

Title	歌声らしさに影響を及ぼす音響的特徴の分析に関する研究
Author(s)	辻, 直也
Citation	
Issue Date	2004-03
Type	Thesis or Dissertation
Text version	author
URL	http://hdl.handle.net/10119/1790
Rights	
Description	Supervisor: 赤木 正人, 情報科学研究科, 修士

Analysis of acoustic features affecting “singing-ness” in singing voice

Naoya Tsuji (210058)

School of Information Science,
Japan Advanced Institute of Science and Technology

February 13, 2003

Keywords: singing voice perception, multidimensional scaling, fundamental frequency, spectrum, vibration, ringing .

Singing voice has unique acoustic features that discriminate it from speaking voice. It makes voices be worthy of singing-voice, “singing-ness”. For the application to voice synthesis, we should consider amount of the acoustic features and interaction among the features. Therefore, relationships between “singing-ness” and the acoustic features should be important.

In earlier studies of “singing-ness”, there are methods: One is relationship between “singing-ness” and acoustic features. Another is relationship between “singing-ness” and psychoacoustical features. However, it is not enough to investigate how much amount of acoustic features affect “singing-ness”.

In this study, we present a three layers model describing relationship between “singing-ness” and acoustic features in order to investigate. This model consists of three layers: the first layer is for “singing-ness”, the second layer contains basic psychoacoustical features, and the third layer contains acoustic features.

We aim to replace psychoacoustical features of “singing-ness” with some basic psychoacoustical features.

We placed 80 data of vowel /a/ from various type of sing and utterer in order of “singing-ness” in the listening experiment to select 11 data for later analysis. We investigated psychological distance in “singing-ness” in the

next experiment and perform Multidimensional Scaling. Then, we choose 3-dimensional according to stress of 5.4. The results suggest that "singing-ness" consists of some basic psychoacoustical features and presented model is reasonable.

Relationship between the first layer ("singing-ness") and the second layer (basic psychoacoustical feature) in three layers model of "singing-ness" were investigated. Adjectives representing basic psychoacoustical features of "singing-ness" were selected with another experiment. In the experiment, subjects answered adjectives corresponding to the data presented. Then we selected vibration, ringing and clearness for the candidates of basic psychoacoustical feature of "singing-ness" from the results. And we investigate distance between data in each adjective. We calculated direction of each adjective using multiple regression analysis in the space of "singing-ness". The closer to 1.00 the values is, the more "singing-ness" adjectives represent. Multiple correlation coefficients of adjectives in the 3-dimension were 0.99 for vibration, 0.99 for ringing and 0.84 for clearness. They are higher values relatively. Because vector of adjectives indicates different directions, "singing-ness" is strongly associated with vibration, ringing and clearness.

Relationship between the second layer (basic psychoacoustical feature) and the third layer (physical feature) in three layers model of "singing-ness" were investigated. Data were analyzed for Fundamental frequency (F0), amplitude envelope, spectrum and noise ratio to show acoustic features related to vibration or ringing. We made synthesized voice by adding features to voice data with little or no perception of vibration and ringing. We investigated if subject can percept the features in voice data in experiment. Results show that 4Hz - 6 Hz modulation in the F0 and amplitude envelope, variation of formant in frequency and amplitude and interaction among these features were significant acoustic features for perception of vibration. Results show that peak of spectrum envelope around 3 kHz and Strong harmonic components around 3 kHz were significant acoustic features for perception of ringing.

Finally, Relation between the first layer ("singing-ness") and the third layer (a physical feature) in three layers model of "singing-ness" were investigated. Amounts of psychoacoustical features are affected by combi-

nations of acoustic features, such as vibration and ringing. Variation of the amount of psychoacoustical feature changes degree of "singing-ness". Then, the several of combination of acoustic features related to vibration and ringing were presented to subjects to investigate relationship between the first layer and the third layer. Because their perceptions of "singing-ness" were changed while acoustic features were changing, these acoustics are connected with "singing-ness" It was found that Acoustic features related to vibration were significant features for "singing-ness". Acoustic features which affected than that of vibration related to ringing were features "singing-ness"