

PhET Wave on a String Sim - Design Brainstorming

Background Information

Sim name: Wave on a String

Link: <http://phet.colorado.edu/en/simulation/wave-on-a-string>

Goal: Analyze the sim and brainstorm design issues (including accessibility and inclusion design issues) and possible solutions. This sim is not currently a sim being worked on as part of any grants - it's purely chosen as an example for a design exercise.

In attendance:

- Dana Ayotte
- Simon Bates
- Julia Foster
- Jesse Greenburg
- Alan Harnum
- Jonathan Hung
- Justin Obara
- Tim Park
- Sepideh Shahi
- Taliesin Smith
- Godfrey Wong

This document is a compilation of notes resulting from a meeting that occurred on July 21, 2016

Description of Sim:

Link to the sim: <http://phet.colorado.edu/en/simulation/wave-on-a-string>

- On first load, the screen shows a string of beads attached to a wrench on the left side and attached / anchored to a clamp on the right side.
- The wrench can be moved up and down with the mouse which causes a wave to travel across the string to the opposite end. The wave will rebound back.
- Other controls on the sim modify the behaviour of the wave - "damping" and "tension".
- You can change the right anchoring to be "fixed", "loose" and "no end"
- You can also change the wrench control scheme from "manual", oscillate, and pulse.

Some Challenges

- Wrench control
 - Range - controls amplitude
 - Speed of movement - controls frequency / period of waves
- Perception of string movement
- State of the sim as a result of user actions

Wrench control challenge

- The wrench controls two variables:
 - Amplitude
 - Frequency
- What would this look like as native HTML controls for keyboard and screen reader access?
 - Amplitude could be a range slider and the speed of which the slider is moved controls the frequency.
 - Raises concerns for motor control
 - Could add an accelerator key of some sort which speeds up movement on the slider.
 - Inequality in experiences: Even if you use a slider or an accelerator key, the end user experience is far from the visceral experience that someone using a mouse has.
- Could also consider having the pointer directly manipulate the wrench without having to click / depress buttons.
 - This would imply having the user switch into a special mode where the mouse / tracker acts as a wrench (i.e. shaking it would shake the wrench).
 - But the user would get into states where their mouse is controlling the wrench and not the actual cursor on the screen which could be very confusing.
 - It's also possible to use the GPII Nexus to have another device control the wrench (a proof-of-concept was made on July 22nd using the tilt sensors on an iPad Mini to control the wrench).
 - Some users can not physically use a mouse or hold another device. How would control be done in this case?

- Head tracker was mentioned but this could interfere with viewing and focussing on the wave

Perception of String Movement

- Initial thought - map the wave created by the string directly to sound as a way of sonifying the data. But there are some issues:
 - How would you sonify the situation where the wave bounces back from the end point?
 - It's possible to have a complicated scenario where the user reduces the tension and damping to 0, and create multiple waves. The waves are constantly colliding and passing through each other - what would this even sound like?
 - The sound of the waves still have to sound nice (even when multiple waves collide)
 - What would the sound differences be for fixed, loose, and open ended?
 - Using volume, pitch to represent amplitude and repetition to represent frequency was suggested
- Is it useful to sonify a single fixed point on the string?
- How can haptics be used?
 - Something like a braille device where you can feel the waves.
- What are the most necessary pieces of information that need to be perceived? (what is the main objective of the physics sim? Understanding concepts or completing calculations?)