Acoustic Features of English Phonemes Obtained with Multivariate Analyses

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論 文 名	Acoustic Features of English Phonemes Obtained with Multivariate				
	Analyses(多変量解析を用いた英語音素の音響的特徴の分析)				
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論文審査の結果の要旨

The general purpose of the dissertation is to elucidate how acoustic features of English speech can be expressed using multivariate analyses. There were three research purposes. The first purpose was to investigate the suitability of factor analyses of changing spectra for studying acoustic natures of English phonemes. Here, the results of a newly developed factor analysis, "origin-shifted factor analysis", were compared with the results of a normal factor analysis to analyze the spectral power fluctuations in English speech. The results show that origin-shifted factor analysis is more recommendable for future speech analyses since it would reduce the generation of continuous noise in the data reduction procedure of factor analysis.

The second purpose was to determine the acoustic features of English phonemes in general, by using a newly recorded and labeled database with higher quality. The results showed that by using origin-shifted factor analysis, regardless of whether three or four spectral factors were extracted, the factors always appeared in a similar set of four frequency bands. Either when three- or four spectral factors were extracted, the distributions of the factor scores on a factor with the frequency loadings around 1200 Hz were very close to the sonority hierarchy in phonology. Sonority is a concept related to phoneme classification, and it is considered necessary to understand syllable formation. The analysis results corresponded to the notion in phonology that vowels have the highest sonority, followed by sonorant consonants, while obstruents are the lowest in terms of sonority. Furthermore, a factor with the frequency loadings around 300 Hz clearly divided English phonemes into obstruents and non-obstruents (vowels and sonorant consonants).

The third purpose was to obtain clear insight into whether and how obstruents would appear in the factor spaces. In the four-factor analysis it was found that the distribution of obstruents in English speech was related to two spectral factors. One factor had frequency loadings around 4100 Hz, while the other around 300 Hz. Generally, the results of the present dissertation clearly show that multivariate analyses can be utilized to connect English phonology and speech acoustics, even for low-sonorous phonemes such as obstruents.

During the investigation, the candidate was advised to increase the number of analyses (e.g., with and without cepstral liftering and to separate the analyses between the male and female speakers to check the effect of cepstral liftering. Furthermore, the candidate was asked to increase the descriptions of general terms related to speech and phonology, and to describe in more detail how the factor analyses were performed. The candidate did this in a suitable way. Given the novelty of the results and the originality of the research methods, the committee members concluded that the present Ms. Yixin Zhang's thesis is a valuable scientific contribution, deserving a doctoral degree(Design).