Sentiment Interpretation in Musical Conducting – a Machine Learning Study

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Abstract

Classical music sound production is structured by an underlying manuscript, the sheet music, that specifies into some detail what will happen in the music, e.g. in terms of rhythm, tone heights, and overall dynamics (i.e., changes in sound level). However, the sheet music specifies only up to a certain degree how the music sounds when performed by an orchestra; there is room for considerable variation in terms of timbre, texture, balance between instrument groups, tempo, local accents, and dynamics [1].

In larger ensembles, such as symphony orchestras, the conductor has the major responsibility for the interpretation. The conductor has prior to the interaction with the orchestra formulated a clear goal function, a vision on how the musical score should be interpreted. During the rehearsals, the conductor then communicates the interpretation to the orchestra, partly through verbal explanations, but to a very high degree through body language. This effect of the conductor's non-verbal signals on the music performance has been verified scientifically [2].

We here investigate in a controlled setting how different aspects of the interpretation are communicated non-verbally. Our findings are intended to be used to guide the

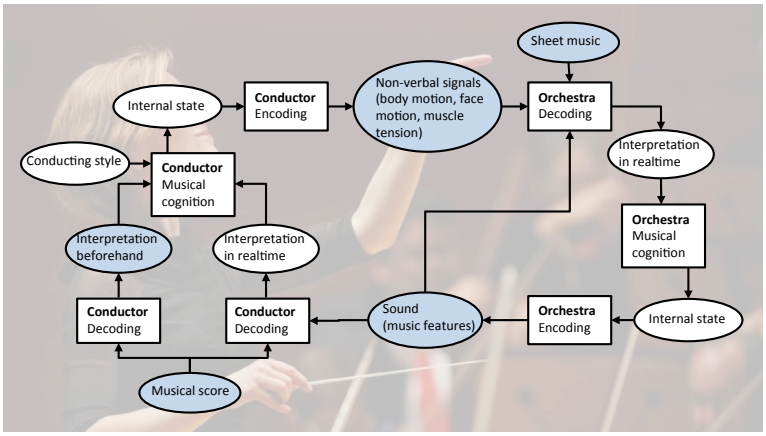

Figure 1. Simplified generative model of the conducting process.

design of computer models of conductor-orchestra communication. We propose to use a Machine Learning approach where a simplified generative model of the entire music production process is modeled and learned from recorded data (Figure 1).

This model can be exploited for two applications, firstly, conductor-sensitive music synthesizers, which can be used as an orchestra simulator for conducting students [3], secondly, tools for analyzing conductor-orchestra communication, where latent states in the conducting process are inferred from recordings of conducting motion and orchestral sound. These latent states can be used as a pedagogical tool for conductors and conducting students [3], potentially enabling the possibility to provide feedback about conducting aspects not visible to the human (teacher) eye.

The feasibility of such a model was evaluated as follows:

We collected a dataset consisting of 20 recordings of the same musical piece played by a professional string quartet following a conductor. It was conducted with 4 different musical intentions in mind. The upper body and baton motion of the conductor was recorded using a motion capture system (mocap), and the sound of each instrument was recorded using microphones attached to each instrument.

We then implemented a Machine Learning method which automatically classifies the musical intention class from the mocap or the audio signal. The results showed firstly that intention was indeed communicated to the musicians almost perfectly, which is in accordance with [2]. Secondly, we found that the motion of the baton communicates energetic intention to a high degree, secondly, that the conductor's torso, head and other arm conveys calm intention to a high degree, and that positive vs negative sentiments are communicated to a high degree through other channels, such as facial expression and muscle tension conveyed through articulated hand and finger motion.

References

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