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Computer Generated Orchestration: Towards Using Musical Timbre in Composition

ABSTRACT

Timbre is a musical attribute that has been largely discussed among the research community. However, there is still a lot to investigate, especially in regards to timbre and orchestration, which involves polyphonic timbre: a phenomenon that emerges from the mixture of instruments playing simultaneously. In this paper, we report on the development of a system capable of automatically analysing and classifying perceptual qualities of timbre within orchestral audio samples. This approach has been integrated in a computer-aided orchestration system for string ensemble. Our rationale for developing such a system is to create a means of incorporating musical timbre in the composition of music, which is often focused mainly on traditional Western music theory. Such developments could enrich creative music systems, and aid composers in their metier.

Background

Timbre is an important property of music. Since the first experiments by von Helmholtz (2013), researchers have produced a large and diverse quantity of work on this complex attribute, both from an artistic and scientific viewpoint (Schouten 1968, Grey 1975, Barrière 1991, Siedenburg et al. 2016). Timbre is traditionally defined as '*that attribute of auditory sensation in terms of which a listener can judge that two sounds similarly presented and having the same loudness and pitch are dissimilar*' (American National Standards Institute 1973). Several works have demonstrated the importance of acoustic features in defining musical timbre (Schouten 1968, Grey 1975, Zwicker et al. 2013).

Timbre is also an important characteristic in musical orchestration. Writing for an ensemble of instruments offers a large range of unique timbres, emerging from the mixture of instruments playing simultaneously. This phenomenon, sometimes named polyphonic timbre (Aucouturier 2006, Alluri et al. 2010), remains an important element to investigate, especially for computer-aided composition tools.

Aims and repertoire studied

This paper reports on the development of a system capable of automatically analysing and classifying specific timbral qualities within orchestral audio samples. Here, we have decided to use verbal descriptors, such as brightness or roughness, to represent the perception of musical timbres. The rationale for using words of the everyday language is to make the tool accessible to non-acoustics experts.

Furthermore, the automatic timbral classification method has been implemented in a computing system capable of generating orchestral excerpts based on timbral properties defined by the user. Our rationale for developing such a system is to create a means of incorporating timbre in the composition of music.

Methods

For our automatic classification system, we experimented with five verbal descriptors: breathiness, brightness, dullness, roughness, and warmth. Further information about our acoustic feature analysis method can be found in a previous publication (Antoine et al. 2016).

There is no agreed metrics for classifying audio samples according to perceived responses of timbre quality. Therefore, we established a comparative scale for each timbre attribute implemented in the system. We collected over 250 audio recordings of various orchestral pieces, and split each 0 audio

they can export the musical excerpts generated by the system as an audio file or as a musical score.

Implications

The audio analysis of orchestral recordings enabled us to define a scale for each verbal descriptor. It also facilitated the creation of a normalisation algorithm, which enables us to compare the data between all timbral attributes. We used the normalised dataset to train a machine learning algorithm capable of automatically classify orchestral audio files according to their polyphonic timbre content. Furthermore, users can personalise the classification by listening and rating a selection of audio files.

We incorporated this automatic timbre classification method into a system designed to generate musical excerpts for string instruments. The generation is based on chord combination rules taken from the traditional Western music theory framework. There is an option to extend the combinatorial rule. Here, the important criteria to guide the generative process is the timbral quality, and not solely pitches or scales. Thus, solutions are output only if the resulted audio combination reproduces the selected timbral attribute using the defined list of instruments.

Such developments could enrich computer-aided orchestration systems by harnessing perceptual aspects of polyphonic timbre within orchestral sound.

Keywords

Timbre, Musical Acoustics, Musical Perception, Orchestration, Computer-Aided Orchestration.

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