2:25

4pMUa2. The cyber-physical system approach for automatic music accompaniment in Antescofo. Arshia Cont (STMS 9912-CNRS, UPMC, Inria MuTant Team-Project, IRCAM, 1 Pl. Igor Stravinsky, Paris 75004, France, arshia.cont@ircam.fr), José Echeveste (STMS 9912, IRCAM, CNRS, Inria MuTant Team-Project, Sorbonne Univ., UPMC Paris 06, Paris, France), and Jean-Louis Giavitto (IRCAM, UPMC, Inria MuTant team-project, CNRS STMS 9912, Paris, France)

A system capable of undertaking automatic musical accompaniment with human musicians should be minimally able to undertake real-time listening of incoming music signals from human musicians, and synchronize its own actions in real-time with that of musicians according to a music score. To this, one must also add the following requirements to assure correctness: Fault-tolerance to human or machine listening errors, and best-effort (in contrast to optimal) strategies for synchronizing heterogeneous flows of information. Our approach in Antescofo consists of a tight coupling of real-time Machine Listening and Reactive and Timed-Synchronous systems. The machine listening in Antescofo is in charge of encoding the dynamics of the outside environment (i.e., musicians) in terms of incoming events, tempo and other parameters from incoming polyphonic audio signal; whereas the synchronous timed and reactive component is in charge of assuring correctness of generated accompaniment. The novelty in Antescofo approach lies in its focus on Time as a semantic property tied to correctness rather than a performance metric. Creating automatic accompaniment out of symbolic (MIDI) or audio data follows the same procedure, with explicit attributes for synchronization and fault-tolerance strategies in the language that might vary between different styles of music. In this sense, Antescofo is a cyber-physical system featuring a tight integration of, and coordination between heterogeneous systems including human musicians in the loop of computing.

2:50

4pMUa3. Automatic music accompaniment allowing errors and arbitrary repeats and jumps. Shigeki Sagayama (Div. of Information Principles Res., National Inst. of Informatics, 2-1-2, Hitotsubashi, Choyoda-ku, Tokyo 101-8430, Japan, sagayama@nii.ac.jp), Tomohiko Nakamura (Graduate School of Information Sci. and Technol., Univ. of Tokyo, Tokyo, Japan), Eita Nakamura (Div. of Information Principles Res., National Inst. of Informatics, Japan, Tokyo, Japan), Yasuyuki Saito (Dept. of Information Eng., Kisarazu National College of Technol., Kisarazu, Japan), and Hirokazu Kameoka (Graduate School of Information Sci. and Technol., Univ. of Tokyo, Tokyo, Japan)

Automatic music accompaniment is considered to be particularly useful in exercises, rehearsals and personal enjoyment of concerto, chamber music, four-hand piano pieces, and left/right hand filled in to one-hand performances. As amateur musicians may make errors and want to correct them, or he/she may want to skip hard parts in the score, the system should allow errors as well as arbitrary repeats and jumps. Detecting such repeats/jumps, however, involves a large complexity of search for maximum likelihood transition from one onset timing to another in the entire score for every input event. We have developed several efficient algorithms to cope with this problem under practical assumptions used in an online automatic accompaniment system named "Eurydice." In Eurydice for MIDI piano, the score of music piece is modeled by Hidden Markov Model (HMM) as we proposed for rhythm modeling in 1999 and the maximum likelihood score following is done to the polyphonic MIDI input to yield the accompanying MIDI output (e.g., orchestra sound). Another version of Eurydice accepts monaural audio signal input and accompanies to it. Trills, grace notes, arpeggio, and other issues are also discussed. Our video examples include concertos with MIDI piano and piano accompanied sonatas for acoustic clarinet.

3:15

4pMUa4. The informatics philharmonic. Christopher Raphael (Comput. Sci., Indiana Univ., School of Informatics and Computing, Bloomington, IN 47408, craphael@indiana.edu)

I present ongoing work in developing a system that accompanies a live musician in a classical concerto-type setting, providing a flexible ensemble the follows the soloist in real-time and adapts to the soloist's interpretation through rehearsal. An accompanist must hear the soloist. The program models hearing through a hidden Markov model that can accurately and reliably parse highly complex audio in both offline and online fashion. The probabilistic formulation allows the program to navigate the latency/accuracy tradeoff in online following, so that onset detections occur with greater latency (and greater latency) when local ambiguities arise. For music with a sense of pulse, coordination between parts must be achieved by anticipating future evolution. The program develops a probabilistic model for musical timing, a Bayesian Belief Network, that allows the program to anticipate where future note onsets will occur, and to achieve better prediction using rehearsal data. The talk will include a live demonstration of the system on a staple from the violin concerto repertoire, as well as applications to more forward-looking interactions between soloist and computer controlled instruments.

3:40

4pMUa5. Interactive conducting systems overview and assessment. Teresa M. Nakra (Music, The College of New Jersey, P.O. Box 7718, Ewing, NJ 08628, nakra@tcnj.edu)

"Interactive Conducting" might be defined as the accompaniment of free gestures with sound—frequently, but not necessarily, the sounds of an orchestra. Such systems have been in development for many decades now, beginning with Max Mathews' "Daton" interface and "Conductor" program, evolving to more recent video games and amusement park experiences. The author will review historical developments in this area and present several of her own recent interactive conducting projects, including museum exhibits, simulation/training systems for music students, and data collection/analysis methods for the study of professional musical behavior and response. A framework for assessing and evaluating effective characteristics of these systems will be proposed, focusing on the reactions and experiences of users/subjects and audiences.