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Phase Transition of a Dynamical System with a Bi-Directional, Instantaneous Coupling to a Virtual System VADAS GINTAUTAS, ALFRED HUBLER, University of Illinois at Urbana-Champaign — As worldwide computer resources increase in power and decrease in cost, real-time simulations of physical systems are becoming increasingly prevalent, from laboratory models to stock market projections and entire "virtual worlds" in computer games. Often, these systems are meticulously designed to match real-world systems as closely as possible. We study the limiting behavior of a virtual horizontally driven pendulum coupled to its real-world counterpart, where the interaction occurs on a time scale that is much shorter than the time scale of the dynamical system. We find that if the physical parameters of the virtual system match those of the real system within a certain tolerance, there is a qualitative change in the behavior of the two-pendulum system as the strength of the coupling is increased. Applications include a new method to measure the physical parameters of a real system and the use of resonance spectroscopy to refine a computer model. As virtual systems better approximate real ones, even very weak interactions may produce unexpected and dramatic behavior. The research is supported by the National Science Foundation Grant No. NSF PHY 01-40179, NSF DMS 03-25939 ITR, and NSF DGE 03-38215.

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