ISE 599[1]: Engineering Approaches to Music Perception and Cognition

Daniel J. Epstein Department of Industrial and Systems Engineering
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COURSE SYLLABUS

Instructor: Elaine Chew <echew@usc.edu>
GER-245, (213) 8.212.414
Office Hours: Wed 3-5 PM

Section: 048-35145D
Day: Thursday 6:30-9:20pm (negotiable at first meeting)
Location: PHE333 (note that this is different from location in your schedule)

Text: Selected technical papers (subject to change)

Pre-requisites: Graduate standing in engineering or by instructor's consent.
Programming experience (C++ or Java).

Course Objectives:

This course surveys computational research in music perception and cognition. Information processing by humans serves as a basis for improving human-computer interaction in music information systems. The topics include basic concepts of music perception and cognition, computational methods for abstracting and extracting pitch and time structures, pattern and style recognition, expression synthesis, analysis and interpretation. Students will gain hands-on experience by implementing selected algorithms from the surveyed literature. The implementation projects will provide computational practice in music analysis, segmentation, synchronization and retrieval.

Class Format, Expectation and Evaluation Method:

In general, each class will consist of a short lecture on a designated topic and 3-4 20-minute paper presentations and an implementation project update.

Homework: Each student is expected to write reviews of two assigned papers (each paper is typically 10-15 pages long) every week. In addition, each student has to write a critical summary of the paper presentations each week.

Presentation: When assigned to present a paper, the student is expected to have read and understood the content sufficiently to present and explain the new experimental findings to the class. Whenever possible, the student is expected to go beyond the paper to seek online resources and examples that illustrate the

[1] The course will be approved for credit towards the MSIMS and MSEE (MCT) and possibily for the MSCSCI (MCT) degrees. It will be cross-listed in the 2004-5 schedule as ISE 575 / EE 675.

principles and algorithms introduced in the paper. Each presentation is equivalent to a short seminar, and the number of presentations will depend on the class size.

Between the paper presentations and the assigned readings, we expect to cover all papers listed in the course syllabus.

Project: For the project, each student is expected to either implement and extend the findings of one of the papers, or propose an independent computing project on a similar topic. The implementation of selected algorithms should be done in teams of no more than two. At the end of the semester, the student is expected to give a presentation to demonstrate the results of the implementation project.

The goal of this course is to acquire domain knowledge in computational music research. As such, the evaluation is based on:

Paper presentations	25%
Paper reviews	35%
Implementation project	30%
Class participation	10%

Schedule and Reading List:

ICMAI = International Conference on Music and Artificial Intelligence
ICMC = International Computer Music Conference
ICMPC = International Conference on Music Perception and Cognition
ISMIR = International Symposium on Music Information Retrieval
ref = indicates a reference book

Introduction	
Week 1:	***Basic Music Theory***
	Desain, P., Honing H., van Thienen, H. and Windsor, L. (1998). "*Computational Modeling of Music Cognition: Problem or Solution?*" Music Perception.
	Jean-Claude Risset (2002). "*Musical Composition and Artificial Intelligence: Some Precedents and Prospects*," keynote lecture at the 2nd ICMAI.
	ref: Bamberger, J. (2002). "*Developing Musical Intuitions: A Project-Based Approach*" MIT Press: Cambridge, MA.
	ref: Kostka, S. (2000). "*Tonal Harmony, With an Introduction to Twentieth-Century Music,*" 4th ed. McGrawHill.
	ref: Merryman, M. (1996). "*The Music Theory Handbook*" Wadsworth Pub Co.
Pitch Structures I: Tonality	
Week 2:	***Models of Tonality***
	Longuet-Higgins, H.C. (1979). "*Review Lecture: The perception of music.*" In Proceedings of the Royal Society, London, B. 205:307-322.
	Carol Krumhansl (1990). "*Quantifying tonal hierarchies and key distances.*" In *Cognitive Foundations of Musical Pitch*, pp.16-49, Oxford University Press.
	Shepard, Roger N. (1982). "*Structural Representations of Musical Pitch.*" In *The Psychology of Music*, pp. 343-390. Academic Press.
	Zatorre, Robert J. & Krumhansl, Carol L. (2002). "*Mental Models and Musical Minds.*" *Science* Dec 13 2002: 2138-2139.

Week 3:	***Key-Finding***
	Chew E. (2001). "*Modeling Tonality: Applications to Music Cognition*." In Proceedings of the 23rd Annual Meeting of the Cognitive Science Society.
	Chew E. (2002). "*An Algorithm for Determining key Boundaries*." In Proceedings of the 2nd ICMAI.
	Longuet-Higgins, H.C. & Steedman, M.J. (1971). "*On Interpreting Bach*." In Meltzer, B. & Michie, D. (eds.) "Machine Intelligence" 6, p. 221-41. Edinburgh, Scotland: Edinburgh U. Press.
	Shmulevich, I., Yli-Harja, O. (2000) "*Localized Key-Finding: Algorithms and Applications*." Music Perception, Vol. 17, No. 4, p. 531-544.
	Temperley, D. & Sleator, D. The Melisma Music Analyzer *http://www.link.cs.cmu.edu/music-analysis*.
Computer Implementation	
Week 4:	***Representing Music***
	Dannenberg, R. (1993) "*Music representation issues, techniques, and systems*." Computer Music Journal, 17:3 pp. 20-30.
	Huron, D. (1992) "*Design principles in computer-based music representation*." In A. Marsden & A. Pople (eds.), Computer Representations and Models in Music. London: Academic Press, 1992; pp. 5-59.
	Wiggens, G., Miranda, E., Smaill, A. & Harris, M.(1993) "*A framework for the evaluation of music representation systems*." Computer Music Journal, 17:3 pp. 31-42.
	ref: Selfridge-Field, E. (1997), ed. "*Beyond MIDI: The Handbook of Musical Codes*." Cambridge, MA: MIT Press.
Week 5:	***The MFSM software architecture*** (guest lecturer: Alexandre François)
	MFSM Open Source homepage: *http://mfsm.sourceForge.net*
	François, A. R.J. & Medioni, G. G. (2000). "*A Modular Middleware Flow Scheduling Framework.*" In Proceedings of ACM Multimedia 2000, p. 371-374.
	François, A. R.J. (2002). "*Components for Immersion*." In Proceedings of the IEEE International Conference on Multimedia and Expo.
	MuSART: a case study of MuSA Real-Time
	Chew E. & François A. (2003). "*Real-Time Music Information Processing*." In Proceedings of the 31st Intl Conf on Computers and Industrial Engineering.
Pitch Structures II: Tonal Patterns	
Week 6:	***Pitch Spelling***
	Cambouropoulos E. (2001). "*Automatic Pitch Spelling: From Numbers to Sharps and Flats*." In Proceedings of the VIII Brazilian Symposium on Computer Music.
	Chew E. and Chen Y.-C. (2003). "*Mapping MIDI to the Spiral Array: Disambiguating Pitch Spellings*." In Proceedings of the 8th INFORMS Computing Society Conference.
	Temperley, David (2002). "*The Cognition of Basic Musical Structures*." Cambridge: MIT Press.
	Temperley, D. & Sleator, D. The Melisma Music Analyzer *http://www.link.cs.cmu.edu/music-analysis*.

Week 7:	***Chord Recognition***
	Conklin, D. (2002) "*Representation and Discovery of Vertical Patterns in Music.*" In Proceedings of the 2nd ICMAI.
	Povel, D.-J. (2002) "*A Model for the Perception of Tonal Melodies*." In Proceedings of the 2nd ICMAI.
	Tee, A., Cooper, D. and McLernon, D. (2002). "*Chord Recognition with Application in Melodic Similarity*." In additional proceedings (online) of the 2nd ICMAI.
	Winograd, Terry (1968), "*Linguistics and the Computer Analysis of Tonal Harmony*." Reprinted in Stephan Schwanauer and David Levitt, Eds., Machine Models of Music, MIT Press, 1993, pp. 113-153.
Pitch Structures III: Melody	
Week 8:	***Linear Structures***
	Narmour, E. 1991. "*The top-down and bottom-up systems of musical implication: Building on Meyer's theory of emotional syntax*." Music Perception 9:1-26.
	Schmuckler, M.A. 1989. "*Expectation in music: Investigation of melodic and harmonic processes*." Music Perception 7 (2):109-135, 143-149.
	Schnellenberg, E. G. 1996. "*Expectancy in melody: Tests of the implication-realization model*." Cognition 58:75-93, 116-125.
Week 9:	***Line Separation***
	Cambouropoulos, E. (2000) "*From MIDI to Traditional Musical Notation*." In Proceedings of the AAAI Workshop on AI and Music: Towards Formal Models for Composition, Performance and Analysis.
	Huron, D. (1991) "*The avoidance of part-crossing in polyphonic music: Perceptual evidence and musical practice*." Music Perception, 9:1. pp. 93-104.
	Kilian, J. & Hoos, H. (2002) "*Voice Separation – A Local Optimization Approach.*" In Proceedings of the 3rd ISMIR, p.39-46.
Week 10:	***Melodic Segmentation***
	Cambouropoulos E. (2001). "*The Local Boundary Detection Model (LBDM) and its Application in the Study of Expressive Timing*." In Proceedings of the ICMC 2001.
	Ferrand, M., Nelson, P. & Wiggins, G. (2002). "*A Probabilistic Model for Melody Segmentation*." Additional proceedings (online) of the 2nd ICMAI.
	Melucci, M. & Orio, N. (2002) "*A Comparison of Manual and Automatic Melody Segmentation.*" In Proceedings of the 3rd ISMIR.
	B. Thom, C. Spevak, and K. Hoethker (2002). "*Melodic Segmentation: Evaluating the Performance of Algorithms and Musical Experts*." In Proceedings of ICMPC 2002, p.7-14.
Time Structures	
Week 11:	***Beats and Rhythm***
	Desain, Peter (1992). "*A (De)Composable Theory of Rhythm Perception*." Music Perception 9, 439-54.
	S. Dixon and W. Goebl (2002). "*Pinpointing the Beat: Tapping to Expressive Performances*." In Proceedings of the 7th ICMPC, p 617-620.
	Paulus, J. & Klapuri, A. (2002). "*Measuring the Similarity of Rhythmic Patterns.*" In Proceedings of the 3rd ISMIR, p. 150-156.
	Parncutt, Richard (1994). "*A Perceptual Model of Pulse Salience and Metrical Accent in Musical Rhythms*." Music Perception 11, 409-464.

Week 12:	***Meter Induction***
	Eck, Douglas (2002). "*Finding downbeats with a relaxation oscillator.*" Psychological Research, 66(1): 18-25.
	Fleischer, Anja (2002). "*A model of metrical coherence.*" In Proceedings of the 2nd Intl Conf on "Understanding and Creating Music", Caserta.
	Johnson-Laird, Philip N. (1991). "*Rhythm and Meter: A Theory at the Computational Level*." Psychomusicology 10, 88-106.
	Povel, D.-J. & Essens, P. "*Perception of temporal patterns*." Music Perception, 2(4):411—440, 1985.
	Steedman, M.J. (1977). "*The perception of musical rhythm and metre*", Perception, Vol. 6
	ref: Hasty, C. (1997). "*Meter as Rhythm*". Oxford University Press.
Style Recognition	
Week 13:	***Pattern Recognition***
	Cope, D. (1992) "*On the Computer Recognition of Musical Style*." In Balaban, M., Ebcioglu K., and Laske, O. "Musical Intelligence." Menlo Park, CA: AAAI Press.
	Cope, D. (1998). "*Signatures and Earmarks: Computer Recognition of Patterns in Music*." In Hewlett, W. B. & Selfridge-Field, E. (eds.) "Melodic Similarity, Concepts, Procedures and Applications." Cambridge, MA: MIT Press.
	Tversky, Amos. (1977). "*Features of Similarity*." Psychological Review. 84: 327-352.
	Whitman, B. & Smaragdis, P. (2002) "*Combining Musical and Cultural Features for Intelligent Style Detection.*" In Proceedings of the 3rd ISMIR.
Performance Analysis	
Week 14:	***Tempo Rubato***
	Mazzola, G & Zahorka O. "*Tempo Curves Revisited: Hierarchies of Performance Fields*." Computer Music Journal 18/1, 1994.
	Neil, T. (1985). "*A Model of Expressive Timing in Tonal Music*." Music Perception 3/1, 33-58.
	Timmers, R., Ashley, R, Desain, P, and Heijink, H. (2000) "*The influence of musical context on tempo rubato*." Journal of New Music Research 131-158.
Week 15:	***Expression and Interpretation***
	Kendall, Roger A. & Edward C. Carterette. "*The Communication of Musical Expression*." Musical Perception, 8 (2) (1990), 129-164.
	Narmour, E. "*On the Relationship of Analytical Theory to performance and Interpretation*" Explorations in music, the Arts, and Ideas E. Narmour & R.A. Solie (eds.) (1988), Stuyvesant, New York, Pendragon, 317-40.
	Palmer, C. (1996). "*Anatomy of a performance: Sources of musical expression*." Music Perception 13 (3):433-453.
Project Presentations (TBA)	

Academic Integrity Policy:

All USC students are responsible for reading and following the Student Conduct Code, which appears in the Scampus and at *http://www.usc.edu/dept/publications/SCAMPUS/governance*. The USC Student Conduct Code prohibits plagiarism. Some examples of what is not allowed by the conduct code: copying all or part of someone else's work (by hand or by looking at others' files, either secretly or if shown), and submitting it as your own; giving another student in the class a copy of your assignment solution; consulting with another student during an exam. If you have questions about what is allowed, please discuss it with the instructor.

Students who violate University standards of academic integrity are subject to disciplinary sanctions, including failure in the course and suspension from the University. Since dishonesty in any form harms the individual, other students, and the University, policies on academic integrity will be strictly enforced. We expect you to familiarize yourself with the Academic Integrity guidelines found in the current SCampus.

Violations of the Student Conduct Code will be filed with the Office of Student Conduct, and appropriate sanctions will be given.

Disability Policy Statement:

Any Student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to TA) as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m. - 5:00 p.m., Monday through Friday. The phone number for DSP is (213)740-0776.