2020 ATMI National Conference
Virtual

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Integrating Music and Genetics through Sonification and Data-Driven Music Composition

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Abstract

This paper presentation will describe a semester-long interdisciplinary research experience for university-level student composers and biologists that is co-taught by a music professor and a biology professor. A part of the Mutational Music Project, this unique beyond-the-classroom experience integrates scientific research in genetics with creative activity in music technology. Composers use techniques from the fields of sonification, algorithmic composition, and data-driven music to assist the biologists in the sonic realization of their projects. Working in groups that pair composers with biologists, the students are asked to create a project that addresses the following question: In what way(s) can basic processes of genetics and evolutionary biology (especially mutation) be effectively represented through musical processes? The presentation will provide an overview of the course and discussion of the technological tools and methodologies employed, as well as selected project examples.

A website for this presentation is available at:

https://reginaldbain.com/atmi20/

University of South Carolina Courses

DUDYCHA BIOL 599
Topics in Biology: Chords and Codons, MW 2:20-3:35 pm
Coker Life Science Building, R202
Syllabus: Available on the presentation website

BAIN MUSC 540/(737)
(Advanced) Projects in Computer Music, TBA
Music Building, Computer Music Studio B, R011
Syllabus: Available on the presentation website

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Interdisciplinary Research Experience Overview

The schedule below lists the combined activities from BIOL 599 & MUSC 540/(737). For a complete listing of activities see the Spring 2020 BIOL 599 and MUSC 540 syllabi, respectively.

SPRING 2020

Introductory Lectures/Activities	
Mon., Jan. 13	Bio 1: Course Introduction
Wed., Jan. 15	Music 1: Music as Organized Sound
Wed., Jan. 22	Bio 2: Genetics Review
Mon., Jan. 27	Music 2: Sonification and Data-Driven Music
Wed., Jan. 29	Bio 3: Mutation
Mon., Feb. 3	Music 3: Mutational Music Project Ideas
Meet the Composers	
Wed., Feb. 5	*Meet the Composers*
Project Brainstorming	
Mon., Feb. 17	Project Brainstorming
Wed., Feb. 19	Bio Group 1-5 Consultations
Feb. 20 - March 3	Bio-Music Group 1-5 Meetings

The biologists and composers meet in their assigned groups from this point forward.

Project Work, Progress Reports, and Consultations	
Wed., March 4	Bio Group 1-5 Status Reports
Wed., March 18	Written Progress Reports/Consultations
Wed., March 25	Written Progress Reports/Consultations
Mon., April 6	Written Progress Reports/Consultations
Mon., April 13	Written Progress Reports/Consultations
Presentation	
Mon., May 4	Bio Group 1-5 Project Presentations

Final Report – Due: Wed., May 6, at noon

Music Lectures

The three music lectures covered:

Lecture 1: Music as Organized Sound

- Music as "organized sound" (Varese and Wen-Chung 1966)
- Music as: perceived, encoded script, number, and data (LaRue 1970; Hofstadter 1979)
    - Musical Instrument Digital Interface – https://www.midi.org
- Algorithmic composition (Nierhaus 2009; McLean and Dean 2018)
    - Mozart's musical dice game (Gardner 1974)
    - Computational thinking in music (Wing 2006; Edwards 2011)

Lecture 2: Sonification and Data-Driven Music

- The harmony of the spheres (Goodstein 2003)
- Sonification (Kramer 1994, Kramer et al. 1997; Hermann et al. 2011; Worrall 2009 & 2019)
- Data-driven music (Scaletti 2016; Vickers 2016)
- Gene music (Hayashi and Munakata 1984; Munakata and Hayashi 1995)
    - Also: Takahashi and Miller 2007; McCormack et al. 2009; Taylor 2017; Temple 2017

Lecture 3: Mutational Music Project Ideas

- "Music as a gradual process" (Reich 1968)
- Visualizing data (Koblin 2009; Kuchera-Morin 2009)
- Survey of previous research in music and genetics (Bain)
- Parameter-based sonification using Cycling '74's Max & MIDI (Bain)
    - Cycling 74's Max – https://cycling74.com/products/max

Student Projects

The research experience was offered during the Spring 2018 and Spring 2020 terms. The collaborative biologist-composer research groups produced the following projects:

SPRING 2020

Group	Biologists	Composers	Title/Description
1	Libby Davenport Patrick Lawson	Ian Jones Jacob Wylie	*The Harmonic Balance of Eat or Be Eaten*
2	Kate Bothe Michelle St. John	Bryce Owens Graeme Rosner	Algorithmically-derived jazz from amino acid data
3	Jacob Brock Dexter Reasons	Elizabeth Greener Hunter Vowell	*Mutations Sonified in a Fugue*
4	Rishi Suresh Frank Webb	Andrew Gretzinger Peter Underhill	*Cytochrome B Sonification using BLOSUM*
5	Abby Askins Jack Gabel	Te-Wei Huang Jesse Kaiser	*What Does Parkinson's Sound Like?*

SPRING 2018

Group	Biologists	Composers	Title/Description
1	Lauren Huffmire Kathryn Metts	Thomas Palmer Morgan Soard	A genetic sequence is directly mapped to a chord progression while implementing the properties of various mutations
2	Zach Spicer Matthew Waller	Ryan Williams	*Waltz Toward Disaster: A Representation of the Accumulation of Mutations Over Time*
3	Rachel May Joel Strom	Michael VanBuhler Robert Wilkenson	A familiar melody is altered according to the rules of genetic mutation
4	Lexi Dickson Olivia Harris	Jacob Wylie	*Hearing the Silent: Musically Expressing Intronic Mutations*

Tools

Software tools used in the student projects include:

- **Notation Programs**
  Avid's Sibelius <https://www.avid.com/music-writing-software>
  MakeMusic's Finale <https://www.finalemusic.com>
  MuseScore <https://musescore.org/en>
  Steinberg's Dorico <https://new.steinberg.net/dorico/>

- **DAWs**
  Ableton Live <https://www.ableton.com/en/live/>
  Apple's Logic Pro X <https://www.apple.com/logic-pro/>
  Reason Studios' Reason <https://www.reasonstudios.com/en/reason>

- **Programming**
  Cycling '74's Max <https://cycling74.com/products/max>
  IRCAM's OpenMusic <http://repmus.ircam.fr/openmusic/home>

- **Audio Editing/Recording**
  Avid's ProTools <https://www.avid.com/pro-tools>

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