ADAPTABLE HOUSE: ANTI-SWAY CONTROL
MECHATRONICS

INTRODUCTION

Background

This project aims to develop a mobility assistance system for individuals with mobility challenges by providing supportive environments

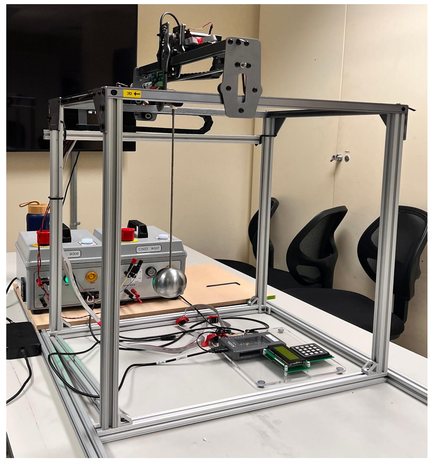

Figure 1: Desktop-Model of System

Problem Definition: The goal of Anti-Sway is to develop a system that supports lateral movement at varying levels of weight support, while providing as little hindrance to the user as possible

Design Requirements

- Safe during operation
- Provides various degrees of support
- Intuitive control (hands off when possible)

DESIGN & IMPLEMENTATION

Controls

Tracking Mode

System Follows User

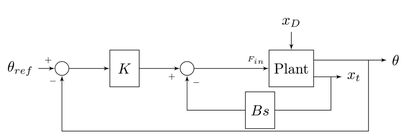

Figure 1: Tracking Mode Control Law

Anti-Sway Mode

System Follows Remote Control

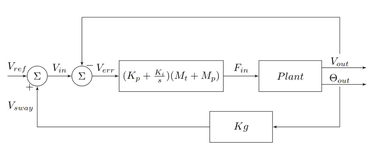

Figure 2: Anti-Sway Mode Control Law

Mechanical

Frame/Support:

- A Modified Laser Printer!!!!
- Trolley & Pendulum

Control Logic/Instruments:

- Angle Sensor
- Motor & Encoder
- MyRIO Microcontroller

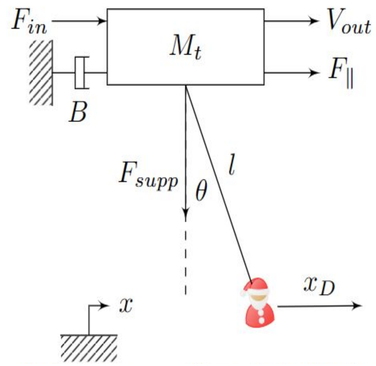

Figure 3: Free Body Diagram of Pendulum System

Electrical

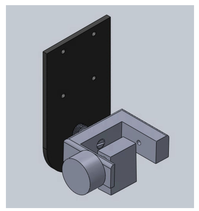

Figure 4: CAD of Potentiometer Mount

Figure 5: Potentiometer (Model STC22E)

Potentiometer (Angle):

- 1% tolerance linearity
- 6mm shaft diameter
- 10k resistor
- Amplifier Circuit to reduce noise

Figure 6: Maxon Motor 273759

Motor Requirements:

- max RPM: 1671
- max torque: 80mN*m
- max amp: 0.728 A
- max voltage: 1.775 V

Software

Features:

- Finite State (Turing) Machine to navigate Modes
- Auto Position/Angular Calibration
- Multipurpose Control Library
- Keypad Control (Anti-Sway Mode)

Limits:

- Positional: 0.350 m x 0.350 m
- Velocity: 1 m/s

```
typedef struct {
    Proportional gain;
    double prev_input;
    double prev_output;
} Integrator;
```

Figure 7: Integrator Data Structure

RESULTS/VALIDATION

Tracking Mode

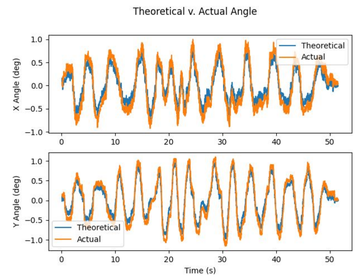

Figure 8a: Theoretical v. Experimental Tracking Mode Angle Comparison

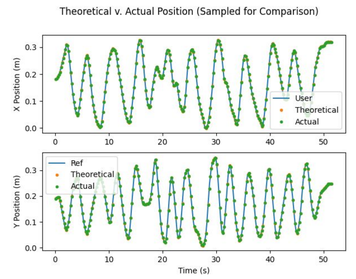

Figure 8a: User v. Theoretical v. Experimental Tracking Mode Position Comparison

Anti-Sway Mode

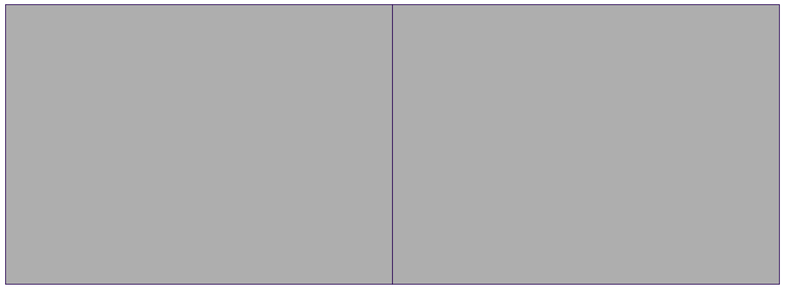

Figure 9a: Theoretical vs Experimental Data Using Anti-Sway Mode

Figure 9b: Theoretical vs Experimental Data Using Anti-Sway Mode

CONCLUSION

Capstone Outcomes

- Control Logic match theory with near negligible error
- High Accuracy sensors are necessary for controllers
- Encoder Signals fail for mysterious reason

Future Work

- Integration with Lift Control for full 3D support
  - Substitution of rod for rope
  - Data Control (Mutual Exclusion) for Parallel Modes
- Build & Test System at Full Scale

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Mechanical Engineering Capstone Exposition

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MECHANICAL ENGINEERING

UNIVERSITY of WASHINGTON