THE ENSEMBLE MEMBER AND THE CONDUCTED COMPUTER

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ABSTRACT A new software environment for conductor-following has been created by a professional, conservatory-trained conductor. Based on the author’s substantial experience on the podium, the system models those aspects of ensemble playing that are typically controlled by the conductor’s baton: the continuous shaping of the tempo along all points of the baton’s path (rubato) and the taking and releasing of control based on the structure of the musical phrase. The system also provides opportunities for rehearsal. The software has been written using custom designed Max external objects, and currently uses the Buchla Lightning as the hardware interface.

1 Rubato Control of Overall Tempo through Continuous Baton Tracking

Previous presentations of conducting systems have primarily tracked the conductor’s baton from beat point to beat point only. Much vital data is ignored in these approaches, since the professional conductor communicates a great deal of expressive information with the baton between beat points. A sudden slow lift of the baton, for example, would result in an immediate response on the part of the orchestra to pull back the tempo slightly, as would a suddenly quick lift result in a quickening of tempo. A robust conductor-following system must take into account the continual shape of the baton’s path in order to give the conductor the necessary control over tempo, resulting in the execution of rubato within the context of computer music performance.

This rubato control is achieved in the following manner: after setting each of the eight zones of the Lightning to a different MIDI controller number, (resulting in a grid of 256x512 points), the system tracks the continual movement of the baton at a sample rate of 40 Hz. Through this continual tracking, three levels of tempo control are derived:

1 The basic beat is derived by observing the points at which the baton changes direction. As the baton changes direction from a downward to an upward motion, a bang is sent out to indicate the incisus of the beat, and when the baton completes its lift and begins to move downwards again, a bang is sent out to indicate the arch of the beat. The time in milliseconds from the incisus of one beat to the incisus of the next is calculated, and this time frame serves to indicate the primary tempo.

2 The first level of rubato is achieved through a prediction of the arrival time of the next incus at the moment when the baton reaches its arch. By keeping track of the time between the incus and arch of the previous beats, a flag is triggered if the arrival time of the arch of the current beat is significantly offset from the norm. The average ratio between the primary tempo and the time from incisus to arch is also calculated and stored. With this data, an adjustment to tempo is made at the moment of the arch of the beat, resulting in a level of control impossible to achieve if only the incus points are processed.

3 Finally, the velocity of the baton is mapped along the entire lift and fall of the beat. Certain observations concerning the ratio of the lift to the acceleration of the baton as it lifts towards the arch of the beat (or falls towards the incus) and the resultant tempo are stored in a data base. Over time, adjustments to tempo are achieved while the baton is in between the incus and the arch, resembling very closely the manner in which a trained ensemble player would respond to the subtlety of a conductor’s gestures.

Through this instantaneous control over the micro-tempo, the conductor is able to introduce a high degree of rubato into the performance of a computer score, resulting in a fluid and expressive performance.

2 Use of Overlapping Phrase Structure to Model the Human Ensemble

The conductor-follower outputs MIDI in the standard manner by sending out a preset number of ticks per beat, the rate of the ticks under the constant control of the tempo reading algorithm described above. It differs in one important way, however, from the MIDI standard, as typified in the “tap tempo” function contained in commercial sequencing packages: the ticks for each beat will conclude their output and pause if the bang from the next incus has not been sent. This allows the conductor the necessary control over orchestral attacks and the shaping of a phrase. This works quite adequately when all the musical lines in the composition share the same phrase structure. But what about situations where different voices begin and end their phrases at different times?
One of the limitations of a MIDI-based system is the absence of a data type which could represent the beginning and end of a musical phrase. This system enhances the MIDI file structure to include the demarcation of phrase points.

The purpose of this enhancement is to provide the various voices in a MIDI-based score a degree of individual freedom when playing from the beginning to the end of a phrase. It is modeled on a typical orchestral situation. Take, as an example, the opening of Beethoven's Seventh Symphony. Here, the oboe and clarinet play sustained phrases while the rest of the orchestra play only on the downbeat of each measure. The conductor must control the attacks of the ensemble while allowing the solos to play each phrase with a degree of artistic freedom.

The effect is achieved in the conductor-follower by demarcating phrase points on each channel of the MIDI file. Once a phrase has been initiated, it is allowed to continue until the next repeat bar line, but will continue to play through the next beat, based on the beat prediction algorithm described above. In a complex score with many overlapping phrases, the result is a performance that more closely resembles that of a human ensemble, where individual players do not necessarily rely on the conductor for each beat while in the middle of a phrase.

3 Interpreting and Remembering a Conductor's Gestures in Rehearsal
Conducting is a highly individualized art, and while there are certain standard gestural practices that all professional conductors are capable of demonstrating, idiosyncrasy is the rule. The trained ensemble player learns to adjust to each conductor. In the conductor-follower system under discussion, a rehearsal module has been created whereby aspects of the conductor's style (such as relative position of beat placement, rate of acceleration during the lift, relationship of cue to the intended beat point) are observed and stored in memory. This data allows the conductor-follower to adjust to an individual conductor's style, and also allows the program to recognize places in the score where the conductor intends something unusual or dramatic, marking this point as the score in the same way that an ensemble player would pencil something into his or her part.

4 Applications
The primary purpose of this conductor-following performance system is to encourage the composition of new works for live performers and computer generated materials, such that both the acoustic and the electronic elements of the performance may be brought under the expressive control of the conductor. It is designed to serve as an alternative to the performance of works for live ensemble and tape. A composition for conductor-following performance system could include traditionally notated music assigned to track the conductor in the usual way in combination with, for example, a concert version of a piece triggered by one arm gesture. Typically, a composition for live ensemble and conductor-following system would result in the freedom to re-create the piece at each performance, to "do it differently every time," a situation that is not the author's intent is the essential task of the performing artist. By bringing the computer under the control of the conductor, the dramatic aspect of the score becomes a part of this re-creative process.

A secondary application of the conductor-following system lies in the area of conductor-training. Often the fledgling conductor has very little opportunity to test the efficacy of his conducting gestures. By having a way of creating and conducting a sample-based synthesizer using this software system, the student would be able to experience more directly the results of his beat and could listen back to a performance to test his ear and expressive control.

References