COMPUTATIONAL MODELING OF ORNAMENTATION IN JAZZ GUITAR MUSIC

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Background

Computational modeling of expressive music performance deals with the analysis and characterization of performance deviations from the score that a musician may introduce when playing a piece. Most of the work in expressive performance analysis focus on duration and energy manipulations, and has mainly studied classical piano music. However, very little work has been dedicated to study ornamentation in popular music. Specifically, in jazz music ornaments are an important part of expressive performance and they are seldom indicated in the score, i.e. it is up to the interpreter when to add/substitute groups of notes in the score. Musicians add ornamentations based on melodic, harmonic and rhythmic contexts, as well as on their musical background. Furthermore, the categorization of ornaments in classical music (e.g. appoggiaturas, trills, mordents, turns, etc.) does not always apply in jazz music, as melodic embellishment in jazz lies in between archetypical ornamentation and free improvisation.

Aims

In this work we present a system to automatically recognize and synthesize ornaments in jazz guitar music. Our aim is to automatically obtain an ornamented rendition of a score by inducing an expressive performance model from a human player. By comparing the similarity between a sequence of score notes and its corresponding sequence of performed notes, we automatically obtain for each performed note (or group of notes) its corresponding parent note in the score, and create a database of ornamentations. After characterizing each performed note by its musical context, we apply machine-learning techniques to learn an expressive ornamentation model in the style of a particular guitarist.

Method

We obtained a MIDI-like machine representation of 27 jazz standard scores and their respective performance audio files, recorded by a professional jazz guitarist. We use dynamic time warping to match the performance and score note sequences and compare this matching with annotations by human experts. For each note in the in the score, we extract a set of melodic descriptors and apply machine learning to generate models to classify score notes into ornamented and non-ornamented notes. Ornamented notes, together with the music context in which it was performed, are included in a database. When a note is classified as ornamented by the model, we automatically select a suitable (according to similar music contexts) ornament from the annotated ornamentation database in order to synthesize an ornamented performance of a particular score.

Results

Quantitative evaluation was performed using a *leave one out* approach. Each song on the data set was used as test data and the rest were used as training data. This "song cross fold validation" scheme was performed for the 27 tunes, obtaining an average accuracy of 81.53% for the test set, and 83.8% for the training set, using a *decision tree* classifier. Qualitative evaluation was performed by music experts based on listening ratings for synthesized pieces.

Conclusions

We implemented a system for automatically recognizing and synthesizing ornamentations in jazz guitar music. We have used a data set of 27 audio recordings of jazz standards performed by a professional guitarist. We have applied dynamic time warping to align the score with the performance of the musician, and match notes of the performance with the corresponding parent notes in the score. Based on the alignment, we have generated a database of embellishments, annotated with the musical context in which they were performed. We have trained machine learning models to classify score notes in to ornamented or not-ornamented and for the former we have apply the k-nearest-neighbour algorithm to find, given a particular score note, the most suitable ornament in the ornament database. Evaluation results show that our approach is able to produce meaningful ornamentation models in order to automatically generate human-like ornamented performances.

Keywords

Expressive Performance Modeling; Machine Learning; Dynamic Time Warping; Ornament Modeling; Jazz Guitar

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