

6-2019

## Simulation of Human Balance Control Using an Inverted Pendulum Model

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### Citation Details

Caneer, Joshua E., "Simulation of Human Balance Control Using an Inverted Pendulum Model" (2019). *Undergraduate Research & Mentoring Program*. 39.

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## Motivation

The nervous system that human beings use to control balance is remarkably adaptable to a wide variety of environments and conditions. This neural system is likely a combination of many inputs and feedback control loops working together. The ability to emulate this system of balance could be of great value in understanding and developing solutions to proprioceptive disorders and other diseases that affect the human balance control system. Additionally, the process of emulating the human balance system may also have widespread applications to the locomotion capabilities of many types of robots, in both bipedal and non-bipedal configurations.

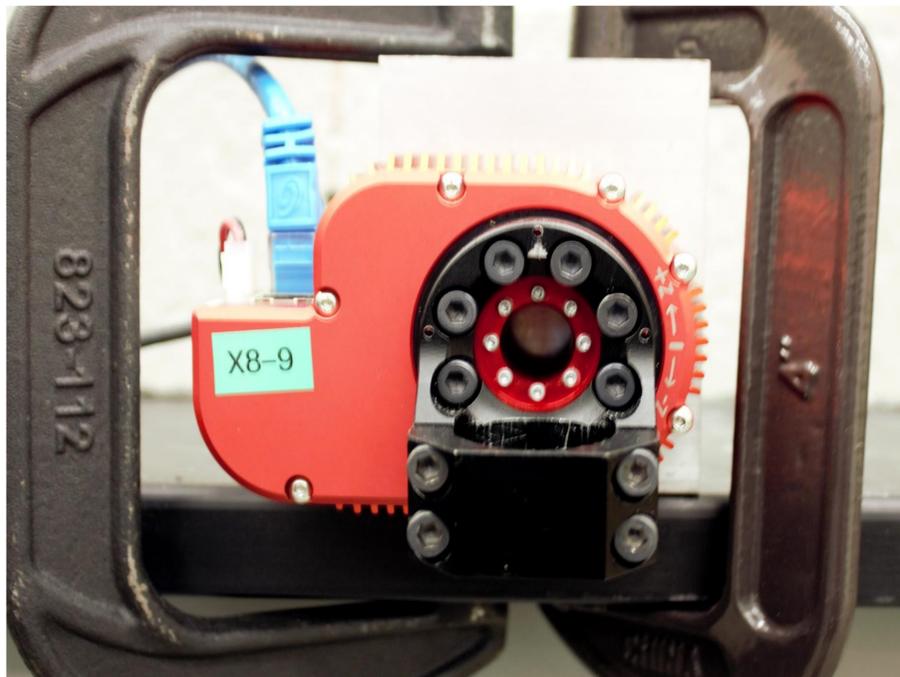


Figure 1: Actuator that simulates the ankle joint

## Acknowledgments

The authors acknowledge the support of the Maseeh College of Engineering and Computer Science (MCECS) through the Undergraduate Research and Mentoring Program (URMP)

This project is based on and is a continuation of work done by Wade W. Hilts

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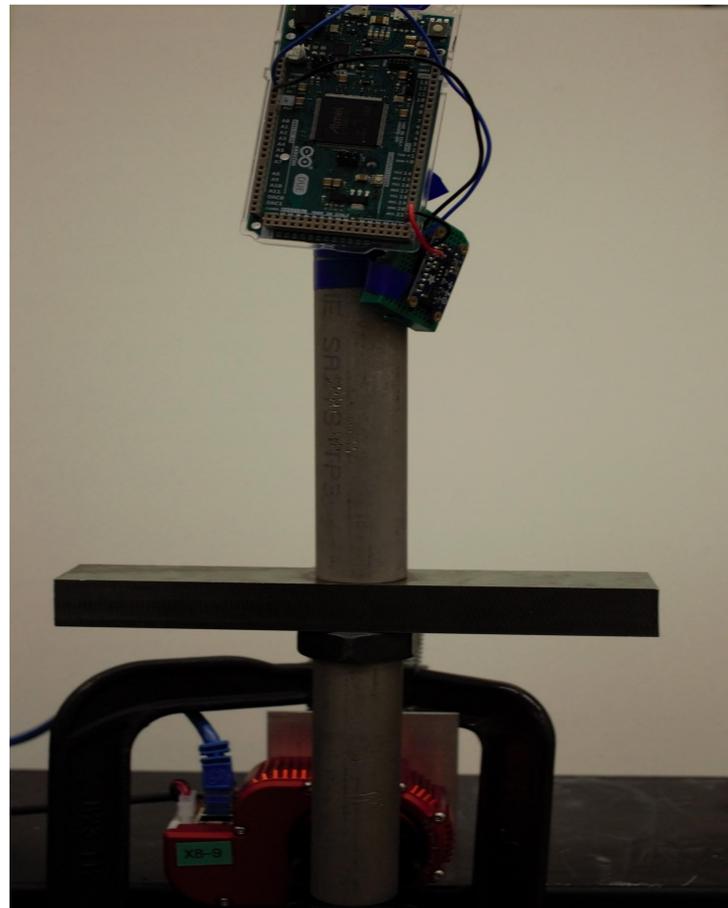


Figure 2: Complete inverted pendulum model

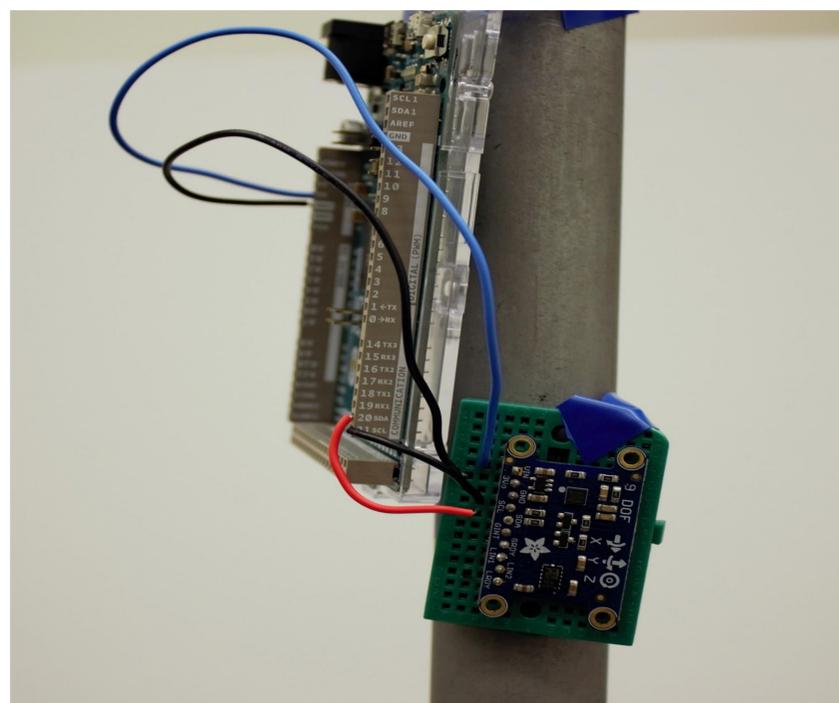
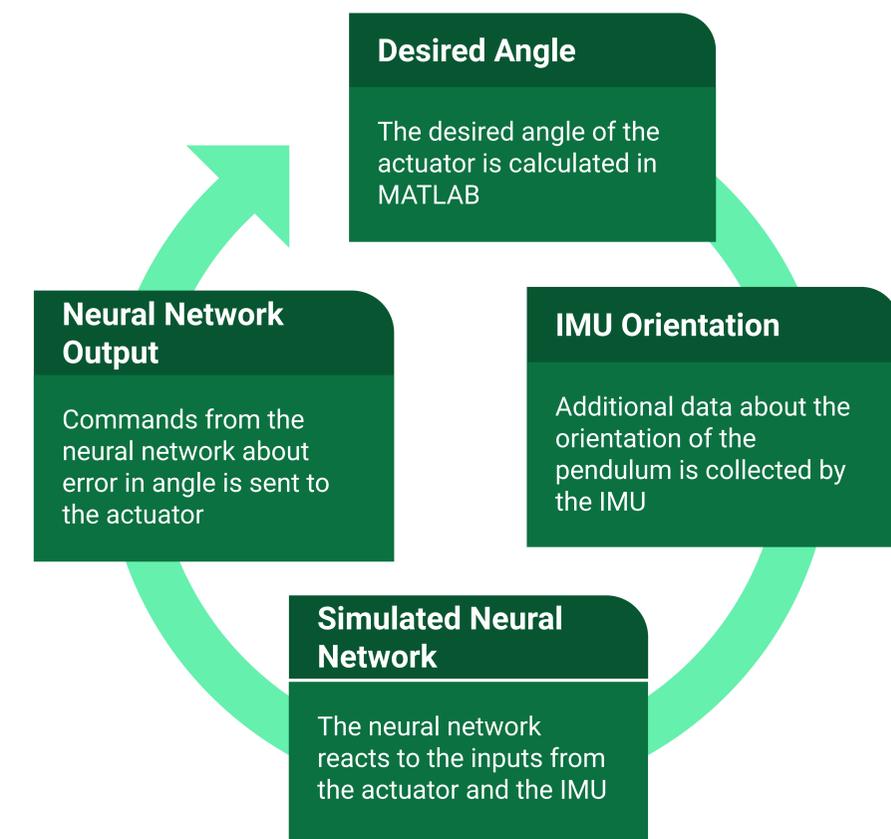


Figure 3: The IMU that simulates the vestibular system

## Neural Control Process

The work done by Wade Hilts et al. created a synthetic nervous system that applies Proportional-Derivative control to a single jointed inverted pendulum model. This model measures angular position at the ankle and applies a corrective torque to the joint to maintain an upright position of the pendulum. I added a simulated model of the vestibular system (inner ear) to this apparatus. The vestibular system model uses an inertial measurement unit (IMU) to collect data about the orientation of the pendulum which will then be applied as an additional input to the neural network simulation. The IMU data is collected by an Arduino Due microcontroller and the neural network is simulated in Animatlab.

## Control Loop and Setup



## CONTACTS

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