VowSpace: A Vowel Formant Analysis Application

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Vowel formant frequency is crucial in phonological and sociolinguistic descriptions, as it varies depending on the vowel and speaker. Interpreting these frequencies can help obtain vowel formant values specific to a particular language, variety, or speaker. This study presents VowSpace, an application that maps vowel formant values onto a vowel space for a specific language, language variety, or speaker. While developing the application, an initial draft code was created using R (R Core Team, 2021) to place vowel formant frequencies in a vowel space based on data prepared by Stanley (2018). This code was later adapted to Python (Van Rossum & Drake, 1995) and integrated into an interface that utilized the Matplotlib (Hunter, 2007) and PyQt5 (PyQt, 2012) libraries. The resulting application applies normalization to a specific dataset provided as input and generates a scatterplot of the vowels using the Matplotlib (Hunter, 2007) library to visualize them in the vowel space. The application can also analyze audio files by visualizing features such as formant, intensity, and pitch in a second window using the Praat (Boersma & Weenink, 2021) source code called "Audio Analysis Tools." After gathering the required data, it can be transferred to the main window to create a vowel space. The application also allows users to save data manually entered or modified data sets in .csv or .xlsx formats, and the drawn graphics in .jpg or .png file extensions. As the application is still under development, voice playback and recording methods, different normalization techniques, and data grouping features will be added in later stages. VowSpace is regularly updated on the GitHub platform, and its source code is available on GitHub, adhering to free software ethics. Considering that normalization processes are carried out in very few studies on vowel analysis in Turkey (Aydın & Uzun, 2020), it is believed that the developed VowSpace application will contribute to researchers aiming to place vowels from different languages, dialects, or speakers into a vowel space by providing them with a dynamic tool for their studies.

Keywords: Phonetics, vowel formant analysis, vowel space, vowel normalization.

References

Aydın, Ö., & Uzun, İ. P. (2020). Ünlü formant normalizasyonu: R programlama dilinde bir uygulama. In İ. P. Uzun (Ed.), *Kuramsal ve uygulamalı sesbilim: Kavramlar, terimler* (pp. 297-322). Seçkin Yayıncılık.

Hunter, J. D. (2007). Matplotlib: A 2D graphics environment. *Computing in Science & Engineering, 9*(3), 90-95. https://doi.org/10.1109/MCSE.2007.55

Lobanov, B. M. (1971). Classification of Russian vowel spoken by different speakers. *Journal of the Acoustic Society of America, 49*, 606-608.

PyQt. (2012). *PyQt reference guide*. [Yazılım]. Accessed from http://www.riverbankcomputing.com/static/Docs/PyQt4/html/index.html on 15 January 2024.

R Core Team. (2021). *R: A language and environment for statistical computing*. [Yazılım]. R Foundation for Statistical Computing, Vienna, Austria.

Remirez, E. (2022). *Vowel plotting in Python: A tutorial on normalizing and plotting vowels in python with pandas, seaborn, and matplotlib*. Accessed from https://lingmethodshub.github.io/content/python/vowel-plotting-py/ on 20 December 2023. https://doi.org/10.5281/zenodo.7232005

Stanley, J. (2020). *Joeysvowels: An R package of vowel data*. Accessed from https://joeystanley.com/blog/joeysvowels/ on 20 November 2023.

Traunmüller, H. (1981). Perceptual dimensions of opennes in vowels. *Journal of the Acoustic Society of America, 88*, 97-100.

Van Rossum, G., & Drake, Jr. F. L. (1995). *Python reference manual*. Centrum voor Wiskunde en Informatica Amsterdam.