The Foucault Pendulum

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Abstract

Classical mechanics is the study of objects in accordance with the laws of motion first proposed by Sir Isaac Newton. One of the richest and most interesting areas of classical mechanics is the study of non-inertial reference systems and fictitious forces. The Coriolis force is a fictitious force that arises from the rotation of the Earth. This force is what dictates the direction of weather systems such as hurricanes and cyclones, and its effects can be demonstrated with a Foucault pendulum. In Dr. TJ Hammond's attosecond condensed matter experiments lab, we have developed one such Foucault pendulum. To predict the motion of the pendulum, we derived the Lagrangian that governs the system. From these equations, it was found that at the latitude of 42.3° N in Windsor, Ontario, once left to swing, the pendulum will complete one 2π precession every 35 hours. To maintain the motion of the Foucault pendulum, the bob is made from a conducting material and an electromagnet is used to provide a force to perturb the pendulum periodically in order to keep it precessing indefinitely. We programmed an Arduino to create a feedback loop to measure and drive the pendulum motion. Until recently, feedback loops were created using analog circuits. Using the Arduino, we developed a closed-loop feedback system that we can digitally program, which is useful for a wide variety of applications such automation and self-driving cars. The Foucault Pendulum acts as a great demonstrative tool for classical mechanics, as well as displaying the function of digital feedback loops using Arduinos. Once the pendulum is started, it can be left on display for people to see, as is done in planetariums and science centres around the world.