MUS109IA:
Introduction to Micro-Structural Composition and Sound Synthesis

Fall 2022

I. Instructor - Myungin Lee
(Advisor - Dr. JoAnn Kuchera-Morin)

II. Time
Tuesday/Thursday 10:00AM-11:50 AM

Following the Fall quarter instruction guidance,
the fall quarter class will be conducted in person.

Classroom: Elings 2611, Experimental Visualization Lab

At this time, the only exceptions to this policy are for serious medical conditions, which may result in a temporary remote teaching accommodation granted to an instructor by the University through a formal process.
The student who wants to participate remotely should individually contact to the instructor to request a hybrid session **a day before the class with the proof of medical conditions**.

III. Helpful Web Links
- AlloLib: https://github.com/AlloSphere-Research-Group/allolib_playground
- C++: http://www.cplusplus.com/doc/tutorial/
- Archive: https://www.myunginlee.com/spring-2022

IV. Lecture Schedule	**Reading & Assignment For Next Lecture**
1. 09/27 (Week 1-1) · Instructor and the AlloSphere Research Group's introduction · Course Description - Review syllabus · Install the software for this course · Brief history of computer music from mainframes to workstations;	Sound Representation = · ROADS- A COMPUTER MUSIC TUTORIAL pp.14-44 · MOORE- ELEMENTS OF COMPUTER MUSIC pp.27-56
2. 09/29 (Week 1-2) · How do computers make music? · Analog to digital and digital to analog conversion systems, introduction to the sampling theorem (aliasing and quantization error) · Digital sound storage and manipulation; sound signal basics = sound representation (analog	Sound Representation (continued) = · ROADS- A COMPUTER MUSIC TUTORIAL pp. 14-44 · MOORE- ELEMENTS OF COMPUTER MUSIC pp.27-56 (Roads 14-44 & Moore 27-56) Acoustics · DODGE (pp.25-61)

representations, transducers, noise distortion, recording) · Digital Audio - sound digitization = ADC/DAC conversion systems, pulse code modulation, sampling theorem (in detail), aliasing, linear quantization, encoding, non linear quantization, digital signal characteristics, digital waveforms	Psychoacoustics · ROADS - COMPUTER MUSIC TUTORIAL, Part VII; and MOORE-, ELEMENTS OF COMPUTER MUSIC (pp.17-23)
3. 10/04 (Week 2-1) · Start acoustics = waveform characteristics, periodic and aperiodic waveforms, spectrum characteristics · Discussion acoustics and psychoacoustics · Digital signal flow diagrams; start discussion of program subroutines for sound generation and sound modification = the table lookup oscillator, noise generators, envelope generators, digital filters; *AlloLib* program design overview = *AlloLib* general discussion Synth 1 instr	· Oscillators, amps, envelope generators etc.... read MOORE (pp.150-175) & ROADS (pp .87-107) · *AlloLib* Documentation · **Make envelope composition Assignment #1**
4. 10/06 (Week 2-2) · Listening and Analysis = Ligeti – Atmospheres (envelopes and waveforms) · Finish AlloLib score, finish discussion of sound generation and sound modification, · Synth 1 instr (cont) · Listening and Analysis = Varese - Octandre Schoenberg – Farben	· Format scores for Synth instr 1 · Synth instr 1 assignment (cont.) · *AlloLib* Documentation · **Make envelope composition Assignment #1** · Sub-audio FM = MOORE (pp.198-203)
5. 10/11 (Week 3-1) · Discuss Synth 2 instr · **Assignment #1 due. Share assignments** · Synth 2 instr continued · Discuss assignment #2, Waveforms · Computer Music Instrument Design - begin discussion of digital sound synthesis applications = detailed discussion of sub-audio frequency modulation and and AlloLib code for	· Make waveform composition **#2** · *AlloLib* Documentation · Sub-audio FM = · MOORE (pp.198-203)(cont) · *AlloLib* Documentation · Continue working on **Assignment #2**

note list parametric data input to sub-audio fm instr (Synth 3 instr)	
6. 10/13 (Week 3-2) · Sub-audio FM continued = Synth 3 instr · Listening and Analysis – Penderecki	· Continue working on **Assignment #2** using vibrato instr, making use of various vibrato experiments; · Read ROADS = audio FM (pp.224-239), MOORE(pp.316-329)
7. 10/18 (Week 4-1) **Assignment #2 due = waveforms** · Finish sub-audio FM = Synth 3 instr · Begin Audio FM discussion · *AlloLib* fm instr note list	· Make a small composition(#3) · Read ROADS= audio FM (pp.224-239), MOORE (pp.316-329) FM (pp.224-239), MOORE (pp.316-329) AM – MOORE (pp.185-189) and ROADS (pp. 215-224)
8. 10/20 (Week 4-2) · Detailed discussion of audio frequency modulation and *AlloLib* code for notelist, pfield data input to the audio FM. · Begin Listening to audio FM pieces (Chowning – Stria, Phonee)	· **Make vibrato composition #3**
9. 10/25 (Week 5-1) **Assignment #3 due = vibrato** · Audio FM in detail	Begin working on **Assignment #4**
10. 10/27 (Week 5-2) · Audio FM in detail · Compositional Process and Listening; · Various audio examples of computer music which demonstrate various computer synthesis techniques (Chowning – Stria, Phonee)	· Work on **Assignment #4,** and reading, AM – MOORE (pp. 185-189) ROADS (pp. 215-224)
11. 11/01 (Week 6-1) · Computer Music Instrument Design continued- · Detailed discussion of audio frequency modulation and *AlloLib* code for notelist pfield data input to the audio fm computer program	· Keep working on **Assignment #4,** · Continue reading
12. 11/03 (Week 6-2) **Assignment #4 due = audio FM** · Computer Music Instrument Design continued- · Begin discussion sub-audio & audio amplitude modulation	· Work on **Assignment #5,** · Continue reading - AM – MOORE (pp. 185-189) read MOORE - additive synthesis Learn sub-audio and audio AM

13. 11/08 (Week 7-1) · Discuss amplitude modulation, sub-audio & audio, amplitude modulation computer programs. · Begin Fourier synthesis	· Learn Additive Synthesis · Use additive synthesis and AM instrs for **Assignment #5**
14. 11/10 (Week 7-2) · Discuss Fourier synthesis computer program pertaining to synthesis discussion · Listening- AM and additive synthesis	· Work on projects = · Add synth/AM project **Assignment #5** AM /Addsyn
15. 11/15 (Week 8-1) **Assignment #5 due = AM/Addsynth** · Subtractive synthesis, filters, noise and complex waveforms	BEGIN WORKING ON FINAL PROJECTS · Read ROADS (pp. 184-197) & MOORE (pp. 263-278)
16. 11/17 (Week 8-2) · Noise, Harmonic Spectra, Filters = Subtractive Synthesis	ROADS (pp.432-440) **Assignment #6 Final Project proposal**
17. 11/22 (Week 9-1) · Physical Modeling - Plucked String Algorithm · Processing Effects - Fixed and Variable · **Assignment #6 due** **Final Project proposal presentation**	ROADS (pp.451-486) MOORE (pp.340-353, 359-360, 369-376, 377-380)
18. 11/24 (Week 9-2) Separate meetings = discuss projects (Graded Progress reports)	Continue working and listening
19. 11/29 (Week 10-1) Separate meetings = discuss projects (Graded Progress reports)	Continue working and listening
20. 12/01 (Week 10-2) Individual Reports = **FINAL PROJECT & DESCRIPTIONS DUE (AlloPortal Concert)**	

V. Description of Final Project

Using instruments given in class, compose a piece of your choice. (length of piece will depend on density of notes, tempo, activity, etc...)

VI. Grading

Assignment 1 = 10%, Assignment 2= 10%, Assignment 3 = 10%, Assignment 4 = 15%,

Assignment 5 = 15%, Final Presentation 10%, Final Assignment = 20%, Classroom/Lab Participation = 10%

VII. Arts Library

Texts Materials will be distributed in class or assigned from the following books:

Required Reading (Books)

ROADS, CURTIS -	A COMPUTER MUSIC TUTORIAL
MOORE, F. R -	ELEMENTS OF COMPUTER MUSIC

Other Books

Bateman, Wayne -	Introduction to Computer Music
Dodge, Charles -	Computer Music Synthesis, Composition And Performance
Howe, Hubert -	Electronic Music Synthesis
Matthews, Max -	The Technology of Computer Music
Strange, Allen -	Electronic Music Systems, Techniques & Controls
Trythall, Gilbert -	Principles and Practices of Electronic Music
Roads, Curtis -	Composing Electronic Music: A New Aesthetic

Other Articles

Chowning, John-	The Synthesis of Complex Audio Spectra by means of Frequency Modulation
Chowning, John -	The Simulation of Moving Sound Sources
Moore, F.R. -	An Introduction to the Mathematics of Digital Signal Processing, Part I
Moore, F.R. -	An Introduction to the Mathematics of Digital Signal Processing, Part II
Moore, F.R. -	Music Signal Processing in a Unix Environment
Moorer J.A	How do Computers Make Music?
Moorer, J.A. -	Signal Processing Aspects of Computer Music
Moorer, J.A. -	About this Reverberation Business
Moorer & Grey -	Lexicon Analyzed Tones (Part I Violin Tone)
Moorer -	Lexicon Analyzed Tones (Part II Clarinet & Oboe Tones)
Truax, B -	Organizational Techniques for C:M Ratios
Schottsteadt,B -	The Simulation of Natural Tones Using Frequency Modulation with a Complex Modulating Wave
Truax, B -	Timbral Construction in Arrays as a Stochastic Process

VIII. List of Important works from Past History

Albright,W	LAST RITES
Arel,Bulent	MIMIANA II: FREIZE

Appleton,Jon	CHEF D'OEUVRE
Appleton,Jon	Of A TONGA
Babbit,Milton	ENSEMBLES FOR SYNTHESIZER
Babbit,M	COMPOSITION FOR SYNTH
Berio,Luciano	OMMAGIO A JOYCE
Berio Luciano	VISAGE
Boretz,Ben	GROUP VARIATIONS
Chowning, J.	PHONEE
Chowning, J.	STRIA
Chowning, J.	TURENAS
Davidovsky,M.	ELECTRONIC STUDY I
Davidovsky,M	SYNCHRONISM 6
Dodge,Charles	THE EARTH'S MAGNETIC FIELD
Druckman,Jacob	SYNAPSE
Druckman,J	ANIMUS II
Leedy,Douglas	ENTROPICAL PARADISE
Ligeti,Georgy	ARTICULATION
Lucier,Alvin	NORTH AMERICAN TIME CAPSULE
McLean,Prisc.	DANCE OF DAWN
McLean,Bart	SPIRALS
Martirano,S.	UNDERWORLD
Oliveros,P	I OF IV
Randall,J.K	LYRIC VARIATIONS
Reich,Steve	COME OUT
Risset,Jean C	MUTATIONS
Rudin,Andrew	TRAGEODIA
Stockhausen,Kh	GESANG DER JUNGLINGE
Stockhausen,K	HYMNEN
Stockhausen,Kh	KONTAKTE
Stockhausen,Kh	KURZWELLEN
Stockhausen,Kh	Mikrophonie I/II
Stockhausen,Kh	TELEMUSIK
Subotnick,M	SIDEWINDER
Subotnick,M	SILVER APPLES
Subotnick,M	TOUCH
Varese,Edgar	POEME ELECTRONIQUE
Vercoe,Barry	SYNTHESIZM
Wuorinen, Ch	TIME'S ENCOMIUM
Wilson, Georg e	EXIGENCIES
Xenakis, I	ORIENT-OCCIDENT