NC STATE UNIVERSITY

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Operations Research Graduate Program
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Daniels Hall Room 218
4:30 pm

Music Science and the Mathematical Modeling of Tonality

Dr. Elaine Chew
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Abstract
The surge in interest in the scientific study of music in recent years is spurred on by widespread access to digitally encoded music, from desktop browsers to handheld devices. A growing group of researchers and scholars are employing mathematical and computational techniques in the scientific analysis and generation of music and expressive performances. I shall begin by introducing the field of music science, and some open courseware I have developed on computational modeling of music analysis, performance, and composition/improvisation.

The main part of the talk will focus on mathematical models for recognizing and tracking tonality in music, with live demonstrations of the MuSA.RT real-time tonal analysis and visualization system. Tonality refers to the system by which pitches relate one to another and generate varying degrees of perceived stabilities amongst themselves. Tonality is central to the understanding of much of the music that we hear. Questions that pertain to tonality include: when does a phrase sound finished? how does one create expectation, tension and release in a composition? what are some bases for musical humour? how does one manipulate timing to produce the desired emotional effect?

I shall motivate and introduce the Spiral Array and related algorithms for tonal induction and segmentation. The Spiral Array is a mathematical model for tonality first introduced in my doctoral dissertation. It combines Euler's geometric representation for music pitches with concepts from interior point methods in Operations Research. MuSA.RT shows the Spiral Array representations of current tonal structures as they are computed in real time. Musical illustrations, with the help of the MuSA.RT system, will provide some answers to the above questions.

The MuSA.RT project is joint work with Alexandre François, who is giving a complementary talk on the underlying software architecture in Computer Science this week.

Biosketch
Elaine Chew is an Associate Professor of Industrial and Systems Engineering and of Electrical Engineering at the University of Southern California (USC) Viterbi School of Engineering. She earned PhD and SM degrees in Operations Research from MIT, and a BAS in Mathematical and Computational Sciences and Music Performance from Stanford University.

Her research interests center on the computational modeling of music and its performance. She founded and heads the Music Computation and Cognition Laboratory at USC, where she conducts and directs research on music and computing. She received the NSF Career/PECASE Awards for her research and education activities at the intersection of music and engineering. Professor Chew is on the founding editorial boards of the Journal of Mathematics and Music, the Journal of Music and Meaning, and ACM Computers in Entertainment. She is the first honoree of the Viterbi Early Career Chair.

Professor Chew also holds diplomas and degrees in piano performance from the Trinity College, London and Stanford University. She received the Laya and Jerome Wiesner Student Art Award for her contribution to the arts at MIT, and subsequently served as Affiliated Artist of Music and Theatre Arts from 1998-2000. Her artistic endeavors include founding of the MIT-based Aurelius Ensemble and field research on contemporary Chinese piano music in China. She has performed widely as a chamber musician and soloist. At USC, she has initiated and performed in the multimedia concerts The Mathematics in Music, Flying Sonics, and Dark Blue Sky Dream.

Professor Chew is on sabbatical in 2007-2008, during which she and her collaborator Alexandre François are Fellows of Harvard's Radcliffe Institute of Advanced Study, where they form a research cluster on Analytical Listening through Interactive Visualization.

Refreshments will be served in 401 Daniels Hall at 4:00 p.m.