Real and virtual pendulums swing as one in mixed reality state

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Using a virtual pendulum and its real-world counterpart, scientists at the University of Illinois have created the first mixed reality state in a physical system. Through bidirectional instantaneous coupling, each pendulum “sensed” the other, their motions became correlated, and the two began swinging as one.

“In a mixed reality state there is no clear boundary between the real system and the virtual system,” said U. of I. physicist Alfred Hubler. “The line blurs between what’s real and what isn’t.”

In the experiment, Hubler and graduate student Vadas Gintautas connected a mechanical pendulum to a virtual one that moved under time-tested equations of motion. The researchers sent data about the real pendulum to the virtual one, and sent information about the virtual pendulum to a motor that influenced motion of the real pendulum.

When the lengths of the two pendulums were dissimilar, they remained in a dual reality state of uncorrelated motion and both soon came to rest.

When the lengths of the pendulums were similar, however, they “suddenly noticed each other, synchronized their motions, and danced together indefinitely,” said Hubler, who also is affiliated with the U. of I. Center for Complex Systems Research.

In this mixed reality state, the real pendulum and the virtual pendulum moved together as one.

While mechanical pendulums have been coupled with springs to create correlated motion in the past, this is the first time a mechanical system has been coupled with a virtual system. The resulting mixed reality state was made possible by the computational speed of current computer technology.

“Computers are now fast enough that we can detect the position of the real pendulum, compute the dynamics of the virtual pendulum, and compute appropriate feedback to the real pendulum, all in real time,” said Hubler, who will describe the experiment and discuss potential ramifications at the annual meeting of the American Physical Society, to be held in New Orleans, March 10-14.

From flight simulators to video games, virtual worlds are becoming more and more accurate depictions of the real world. There could come a point, a phase transition, where the boundary between reality and virtual reality disappears, Hubler said. And that could present problems.

For example, no longer able to determine what is real and what is not, an individual might become defensive in the real world because of a threat perceived in a virtual world.

A better understanding of this potential phase transition is needed, Hubler said. “As virtual systems continue to improve and better approximate real ones, even weak couplings – like those between real and virtual pendulums – could induce sudden transitions to mixed reality states.”

Source: University of Illinois at Urbana-Champaign