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ISE575b-report#11

Exploring Expressive Performance Trajectories: Six Famous Pianists Play Six Chopin Pieces

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This study presents an approach to analyzing large amounts of expressive performance data. Tempo and loudness information from audio recording of six famous pianists were used. This study focuses on timing and loudness, captured fundamental expressive information about 36 complete performances and used novel clustering techniques to reduce complexity of the data. Six complete romantic piano pieces were played by concert pianists, to reveal expressive principles of performers or expressive constrains of certain phrases determined by the score. The two dimensional data was segmented into musically phrases, normalized and smoothed in different grades. The data set was clustered using a novel computational technique and visualized by an interactive user interface. The goal of study was to explore the expressive tempo-loudness phrase patterns and to determine typicality of individual performers.

The 3 Nocturnes and 3 preludes by Fredric Chopin were played by 6 famous pianists. For each measured onset, and overall loudness value was firmed from the audio signal to get measure of dynamics. All phrases of the six pieces by six performers resulted in more than 1600 two-dimensional time series each representing the tempo-loudness performance trajectory of one phrase played by one pianist. In order to compare the phrase segments of each other, they had to have exactly the same number of data pairs. All phrase segments were interpolated so that each phrase segment contained 25 data pairs.

The clustering technique used in this study is designed to give the researcher the opportunity to define various sets of input parameters. After computing combinations of parameters, their impact of the clustering process can be explored in a graphical user interface. There are three different parameters: the type of normalization applied to the data in order to make them comparable, the degree of smoothing, and the weighting between tempo and loudness.

Exploring unsmoothed performance data reveals every single accent or delayed note. There are five different levels of smoothing. The whole data sets with all its different parameterizations were input to the self-organization maps algorithm. The SOM algorithm is usually randomly initialized and stopped when a convergence standard is satisfied. The algorithm calculates for each parameterization a SOM that is explicitly forced to form its clusters at the same locations as the adjacent SOM with similar parameters. The user can continuously vary input parameters, and study their influence on the clustering process by examining the gradual changes in the aligned maps.

The results were visualized as an interactive HTML page. For exploring which phrase segments were included in one particular cluster, the user interface extended with a “cluster inspector”. It displays all performance segments of that specific clusters preceded by histograms by pianists, pieces, and phrases.

The normalized data clusters along piece boundaries, certain expressive strategies show the characteristic of individual pianists. To compare phrase segments with different basic tempo and loudness, the data were normalized.

A considerable number of common phrase shapes were observed in the experiments. Two examples showed similar strategy that caused pianists` phrases to be arranged in the same cluster. An extreme case is in which specifications from the score liberated the shape of the trajectories so that possible individual performance characteristics did not become visible.

There are some limitations which should be considered. Only overall loudness was measured from the sound file, disregarding the loudness of individual voices. This measure depends on the texture of the music. Performance information was determined at a defined track level. And the measurement error should be covered. Most important factor is data interpolation for comparisons. This processing step is necessary to compare phrases of varying length. The input variable smoothing condition makes the cluster prototypes smaller with growing smoothing window. The two-dimensional data representation concurrently used information from only two performance parameters. It disregards information on articulation and pedaling, and the score. To understand the worm shapes while listening to the music, sometimes the perception of tempo and loudness evolution gets confused with the perception of pitch and melody.

This study discovered both diversities and commonalities among performers. The advantage of this study was because dealing with large amount of data and it reduces their complexity and visualizes them with an interactive user interface. It will be good if it incorporate with different score and performance information.