Multidisciplinary and Interdisciplinary Faculty Collaboration

Matt Klassen and Greg Dixon

DigiPen Institute of Technology, Redmond, Washington, USA

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Goal of this talk:

- To end by 12:30 for LUNCH!!

Purpose of this talk:

- To promote collaborative, multidisciplinary faculty work as a fantastic opportunity for learning, doing research, producing creative content, and reflecting back on the teaching process.
- To give brief context and background for this type of work, and multidisciplinary vs interdisciplinary work
- To give examples from our math and music collaboration
- all content is here: https://azrael.digipen.edu/research/

Multidisciplinary Coursework:

- The hallmark of my career at DigiPen: combining Math and Computer Science
- Geometric Modeling and Splines (since 2000)
- Quaternions and Animation of Rotations (2001)
- Combinatorial Game Theory (2010)
- Mathematical Music Theory (2012)
- Digital Signal Processing (2013)
- 3D Audio Modeling (2018)
- Quantum Algorithms (2025)

Multidisciplinary means combining or involving several different academic fields of study, professional trades, or areas of expertise to address a common topic, project, or problem. In a multidisciplinary approach, experts work side by side, but each person contributes from their own specific point of view and uses the tools of their own distinct field. (thanks Gemini)

Key Features

- Separate roles: Each expert focuses on their own part of the task.
- No deep blending: Ideas from different fields do not mix together into a new single method.
- Shared goal: All team members work on the same overall problem or project.

Interdisciplinary Interdisciplinary means combining two or more academic fields, professional trades, or areas of expertise into a single, unified approach. Instead of working side-by-side on separate pieces, experts blend their methods, concepts, and data to solve complex problems that a single field cannot handle alone.

Key Features

- Blended methods: Principles from different fields merge to create a new way of thinking.
- Deep collaboration: Team members cross over boundaries to learn and use each other's tools.
- Unified solution: The final product is a seamless integration, not just a collection of separate parts.

- **Collaborative** work can be done in either of the modes *Multidisciplinary* or *Interdisciplinary*.
- **Solo** work can also be done in either of the modes *Multidisciplinary* or *Interdisciplinary*.
- Research, creative work, production, project development, can switch back and forth between these modes.
- There are many advantages and disadvantages to staying primarily in one mode or the other.
- Example: working in parallel (multidisciplinary) can be more efficient, avoid known mistakes or misunderstandings, but it can also miss out on creative opportunities or simplifications.

Research in Mathematics and Computation in Music (MCM):

In a nutshell: My work is about mathematical modeling of musical elements

- *harmony* - seventh chords, progressions, classification, group theory (2019)
- *timbre* - waveform modeling, cycle evolution, spline models (2022)
- *melody and rhythm* - cycle sampling for melodic contour (2024)
- *blending and combining* the above, polyphonic cycles (2025)
- *generation of musical fragments with a quantum circuit* (2025)

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Process for generation of musical fragments may include any of the following:

- cycle sampling of instrument samples, such as clarinet, flute, guitar
- B-spline modeling of cycles
- tone generation with cycle interpolation
- melodic fragment generation with spline contours
- blending and layering of melodic fragments
- polyphonic cycle generation
- harmonic progression and voice leading

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Examples of interdisciplinary collaboration:

- cycle evolution in one tone stretched to an entire phrase, as in Mirror Entropy (Coimbra, Portugal, MCM 2024)
- polyphonic cycle generation as an effect on pitch and timbre, as in SplineKlang (Boston, ICMC 2025)

Thank you for Listening!