

Generating Orchestral Sequences with Timbral Descriptors

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Aims/goals

This project aimed to develop a computing system capable of generating sequences of orchestral instrument combinations matching specific perceptual qualities represented by timbre properties.

Background information

One of the characteristics of orchestration is the ability to create unique sounds or textures, an outcome appreciated by composers and utilized to produce specific perceptual effects. This compositional practice involves writing for several instruments, which means a large number of potential combinations. The significant search space is challenging when developing computing system designed to aid in orchestral composition. The presented research combines the work on analysis and classification of timbre within orchestral audio and machine learning developed at Plymouth University's ICCMR (Antoine et al. 2016; Antoine and Miranda 2017a; Antoine and Miranda 2017b) and the research into methods and tools to write and execute interactive scenarios developed at University of Bordeaux's LaBRI, conducted under the OSSIA (Open Scenario System for Interactive Applications) project (Celerier et al. 2015; De la Hogue et al. 2014).

Methodology

The presented approach uses machine learning methods for classification and regression tasks. First, supervised learning algorithms are utilized to harness and learn specific timbre properties from orchestral audio sources. Here, Artificial Neural Networks (ANNs) are trained with a training corpus manually labeled by the authors in order to create classification models to automatically estimate and evaluate the perceptual qualities of instrument combinations. The second set of supervised learning methods provides regression models to predict the timbre properties of note combinations without the need to perform an acoustical and psychoacoustical analysis. Once again, ANNs algorithms are utilized to create regression models, which have been trained using sets of instrument combination examples along with their calculated timbral values. Notes are then combined following predefined interval rules and are output only if they match the desired perceptual qualities. Therefore, the search algorithm is guided by the potential perception of the instrument mixture. The different timbre classification and regression models have been incorporated into the OSSIA *Score* software¹, which offers an interface to design scenario of orchestration sequences. Users can select different groups of orchestral instruments and specify the desired perceptual qualities represented with timbral descriptors such as *brightness* or *roughness*.

Results

The regression and classification models created by supervised learning methods have been able to predict timbral characteristics of note combinations, which can be used to identify perceptual features directly from instruments information. Such techniques, when integrated into a generative system, allowed for the instant perceptual characteristics estimation of instrument combinations, and thus, to generate orchestrations based on their potential perceptual qualities. Their integration in the OSSIA *Score* software (Fig. 1) has enabled a method to generate sequences of instrument combination guided by lists of timbral descriptors describing their potential perceptual qualities. Moreover, *Score* incorporates

¹ <https://ossia.io/>

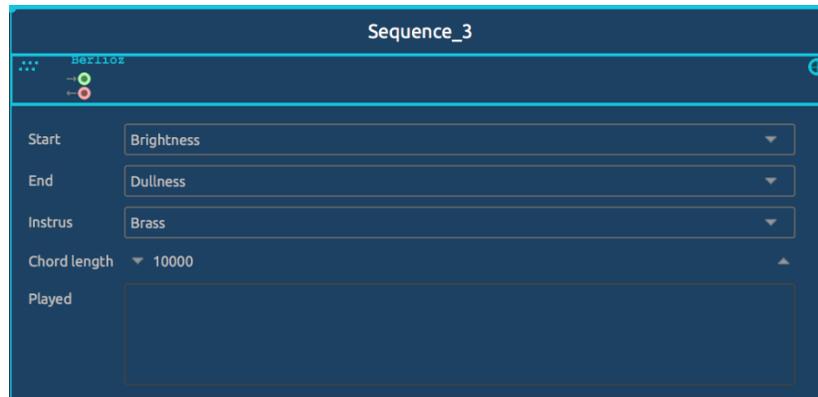


Figure 4. The generative process embedded in a OSSIA Score object.

conditional processes, which offers the design of multiple scenarios. This can be used as an exploratory technique to test different orchestration ideas.

Conclusions

This paper presented an approach designed to generate instrument combinations based on their potential perceptual qualities. The use of supervised machine learning methods has enabled the automatic prediction of timbre characteristics representing the perception of sonic properties, without the need to perform acoustical and psychoacoustical analysis on an audio source. The integration of the different classification and regression models in the OSSIA Score software has offered a method to design interactive and conditional scenarios representing sequences of orchestral instrument combinations to be generated following timbral descriptors. Such an approach could be utilized to refine the significant instrument search space faced in computer-aided orchestration systems.

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