Mechanics
of Dance
How do artists draw their inspiration?

**TRADITIONAL METHOD**
- Poetry
- Music
- Experiences
- Feedback usually instantaneous; can see exactly what is happening in a mirror’s reflection

**NOVEL APPROACH**
- Draw inspiration from math, science and engineering
- Feedback is more abstract and quantifiable
The Players

Who's involved?

THE TEAM
• Bowen McCauley Dance Co.
• Last Name Left Productions
• Drexel University

THE GOALS
• Create a dance piece inspired by mathematical and engineering concepts
First, a quick math refresher

- Pi (π) is an irrational number and mathematical constant
- Ratio of a circle’s circumference to its diameter
- Pi is imperative to being able to quantify and define wave equations
Pi (π) is an irrational number and mathematical constant.

Ratio of a circle’s circumference to its diameter.

Pi is imperative to being able to quantify and define wave equations.
Where can waves be found?
Simple Harmonic Motion

• Periodic motion or *oscillation*
• Repetitive, forms some sort of pattern
Lissajous Figures

• Also known as “Bowditch Curves”
• Parametric equations that deconstruct into equations of simple harmonic motion
• Lissajous figures relate to the frequency ratio of two waves and the phase lag between them
Lissajous Figures

- $\omega$ is defined as *frequency*
  - $\omega_1:\omega_2$ is the ratio between the frequencies of the two waves

- $\phi$ is defined as *phase*
  - Phase lag between waves means that they are not in sync
Lissajous Figures

• Example of how two different waves can, when plotted together, form a new, unique pattern
Lissajous Figures
Lissajous Figures
Lissajous in Music

• Initially discovered to visualize acoustic vibration phenomenon in the mid-nineteenth century
• Used to analyze single tones, chords, and musical intervals of instruments
Lissajous in Movement

- Has not been investigated until this project
- Accelerometers were used to measure acceleration in your x-, y- and z-directions
Lissajous in Movement

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![Acceleration A vs. Time](image1)

![Acceleration B vs. Time](image2)
Lissajous in Movement

- Acceleration A vs. Acceleration B forms a Lissajous figure
Lissajous in Dance

- Eight dancers
- Accelerometers were attached to various parts of the dancer’s body
  - Center of gravity
  - Ankle
  - Knee
  - Wrist
Lissajous in Dance

- Acceleration data from different dancers were recorded
- Plotted individually
- Plotted one dancer vs. another
Lissajous in Dance
Acceleration in 3-D Space

Mackenzie, acceleration, right knee

Aaron, acceleration, center of gravity
Resulting Lissajous Figure
Premiere: Dance Place, Washington, DC

Photo Credit: Jeff Malet
The Kennedy Center, Washington, DC

Performed May 17-18th 2019
The Kennedy Center, Washington, DC
Important Takeaways

• Remind young boys and girls that science and the arts are not mutually exclusive
• Continue this method in acceleration visualization analysis and apply it in other types of movements, like sports
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