University of Rochester
Department of Electrical and Computer Engineering
Colloquia Series

New Horizons with Musical Accompaniment Systems

Dr. Christopher Raphael

Wednesday, December7th
12:00PM – 1:00PM
Computer Studies Building (CSB) 209

Abstract: I discuss my ongoing and future work in creating a computer system that plays the role of musical accompanist in a non-improvisatory composition for soloist and ensemble. This application simulates a concerto-like setting for a live soloist, allowing the soloist to *lead* an interactive real-time audio synthesis of the accompanying ensemble, ranging from single piano to full orchestra. An accompanist must synthesize a number of different sources of information. First of all, the accompanist must perform a real-time analysis of the soloist's acoustic signal enabling the accompanist to "hear" the soloist. The accompaniment must also understand the basic template for musical performance that is described in the musical score, (notes, rhythms, etc.) thereby allowing the system to "sight-read" (perform with no training) credibly. However, the accompanist must also be able to improve over successive rehearsals, much as live musicians do; thus the accompanist must be capable of learning from training data. The "hearing" component is implemented with a hidden Markov model that tracks the live player's progress through the musical score and communicates the times at which note onsets are observed. The probabilistic nature of this approach allows the model to effectively navigate the tradeoff between latency and accuracy in making detections. In addition, standard training ideas from HMMs allow the system to improve its performance through practice by adapting both the hidden Markov model and the observable distributions. The "brain" of the system is a Gaussian Bayesian belief network that models hundreds of variables relating to musical timing of the performance. Some of these variables are observable, such as the actual times of accompaniment events and the estimated times of solo events. Other variables are hidden, such as local tempo and other variables relating to rhythmic interpretation. A simple and sensible musical model combines these variables and allows real-time inference and off-line learning. During live performance, the belief network operates as a scheduler that repeatedly estimates the time of the next unplayed accompaniment note as new information becomes available. These predictions guide the audio synthesis of the accompaniment instruments like a trail of bread crumbs. I will provide a live demonstration with violinist Jing Xing, from the Eastman School of Music, as well as showing various aspects of what is "under the hood." Many examples can be heard at http://music.informatics.indiana.edu/~craphael/info_phil/

Bio: Christopher Raphael heads the Music Informatics program in the School of Informatics and Computing at Indiana University, as well as holding adjunct appointments in the Jacobs School of Music, Cognitive Science, and Statistics. After receiving his PhD in Applied Mathematics from Brown University in 1991, he worked on a wide range of problems in both industry and academia including Arabic character recognition, magnetic resonance spectroscopy and mine detection before coming to focus on music. His musical research includes accompaniment systems, optical music recognition, computer generated musical analysis, musical signal processing, and modeling of musical interpretation. As a former professional oboist, he won the San Francisco Young Artist competition and soloed with the San Francisco Symphony, played principal oboe in the Santa Cruz Symphony, and was a fellow at Tanglewood.

Refreshments will be provided