

Force and Acceleration in Virtual Reality Simulations with Haptic Cues

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Outline

- Why bother?
- The VR Environment
- Demonstration
- Applications for Instruction
- Preliminary Research
- The Future

Why bother?

- Lab experiences have important weaknesses.
 - limited room
 - real-world complications
- Existing simulations are inadequate.
 - artificial
 - technical
 - non-“physical” (button pushing)
- Our simulations allow direct, physical manipulation of objects under controlled conditions.

The VR Environment

- Robust 3D environment can host almost any type of physics simulation.
 - mechanics (concrete)
 - EM fields (unfamiliar)
 - wavefunction evolution (abstract)
- Other features:
 - automatic “data” collection
 - stereoscopic 3D mode
 - *joystick input*

Haptic Cues

- Why a joystick input?
 - requires constant interaction
 - staves off detachment from the simulation
 - allows students to “feel” the simulated object
 - closer to everyday experiences

Demonstration

- Linear motion module.

Applications for Instruction

- Can be used as a supplement or even a “replacement” for some lab activities.
 - 1D motion simulation does everything a single-cart air track lab does
- Viable as a demonstration tool.
- Good for simply “playing around” with.

Preliminary Research

- Simulation exposure so far:
 - department open houses for high school and elementary school students
 - one-on-one sessions with algebra-based intro physics students
- Typical questions:
 - From rest, reach and maintain a constant speed.
 - Apply a constant force.
 - Predict the velocity graph given this force graph.

Preliminary Research

- Reaction to the simulations is highly favorable. Students report that they are helpful, and they are seen as “fun”.
- However, preliminary study of effects on learning is inconclusive.
 - very small sample
 - strong interference effects from course

The Future

- Adoption in large-enrollment course for the fall.
 - much better for studying effect on understanding
- Interactive use in lectures, allowing students to control projected simulations with their SRS transmitters.
- Study effect of simulations' contextual features.
 - i.e. change abstract block to rocket sled or ice boat, remove road and hills, etc.