Computing in the Arts: Music, Art, and Computation

Workshop 1

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<tr>
<th>Bill Manaris and Marian Mazzone</th>
<th>Jennifer Burg</th>
<th>Susan Reiser and Rebecca Bruce</th>
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<tr>
<td>College of Charleston</td>
<td>Wake Forest University</td>
<td>UNC Asheville</td>
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<td>Wake Forest University</td>
<td>Winston-Salem, NC</td>
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This workshop is funded by a National Science Foundation TUES grant DUE 1323593, Transforming Undergraduate Education Type 2 Project.
Goals of the grant

• Leverage synergistic research and programs at partner institutions
• Refine the notion of creative computational problem solving in the visual arts, music, theatre, and performance arts;
• Create instructional material that gives a substantive foundation to cita;
• Continue to develop courses and instructional material that synthesize the learning experiences of students coming from different art areas
• Disseminate the model program, instructional methods, and material to other schools
Focus

- Share **curriculum material** already available
- Share ideas for **synthesis projects** that maximize the synergy between students of different backgrounds as they collaborate
- Share ideas regarding the **initiation and development of computing in the arts programs**.
Example Synthesis Experiences and Projects

- Sculpting sound with MATLAB and Octave
- Developing interactive computer music applications in Python.
- Share ideas regarding the initiation and development of computing in the arts programs.
- Fabricating of a mini-keyboard instrument using a 555 timer housed in an Altoid tin.
- Experimenting with data visualization.
DIGITAL SOUND & MUSIC
CONCEPTS, APPLICATIONS, AND SCIENCE
with...

DIVERSE LEARNING SUPPLEMENTS

INTERACTIVE TUTORIALS & DEMOS

& HANDS ON PRACTICAL EXERCISES

FLASH TUTORIALS
MAX DEMOS
MATLAB EXAMPLES
PROGRAMMING ASSIGNMENTS
PRACTICAL EXERCISES
VIDEO DEMOS

Linking Science, Art, and Practice Through Digital Sound

Using examples from theatre, movies, music production, & more, our curriculum tackles the science and mathematics of digital sound in a practical, applicable way.
The Interdisciplinary Nature of Computing in the Arts

- Music
- Theatre
- Visual arts
- Performance arts
- Computer science
- Mathematics
- Physics
- Engineering
- Electronics
Basic Concepts
Synthesized in my Courses

• Physics and mathematics
  o The sense in which sound is a wave (Section 2.1.1)
  o Sine wave modeling single-frequency sounds (Sections 2.1.2, 2.3.3)
  o Frequency and amplitude of a wave (Section 2.1.2)
  o Sound waves with multiple frequency components (Sections 2.2.2, 2.2.3)
  o Square, sawtooth, and triangle waves (Sections 2.2.4, 2.3.3)
Basic Concepts

Synthesized in my Courses

• Computer Science and Digital Media
  o Analog vs. digital (Sections 1.4.1, 2.1.5)
  o Digitizing sound (Section 5.1.2)
  o Sampling and quantization (Section 5.1.2)
  o Programming concepts and structures
    • Variables
    • Expressions
    • Assignment statements
    • Conditional statements (if/else)
    • Iteration (for and while loops)
    • Functions and parameters
    • Libraries
Basic Concepts

Synthesized in my Courses

• Music theory and the mathematics of music
  o Pitch and frequency, tones and notes (Section 3.1.2)
  o Amplitude and loudness
  o Scales and keys (Sections 3.1.4, 3.1.5.5, 3.1.5.6)
  o The frequency relationships between neighboring semi-tones and octaves (Sections 3.1.2, 3.1.4)
  o Intervals and chords (Section 3.1.6.2, 3.1.6.3, 3.1.6.4)
  o The frequency relationships between a fundamental frequency and its overtones (Section 2.1.4.1)
  o Melody and harmony (3.1.6.2)
  o Chord progressions (3.1.6.4)
What’s Missing in the Art Component, as I Teach these Courses

- Design
- Composition
- Aesthetics
We’re Throwing You Right in the Water!

“Sculpting Sound in MATLAB and Octave”

Students would not be thrown into the middle of this assignment so abruptly. They’d have already have background from their respective disciplines to bring to bear on the exercise. They would also cover basic concepts together before beginning this project.
Dual Roles in this Workshop

• Think of yourself as a student of (computer/science/music/art) collaborating with a student of (computer/science/music/art). How difficult or interesting or relevant or effective would this assignment be for you?

• Also, view the example projects as teachers, considering how you might use, adapt, or improve the assignments.
My Badly-Focused Prompt

Make a 10 second segment of sound that

“is musical”

“sounds cool”
Getting Started

Go to MATLAB. (It should already be up and running for you and have the correct folder selected as your current folder.)

Double-click on one of the .m files in the Current Folder window. For example, singlePitchWave.m.

Cut the example function call from the comment in the program and paste it into the Command Window.

You’ll see the variable y appear in the Workspace window. This is an array of sound samples. You can add other sound components to this wave, concatenate other arrays onto it, apply LFOs for frequency and amplitude, etc.
Try making triangle, square, and sawtooth waves as well, all of different frequencies. Give the arrays different names. Then concatenate them into one sound segment called w.

```plaintext
x = sawtoothWave(262, .9, 2, 44100);

y = squareWave(330, 20, 0.9, 2, 44100);

z = triangleWave(392, 20, 0.9, 2, 44100);

w = [x, y, z];

sound(w, 44100);
```
Now try adding a LFO on amplitude for tremolo effect.

\[ y = \text{LfoAmp}(5, z, 44100); \]

You can also make a sound wave with a vibrato effect using the \textit{LfoFreq} function.

Have at it!!!!

Look through the curriculum material and experiment for the next 45 minutes. Then we’ll get together to discuss the questions.