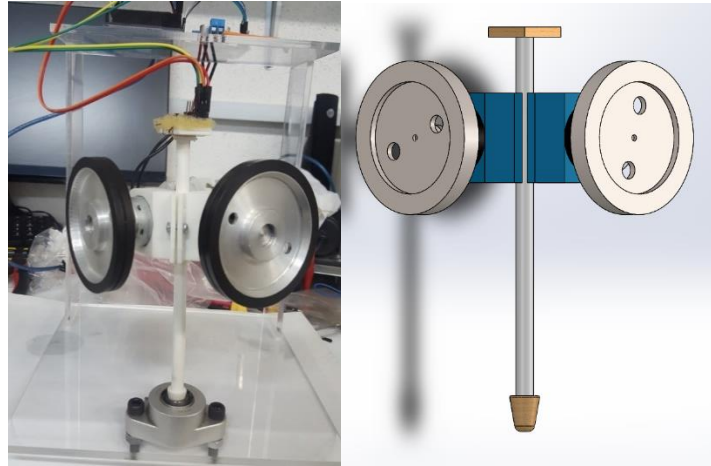


Bachelor's thesis abstract

Thesis title: Designing, Modeling, and making a 2-Axis Reaction Wheel Inverted Pendulum test-bed with Controller Design and Implementation.



Abstract

One of the most recent methods controlling an inverted pendulum is to utilize reaction wheels. These wheels are mounted on top of the pendulum rod and by rotating around the center of the rod they can apply torque to move the pendulum body in a certain direction. The 3rd law of Newton is the basis of controlling the inverted pendulum with reaction wheels.

In the outline of this project, there is body designing and primary simulations, and afterwards there is mathematical modeling and controller design for stabilizing purposes. The actual system was built after simulating the closed-loop system with designed controllers. To control the introduced plant in this project we needed precise sensory data. Therefore, beside sensor calibration, we used algorithms and filters like Kalman filter, complementary filters and observers for optimal estimation of data.

The designed controllers and algorithms are applied to the plant with an Arduino board and C++ programming language. Finally, the plant was able to maintain its balance about 22 seconds with a cascade controller.