Adam Sequeira

Engineering Portfolio

Introduction

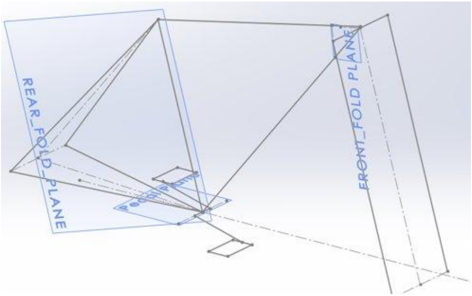
The following projects are a compilation of some of my work to allow individuals to better assess where my skills could be applied to an organization.

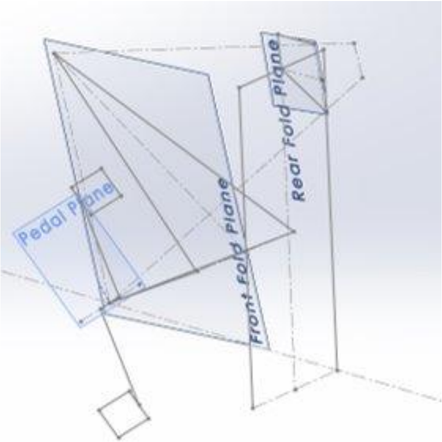
Thank you for taking the time to look through my portfolio.

Mechanical Design - Foldable Bike Frame

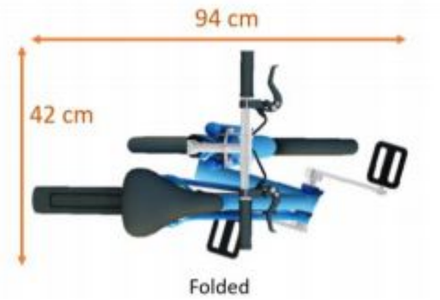
Aim: To design a folding bike frame that is able to decrease the overall area of a mount bicycle by 40% without compromising rigidity and performance.

The image to the left represents the initial concept sketch and desired outcome of the frame.



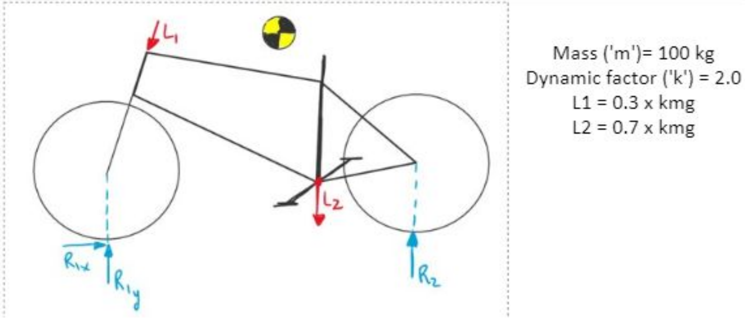


2D Wireframe models were created in Solidworks as an initial interference check.



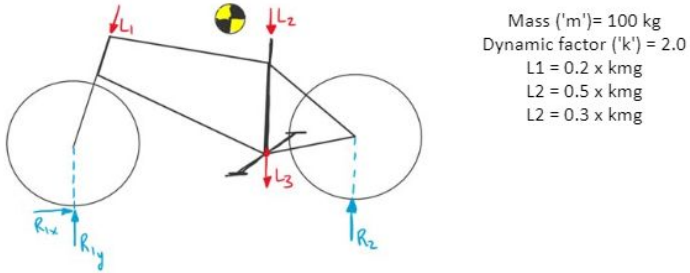
Top View Dimensions of the desired Frame Geometry

Standing Load Case

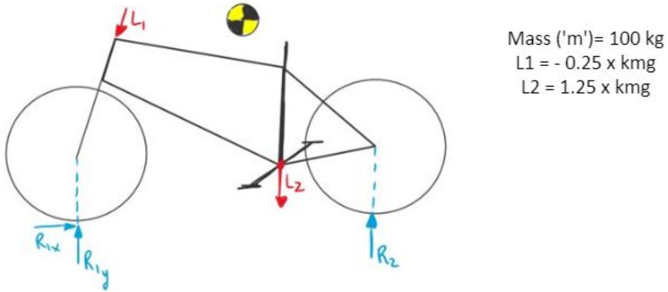


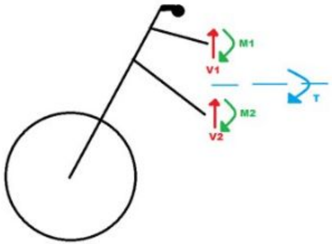
The Following Images display the unfolded load case calculations for standing and seated weight distribution as well as Torsion.A 100 kg man was the maximum capacity of the bike frame which was based on market research

Seated Load Case

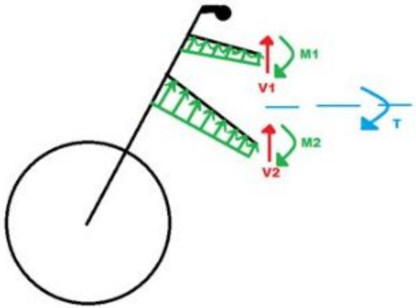


Torsion Load Case



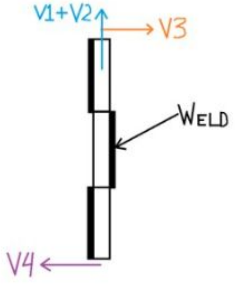


- V1(max) = 205 N (Load Case 1 - Dynamic)
- V2(max) = 307 N (Load Case 1 - Dynamic)
- M1(max) = 122 N-m (Load Case 1 - Dynamic)
- M2(max) = 155 N-m (Load Case 1 – Dynamic)
- T = 172 N-m (Load Case 3)

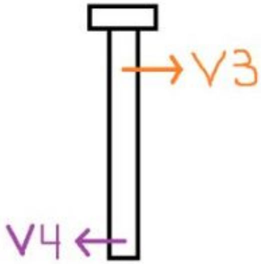


- M1(max) = 122 N-m
- M2(max) = 155 N-m

The following images denote the calculations for load on the hinge locations on the front fork of the bike frame. The hinge locations were selected based on geometry shown in the slide before. These calculations were used when deciding how to weld the hinges to the main frame.



- V1(max) = 205 N
- V2(max) = 307 N
- V3 = 1164 N
- V4 = 776 N
- Primary Shear: 5.08 MPa
- Secondary Shear: 0.31 MPa
- Welding Safety Factor (for electrode chosen): >60



- V3 = 1164 N
- V4 = 776 N
- Total Shear Stress in Pin: 9.8 MPa
- Steel Pin Allowable Shear Stress: ~300 MPa
- Factor of Safety: ~30.6

These final set of hand calculations denote the load situations on the pins and welded hinges. This calculations would be important when selecting the size of the hinge pins and the hinge itself.

Final Industrial CAD

A final industrial CAD was developed using the calculations of the each extreme load case on the frame as well as the pins. Note the hinges are essentially HSS tubing welded to the frame. Tubes are welded on each side of the HSS tubes and a metal pin with a sleeve is what allows the folding action. The back fold uses the actual seatpost as the hinge, for the purposes of a prototype this was however not done because this would require building a bike frame from scratch.

Working Prototype

The above two photographs denote a working prototype of the bike frame. A frame was used from an existing mountain bike and but and hinges were welded in the design locations. Pins were also created to meet the calculated specifications.

The images show the HSS tubing welded to the pins, the advantage of this approach as opposed to many existing folding bikes is that the HSS is thick and rigid, and the locking of the bike in the unfolded position is held by a sold stainless steel pin as opposed to traditional folding bikes which use a set screw or spring to lock the bike in place.

The final assembly after painting

Some advantages of the design is that a mountain bike can now fit comfortable in the trunk of a small sedan

Video Demonstration Link:
https://drive.google.com/open?id=1WVkw_XQFK2SF2xDpWhpCATaco1f0tyOz

https://drive.google.com/open?id=1rvdqluC6qF6GMqD7EHYrhKcdnt_FNJNx

Special Thanks To: Joshua Fernandes, Graham Waechter, Nicholas Aydemir

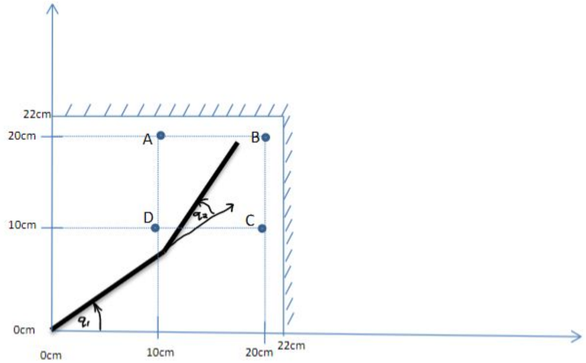
Controls Design: Two Link Manipulator Controller

Project Description: Design a Two Arm robot arm controller using MIMO techniques that will go through Points A through B while maintaining stability.

$$\tau_1 = \left[\frac{m_1 l_1^2}{3} + \frac{m_2 l_2^2}{12} + m_2\left(l_1^2 + \frac{l_2^2}{4} + l_1 l_2 \cos(q_2)\right)\right]\ddot{q}_1 + \left[\frac{m_2 l_2^2}{3} + \frac{m_2 l_1 l_2}{2}\cos(q_2)\right]\ddot{q}_2$$

$$- m_2 l_1 l_2 \sin(q_2)\dot{q}_1\dot{q}_2 - \frac{m_2 l_1 l_2 \sin(q_2)}{2}\dot{q}_2^{\,2} + \left(\frac{m_1 l_1}{2} + m_2 l_1\right) g \cos(q_1) + \frac{m_2 l_2}{2} g \cos(q_1 + q_2) + c_1 \dot{q}_1$$

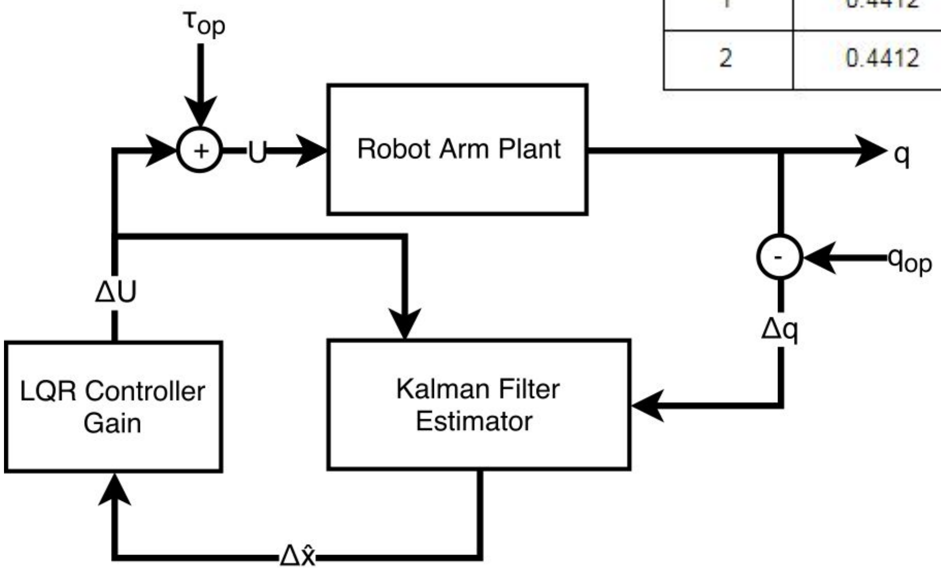
$$\tau_2 = \left[\frac{m_2 l_2^2}{3} + \frac{m_2 l_1 l_2}{2}\cos(q_2)\right]\ddot{q}_1 + \frac{m_2 l_2^2}{3}\ddot{q}_2 + \frac{m_2 l_1 l_2 \sin(q_2)}{2}\dot{q}_1^{\,2} + \frac{m_2 l_2}{2} g \cos(q_1 + q_2) + c_2 \dot{q}_2$$



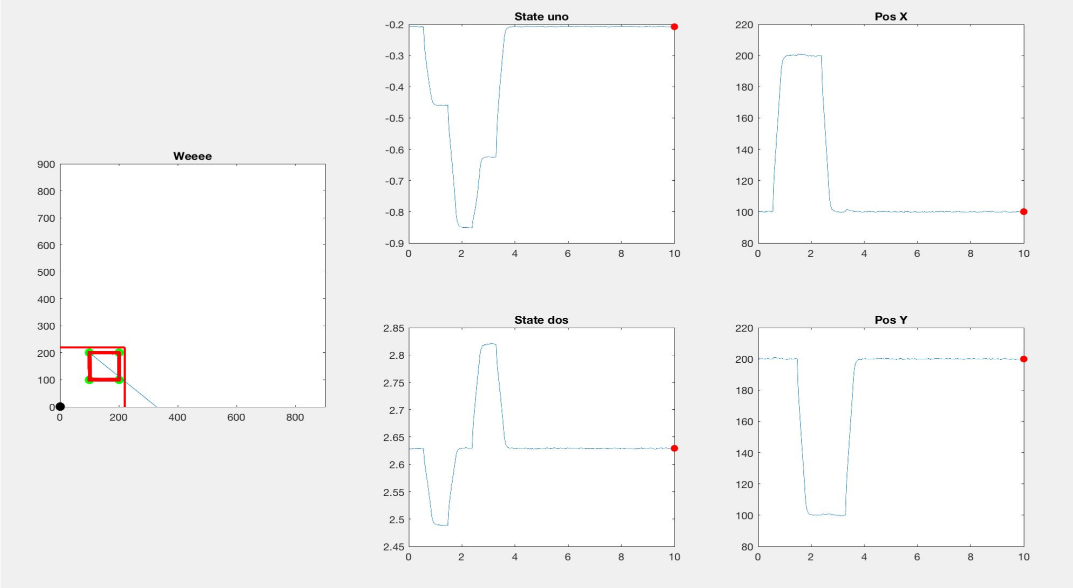
Controller Design

Table 2: Robot arm parameters

Link	Length (m)	Mass (kg)	c (N/(rad/s)	Initial q (rad)	q_dot (rad/s)
1	0.4412	0.3750	8	-0.2067	0
2	0.4412	0.3750	8	2.6278	0



Controller Simulation



Github Repository Link for Matlab Code:
https://github.com/addybrown/RobotController

Signal Processing - Gait Detection Fusion Project

Project Description: As part of an ongoing project to be able to detect the intent to walk from sensors, the goal of this project is to combine or fuse accelerometer and gyroscope data placed on the body to detect a deviation from the centre of mass.

Signal Processing - Raw Data

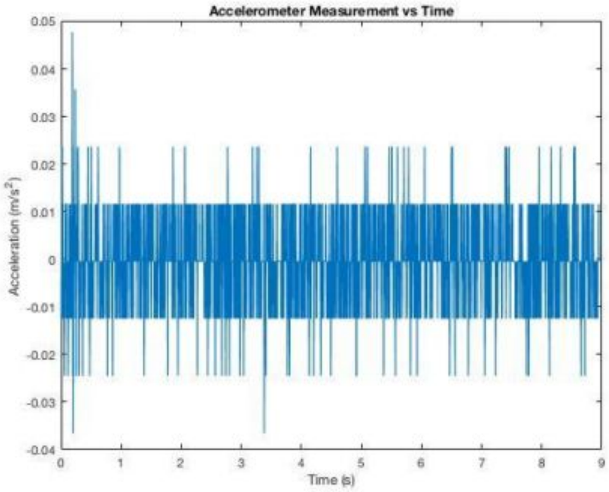


Figure 3: Noise Characterization for Accelerometer

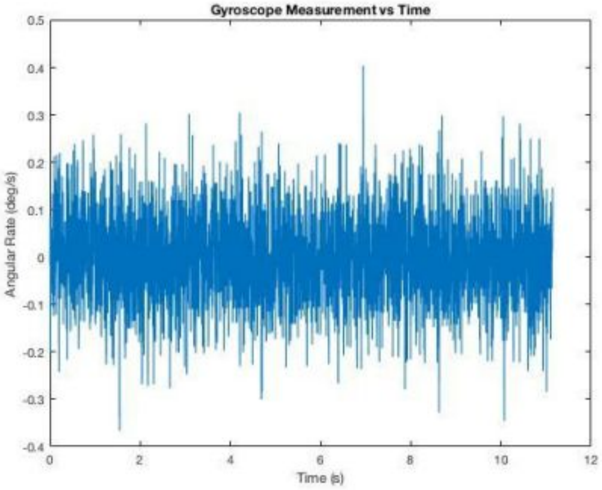
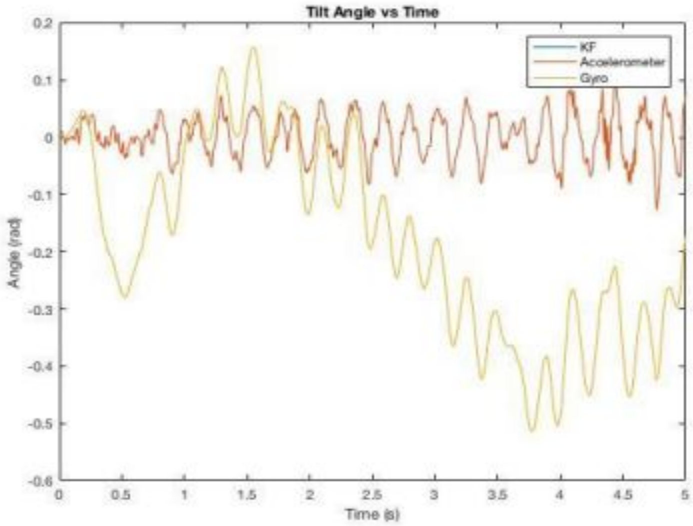
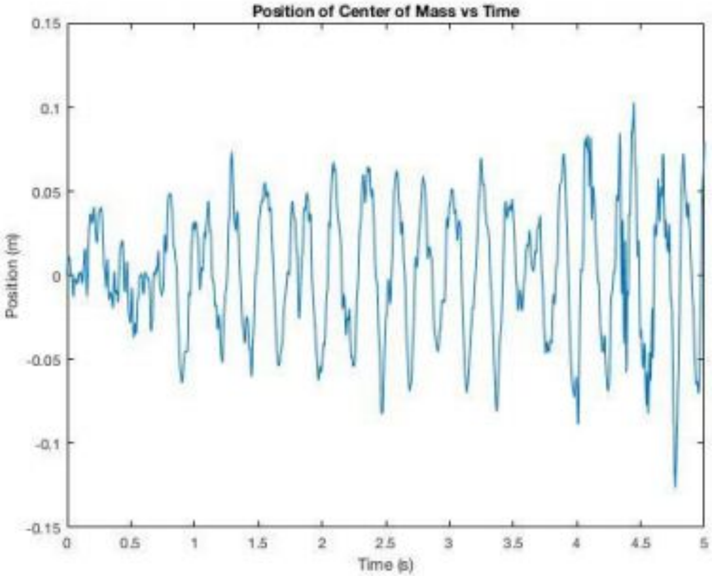


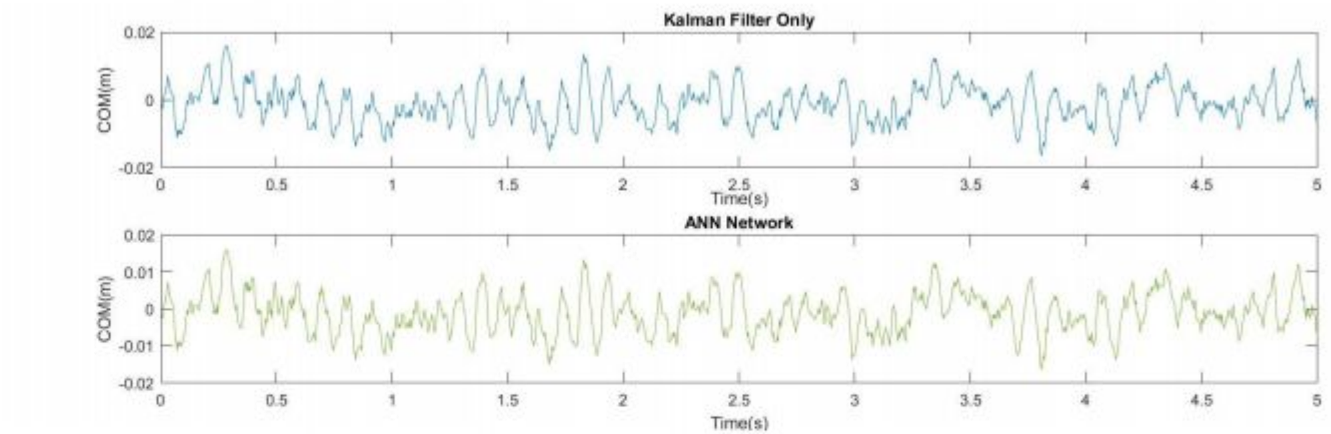
Figure 4: Noise Characterization for Gyroscope

Kalman Filter- Combined Data





Neural Network



An Artifical Neural Network was implemented to map the data from learning from the kalman filter algorithm, this ultimately saves processing time.

Please Visit Github Repository for More Info on Project:
https://github.com/addybrown/Postural-Sway-Trials

Special Thanks to Curtis Chan