of NL and ES vowels using the Euclidean distance was made. Based on the resulting classification matrix of NL and ES speech, the results of classification were compared. The discriminant analysis based on cepstral features showed 76% of the mean classification score for ES speech and 90% for NL speech. The Euclidean distance showed low differences between the vowel /a/ of NL speech and the vowel /a/ of ES speech and between the vowel /e/ of NL speech and the vowel /e/ of ES speech.

Keywords: normal speech, esophageal speech, cepstral features, discriminant analysis, vowels recognition.

Analiza cepstralna samogłosek mówców mowy przełykowej

Streszczenie

Celem pracy było porównanie sygnału mowy normalnej (NL) i przełykowej (ES) w zakresie samogłosek w celu wykazania różnic pomiędzy sygnałami. Przeprowadzono analizę dyskryminacyjną współczynników cepstralnych uzyskanych z samogłosek mowy NL i ES. Porównania dokonano na podstawie uzyskanych współczynników funkcji klasyfikacyjnych oraz otrzymanych wyników klasyfikacji dla każdej mowy. Sygnał mowy każdej samogłoski pozyskany został od 10 mówców mowy NL i 10 mówców mowy ES. Analizę dyskryminacyjną przeprowadzono w oparciu o współczynniki cepstralne oddzielnie dla mowy NL i mowy ES. Następnie dokonano porównania uzyskanych współczynników funkcji klasyfikacyjnych samogłosek mowy NL i mowy ES, wykorzystując do tego celu odległość Euklidesa. Na podstawie macierzy klasyfikacji otrzymanej dla mowy NL i ES porównano rezultaty klasyfikacji. Analiza dyskryminacyjna w oparciu o współczynniki cepstralne wykazała 76% jako średni wynik klasyfikacji dla mowy ES, natomiast 90% dla mowy NL. Odległość Euklidesa wskazuje na najmniejsze różnice w zakresie samogłoski /a/ i /e/ mowy NL i ES.

Słowa kluczowe: sygnał mowy normalnej i przełykowej, współczynniki cepstralne, analiza dyskryminacyjna, rozpoznawanie samogłosek.

1. Introduction

After removal of the larynx, patients commence phonation by passing air into the esophagus. There are several alternatives by which voice and speech rehabilitation may be accomplished. The most common rehabilitation therapy involves teaching esophageal (ES) voice production. The most difficult portion of ES voice production is that of getting air through the pharyngoesophageal (PE) segment into the esophagus. The ES speech is achieved by an intake of air through either injection or inhalation causing the PE segment to vibrate.

An acoustic time-based evaluation of ES voice includes measures of duration, intensity, fundamental frequency, jitter, percentage of voiced, harmonics-to-noise ratio, glottal-to-noise excitation ratio, and band energy difference. Most of the acoustic analysis of laryngectomized speakers was carried out during production of vowels and using first (F1) and second (F2) formant frequency values. For example, all Finnish vowels produced by ES speakers are characterized by higher formant values compared with normal (NL) speakers, with the exception of F1 of /u, o, e/ [1]. English-speaking laryngectomees obtain higher formant frequency values in the English vowels than NL speakers [2]. During a reading task for the Dutch vowels, the alaryngeal speakers consistently produce vowels with significantly higher F1 and F2 values compared to NL speakers [3]. Higher formant frequency values for alaryngeal speakers were also reported when examining the vowel production among native Spanish laryngectomees [4], and in a recent study of Mandarin ES speech [5] and Cantonese vowels [6]. The acoustic findings suggest that higher formant frequency values may be attributed to general shortening of the effective vocal tract length for resonance in esophageal speakers [6]. The spectral analysis of Polish ES vowels showed significantly higher values of F1 and F2 than those produced by NL speakers, with the exception of F2 of /i/ and /y/ produced by ES speakers. Discriminant analysis of formant frequency values showed 60% of mean classification score for ES speakers and 91% for NL speakers based on formant frequency values [7]. The difference in formant frequencies of vowels between ES speech and NL speech appears to be similar across languages.

Automatic speech recognition methods have recently become popular in intelligibility evaluations of laryngectomees' substitute speech. In [8], the authors improved recognition results by adapting the speech recognition trained on normal non-pathologic voices to alaryngeal speakers by an unsupervised hidden Markov model (HMM) interpolation. In [9] authors used a HMM-based recognition system to evaluate intelligibility of native German-speaking laryngectomees using standard text. Alaryngeal speakers presented lower syllables and lower word accuracy than laryngeal speakers – word accuracy between 10 and 50% (28.7+/-12.1%). Speech recognition of Polish-speaking laryngectomees, based on dynamic time warping classifier and cepstral features showed 33% of recognition accuracy [10]. When examining vowel recognition, based on Artificial Neural Networks, Support Vector Machines and Naive Bayes, the highest recognition rate was evaluated using Support Vector Machines. Laryngectomees with different quality of speech achieved 75% acoustic recognition performances [11].

The aim of this study was to compare NL and ES speech signals in scope of vowels in order to show differences between signals.

Discriminant analysis based on cepstral features extracted from vowels of NL and ES speech was performed. The comparison was made on the basis of the classification function coefficients and the results of the classification for each speech.

2. Speech material, recording procedures, and feature extraction

Voice samples were recorded of 10 male ES speakers from Holy Cross Cancer Center, Department of Head and Neck Surgery in Kielce, Poland. Patients ranged in age from 50-73, with an average age of 65 years old. Speech recordings were made in an audiometric room in regular conditions with OLYMPUS LS-11 digital recorder. Patients were in a sitting position; the mouth-to-microphone distance ranged from 0.35 to 0.40 m. The voice samples of NL speech were collected in regular conditions in the same settings as laryngectomized patients from 10 speakers (mean age: 56). All speakers were native Polish speakers. The speech sound was recorded with a 22 kHz sampling rate and 16 bit signal resolution.

The recordings consist of six Polish isolated vowels, IPA notation presented in Tab. 1. Every vowel was uttered ten times by each speaker.

Tab. 1. The IPA notation
Tab. 1. Notacja IPA

Vowel	IPA
/a/	/a/
/e/	/ɛ/
/i/	/i/
/o/	/ɔ/
/u/	/u/
/y/	/ɨ/

Cepstral features were extracted from the speech recordings using Matlab. The cepstral features were calculated for a speech signal frame in the time domain using the following formula:

$$c(n) = \frac{1}{N}\sum_{k=0}^{N-1} \ln\left|\sum_{m=0}^{N-1} w(m)x(m)e^{-j2\pi km/N}\right| e^{+j2\pi kn/N} \quad (1)$$

where: *w(m)* - Hamming Window, *x(m)* – signal, *N*-the length of the signal ($n = 1 \ldots N$). Twelve cepstral features (12CC) were calculated for each frame.

3. Discriminant analysis of features

Cepstral features were analyzed with the discriminant analysis using STATISTICA Software [12, 13]. In this study, the discriminant analysis was based on 12CC features as independent variables and vowels of NL/ES speech as a grouping variable. The discriminant analysis was used to determine which variables discriminate between vowels occurring groups. Five discriminant functions (Root1, Root2, Root3, Root4, and Root5) due to 12CC features were created. In order to determine if actually the considered discriminant function could be regarded as significant, the *Wilks' Lambda* statistic and correlation coefficient *R* between groups and each discriminant function were considered. The discrimination can be considered as significant if coefficient R is close to 1 and the Wilks' Lambda is close to 0 value.

After determining parameters that discriminate between vowels in each analyzed speech, the classification process was applied to the analysis. There were created six classification functions as a linear combination of 12CC entry variables using the following formula:

$$K_i(v) = c_{i0} + w_{i1}CC_1 + w_{i2}CC_2 + \ldots + w_{i12}CC_{12} \quad (2)$$

where: the subscript i denotes the respective group; c_{i0} is a constant for the i'th group, w_{ij} is the weight for the j'th variable in the computation of the classification score for the i'th group; CC_j is the observed cepstral value for the respective case.

There were created six classification functions as there were six vowel groups of NL/ES speech. In general, each case was classified to the group for which it obtained the highest $K_i(v)$ value.

The discriminant analysis was conducted separately for NL speech and ES speech.

The Euclidean distance for each vowel, between the coefficients of NL classification functions and the coefficients of ES classification functions, was calculated with the following formula:

$$K(v) = \sqrt{\begin{array}{l}(c_{i0}(v)_{NL} - c_{i0}(v)_{ES})^2 + (w_{i1}(v)_{NL} - w_{i1}(v)_{ES})^2 + \ldots + \\ + (w_{i12}(v)_{NL} - w_{i12}(v)_{ES})^2\end{array}} \quad (3)$$

where: v – vowel /a/, /e/, /i/, /o/, /u/, and /y/.

4. Results

Before start to proceed the discriminant analysis, it should be checked if the discriminant analysis is significant. The discriminant stage informs about the significance of discriminant analysis on the basis of Wilks'-Lambda statistic. The discriminant analysis performed for the NL vowels showed significant main effects for all cepstral variables (12CC) used in the model (Wilks'-Lambda: 0.012, approximation F(60,6161)=160.12, p<0.0001). Five discriminant functions (Root1, Root2, Root3, Root4, and Root5), based on 12 CC entry variables, were created.

Chi-square tests of the canonical stage showed significance of all created discriminant functions used in the model – Tab. 2 (R=0.944, Wilks'-Lambda=0.012, p<0. 000001).

Tab. 2. Chi-Square Tests with Successive Roots Removed – NL speech
Tab. 2. Testy Chi-kwadrat dla mowy NL

Roots Removed	Canonical R	Wilks' - Lambda	p-value
0	0,944	0,012	0,000001
1	0,901	0,112	0,000001
2	0,613	0,595	0,000001
3	0,208	0,954	0,000001
4	0,055	0,997	0,860300

As presented in Tab. 2, the chi-square tests showed a high canonical value R between groups and discriminant functions (R=0.901, Wilks'-Lambda=0.112) when removing the first discriminant function. In general, the chi-square tests showed high correlation indexes between the groups and the discriminant functions, except for the last case when four discriminant functions were removed (p=0.860300).

Also for ES speech, before performing any discriminant analysis of features, the Wilks'-Lambda statistic at the discrimination stage should be considered. For the ES vowels, the discriminant analysis showed significant main effects for all cepstral variables used in the model (Wilks'-Lambda: 0.048, approximation F(60, 1731)=26.32, p<0.0001). Five discriminant functions (Root1, Root2, Root3, Root4, and Root5) were created. The Chi-Square tests with successive roots removed performed at the canonical stage are presented in Tab. 3.

As presented in Tab. 3, every discriminant function was important in the discrimination process (R=0.894, Wilks'-Lambda=0.048, p<0. 000001). Removing the first discriminant function showed a high canonical value R between the groups and the discriminant functions (R=0.815, Wilks'=Lambda=0.238). In general, the more removed functions, the less discrimination between groups. Removing 4 roots showed low significance of a single discriminant function in discrimination (p=0.622576).

Tab. 3. Chi-Square Tests with Successive Roots Removed – ES speech
Tab. 3. Testy Chi-kwadrat dla mowy ES

Roots Removed	Canonical R	Wilks' - Lambda	p-value
0	0,894	0,048	0,000001
1	0,815	0,238	0,000001
2	0,402	0,711	0,000001
3	0,371	0,848	0,000001
4	0,128	0,984	0,622576

The issue of classification is another major purpose to which the discriminant analysis is applied. After deriving the discriminant functions and determining the variables, 12CC features, that discriminate most between vowel groups, there was proceeded the classification stage. The coefficients of classification functions obtained for NL vowels are presented in Tab. 4.

Tab. 4. The coefficients of classification functions obtained for NL vowels
Tab. 4. Współczynniki funkcji klasyfikacyjnych samogłosek mowy NL

c_i	$K_1(a)$	$K_2(e)$	$K_3(i)$	$K_4(o)$	$K_5(u)$	$K_6(y)$
Speech NL						
c_{i0}	-67,697	-56,088	-44,450	-44,318	-28,041	-48,124
w_{i1}	65,215	69,306	53,493	51,635	43,716	65,471
w_{i2}	-29,561	-28,793	-33,548	-26,185	-25,290	-28,823
w_{i3}	-2,193	-5,367	-6,808	-1,968	1,300	-6,209
w_{i4}	-2,151	-4,465	-3,417	2,927	5,511	-5,273
w_{i5}	-19,390	-21,998	-17,269	-12,886	-13,661	-21,698
w_{i6}	-6,932	-6,548	-0,479	-3,554	-0,060	-3,656
w_{i7}	-12,493	-9,991	-2,486	-4,808	1,836	-6,772
w_{i8}	-13,358	-8,404	0,930	-7,696	-4,852	-2,308
w_{i9}	-20,504	-12,452	-0,244	-16,970	-9,126	-4,502
w_{i10}	-28,396	-20,482	-11,379	-23,690	-10,915	-12,764
w_{i11}	-23,428	-13,399	-6,932	-17,219	-13,733	-6,061
w_{i12}	-109,734	-41,354	-0,639	-108,975	-57,468	6,422

Tab. 5. The coefficients of classification functions obtained for ES vowels
Tab. 5. Współczynniki funkcji klasyfikacyjnych samogłosek mowy ES

c_i	$K_1(a)$	$K_2(e)$	$K_3(i)$	$K_4(o)$	$K_5(u)$	$K_6(y)$
Speech ES						
c_{i0}	-101,619	-82,954	-84,195	-97,069	-93,617	-75,566
w_{i1}	115,553	105,181	111,415	128,418	138,161	103,072
w_{i2}	-64,594	-61,941	-66,822	-68,384	-70,384	-60,522
w_{i3}	19,574	15,370	21,614	25,831	31,479	15,834
w_{i4}	0,551	2,928	6,535	7,926	11,319	6,419
w_{i5}	-22,005	-27,160	-28,706	-19,811	-22,453	-29,600
w_{i6}	14,760	11,506	14,649	13,889	17,650	13,100
w_{i7}	-26,800	-23,590	-22,294	-20,301	-19,508	-21,679
w_{i8}	-22,428	-21,541	-19,674	-19,897	-15,695	-20,848
w_{i9}	1,976	11,825	12,553	2,851	10,685	16,289
w_{i10}	-33,721	-22,964	-18,314	-20,026	-23,262	-16,606
w_{i11}	-2,246	7,584	20,184	3,651	13,565	16,572
w_{i12}	-259,478	-201,321	-187,222	-270,817	-207,065	-181,865

The c_{i0} coefficients obtained for vowels of NL speech were lower than those for ES speech. Tab. 6 presents the Euclidean distance between the coefficients of appropriate classification functions obtained for NL and ES vowels.

Tab. 6. The Euclidean distance between the coefficients of appropriate classification functions of NL/ES vowels
Tab. 6. Odległość Euklidesa pomiędzy współczynnikami odpowiednich funkcji klasyfikacyjnych uzyskanych dla samogłosek mowy NL/ES

K(a)	K(e)	K(i)	K(o)	K(u)	K(y)
172	176	209	198	202	203

Both speeches differ in the obtained models of classification functions. The smallest distance value was observed for vowels /a/ (172) and /e/ (176). The largest distance value was noted for vowel /i/ (209).

The results of classification using classification functions $K_i(v)$ for NL and ES vowels are given in Tab. 7.

Tab. 7. The classification scores obtained for NL and ES vowels
Tab. 7. Wyniki klasyfikacji uzyskane dla samogłosek mowy NL i ES

Vowel	Speech	a	e	i	o	u	y
a	NL	**90%**	3%	-	7%	-	-
	ES	**87%**	7%	-	6%	-	-
e	NL	5%	**85%**	-	-	-	10%
	ES	3%	**65%**	18%	-	-	14%
i	NL	-	-	**97%**	-	-	3%
	ES	-	6%	**75%**	-	3%	16%
o	NL	7%	1%	-	**88%**	4%	-
	ES	7%	-	-	**83%**	10%	-
u	NL	-	-	-	2%	**98%**	-
	ES	-	2%	-	5%	**92%**	1%
y	NL	-	10%	10%	-	-	**80%**
	ES	-	19%	21%	-	3%	**57%**
Mean:	NL	**90%**					
	ES	**76%**					

As presented in Tab. 7, a dash "-" in a column means that no case was classified to this vowel group. The mean value obtained for each speech NL/ES was calculated as a mean value of the best results of classification bolded values in every column that represented the vowel group of the considered speech. For the NL vowels, the lowest score of classification was obtained for the vowel /y/ (80%). The highest score was obtained for the vowel /u/ (98%). The mean classification of vowels was 90%. For the ES vowels, the lowest result of classification was obtained for the vowel /y/ (57%). The highest score was obtained for the vowel /u/ (92%). The mean classification score was equal to 76% and was 14% lower than the classification score obtained for the NL speech.

5. Conclusions

The aim of this study was to compare NL and ES speech signals in scope of vowels in order to show differences between signals. The discriminant analysis based on cepstral features extracted from vowels of NL and ES speech was performed. The comparison was made on the basis of the classification function coefficients and the results of the classification for each speech.

The discriminant analysis showed significance of all discriminant functions used in the model for both speeches due to the canonical value R obtained in chi-square tests with successive roots removed. Cepstral features much better discriminate vowels of NL speech than ES speech. Moreover, cepstral features much better discriminate vowels of ES speech than formant frequency values F1 and F2.

The discriminant analysis and cepstral features showed the mean classification score equal to 90% for NL vowels, and 76% for ES vowels. NL speakers obtained better classification scores than ES speakers. The discriminant analysis applied as a classifier improved classification scores of ES vowels. Higher tendency to classify the vowel /y/ as /i/ (21%) than the vowel /i/ as /y/ (16%) was observed for ES speech. The vowel /y/ obtained the lowest classification score for ES speech (57%), as well as for NL speech (80%). The vowel /u/ obtained the highest classification score for ES speech (92%) and for NL speech (98%).

The Euclidean distance calculated for appropriate classification functions of NL and ES vowels differs in values. The smallest differences were observed for vowels /a/ and /e/. The highest value of Euclidean distance was obtained for vowels /i/, /y/, /u/, and /o/. It may suggest that ES speech differs from NL speech in vowels /i/, /y/, /u/, and /o/, but it requires a further study.

6. References

[1] Kytta J.: Finnish oesophageal speech after laryngectomy: sound spectrographic and cineradiographic studies. Acta Otolaryngol, 195: 1–94, 1964.

[2] Sisty N.L., Weinberg B.: Formant frequency characteristics of esophageal speech. Journal of Speech and Hearing Research, 15: 439–448, 1972.

[3] van As C.J., van Ravesteijn A.M.A., Koopmans-van Beinum F.J., Hilgers F.J.M., Pols L.C.W.: Formant frequencies of Dutch vowels in tracheoesophageal speech. Institute of Phonetic Sciences, University of Amsterdam, Proceedings,21: 143–153, 1997.

[4] Cervera T., Miralles J.L., Gonzáles-Àlvarez J.: Acoustical analysis of Spanish vowels produced by laryngectomized subjects. Journal of Speech, Language, and Hearing Research, 44: 988–996, 2001.

[5] Liu H., Manwa L. Ng: Formant characteristics of vowels produced by Mandarin esophageal speakers. Journal of Voice, 23(2):255-260, 2009.

[6] Manwa L. Ng, Rhoda Chu: An Acoustical and Perceptual Study of Vowels Produced by Alaryngeal Speakers of Cantonese. Folia Phoniatr Logop, 61:97–104, 2009.

[7] Mięsikowska M., Radziszewski L., Acoustical analysis of Polish vowels of esophageal speakers, Measurements Automation and Monitoring (PAK), Vol.57, 12 (2011).

[8] Haderlein T., Steidl S., Noth E., Rosanowski F., Schuster M.: Automatic Recognition and Evaluation of Tracheoesophageal Speech. Proceedings LNAI 3206 (2004), p.331-338.

[9] Schuster M., Haderlein T., Noth E., Lohscheller J., Eysholdt U., Rosanowski F.: Intelligibility of laryngectomees' substitute speech: automatic speech recognition and subjective rating. Eur Arch Othorinoloryngol, 263: 188-193, 2006.

[10] Mięsikowska M., Radziszewski L.: Automatic Assessment of Vowels Intelligibility in Laryngectomized Speakers. Polish Monograph: Postępy automatyki i robotyki, Part I, pp.366-375, 2011.

[11] Pietruch R., Grzanka A.D.: Vowel Recognition of Patients after Total Laryngectomy using Mel Frequency Cepstral Coefficients and Mouth Contour. Journal of Automatic Control, Vol.20(1): 33-38, 2010.

[12] Discriminant analysis – STATSoft Electronic Documentation: http://www.statsoft.com/textbook/discriminant-function-analysis/

[13] Stanisz A.: Accessible statistic course, StatSoft Poland, Cracow, 2007.

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