Joel Gisleskog

Project Portfolio

Lerner robotic arm project:

Cross section analysis: in this project I tested the effects of changing wall thickness and length across two different geometries (circular and rectangular). To see the effects on deflection and bending stress.

Analytical Task assignment HW 4

Lerner Robotic arm #

Joel Gisleskog

project introduction:

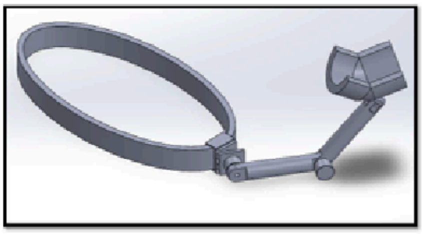
Strokes are the leading cause of upper limb disability; survivors often report loss of mobility in one arm which limits daily use. Our hope is to develop a robotic arm which could assist a client's arm so that they can move their arm with ease of use. The robotic arm will be mounted at the waist, low-profile, lightweight, and provide active gravity compensation. The end effector will be attached to the elbow. The project sponsor is Dr. Zach Lerner.

Our budget is a generous 4000 dollars, and W.L gore is largely responsible for the funding. We plan to raise at least 400 dollars as this is the fundraising minimum (10%), however we hope to raise much more.

We believe our project is important as there are over 795,00 people each year in the US who experience a stroke. Around 6,3 million people are living with stroke-related consequences in the US, and some studies suggest 40-70% of survivors are affected by arm paresis (weakness) initially, and among those around half have little function in the following 6 months. We want to help those less fortunate than ourselves and believe that helping survivors regain their independence and ability is a great cause. Additionally, although our design is focused on helping those with upper limb disability from strokes, we hope our design can help anyone with impairment in their arms.

Chosen analysis:

Our full robotic arm consists of a weighted belt, a hinge joint , 2 identical motor mounts, 2 ak45-36 Motors, 2 identical linkages, elbow joint and screws and bolts. Most pieces are 3d printed including the 2 linkages which make the bulk of the arm. Here is a rough cad model for reference:



My analysis will be focusing on the geometry of the linkages working to optimise the shape and size in order to create a comfortable functioning robotic arm.

Sensitivity analysis: in this project I elaborated on my previous work (in group reports and presentations) on forward and inverse kinematics. I determined how detrimental a change of 1 degree is in either the hinge, link1 or link 2 for the co-ordinate in space.

Individual Analytical Tasks Assignment

Joel Gisleskog

Project introduction:

Strokes often result in reduced movement or strength in one arm, which can make basic daily tasks difficult. The aim of this project is to design a wearable robotic arm that can assist a user's arm movement by partially supporting its weight and guiding motion. The device is mounted at the waist and supports the arm using two actuated links, with the end effector attached near the elbow.

Because the arm is worn directly on the body and interacts with the user's own movement, it is important that the motion feels smooth and predictable. Small errors in sensing or actuation are unavoidable, especially in a system that relies on user intent rather than precise position commands. These errors could come from motor backlash, encoder resolution, sensor noise, or small amounts of flexibility in the links.

While inverse and forward kinematics describe how the arm reaches a target position, they do not describe how sensitive the arm is to small joint errors. This analysis looks at that problem directly.

Chosen analysis:

In a previous engineering calculations report I worked on both the forward and inverse kinematics of the robotic arm. I was able to input a target co-ordinate (within the robotic arms range) and calculate the required angles for the waist hinge and each link. For this assignment I want to build on that work by carrying out a sensitivity analysis to see how much an error in joint angles effects the end effector position.

The goal of this analysis is to understand whether small angle errors, which are unavoidable in a real system, could lead to large or uncomfortable movements at the user's arm.

ANSYS FEA Analysis:

I completed 5 computational lab reports all extending on my previous ability learned in ANSYS. I learnt to do FEAS on springs, circular material, 2d heat transfer and more.

LAB REPORT 1:

ME 358-system dynamics final report:

I along with my teammate Jaime Lopez conducted a system dynamics analysis of a car suspension system.

ME 358 – System dynamics Final report – Joel Gisleskog and Jaime Lopez – Analysis of a car suspension system.

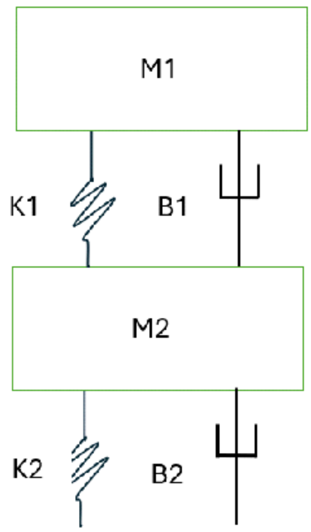
Introduction

Vehicle suspension systems are designed to reduce the transmission of road-induced vibrations to the vehicle's body. Understanding the dynamic behavior of these systems is essential for improving comfort and safety.

In this project, a simplified car suspension model for one of the wheels (quarter-car model) is developed to study the dynamics of the vehicle subjected to road disturbances.

Modelling

The model consists of two masses representing the vehicle's body (m_1) and the wheel (m_2), connected by spring and damper elements (k_1 and b_1). Vertical displacement of the road is called r(t) and there are also a spring and damping elements (k_2 and b_2) between the wheels and the ground. This simplified model of a real suspension system is commonly used in automotive engineering for suspension design and analysis.



The resultant equations of motion are the following:

$$m_1 \ddot{x}_1 + b_1(\dot{x}_1 - \dot{x}_2) + k_1(x_1 - x_2) = 0$$

$$m_2 \ddot{x}_2 - b_1(\dot{x}_1 - \dot{x}_2) + k_1(x_1 - x_2) + b_2(\dot{x}_2 - \dot{r}) + k_2(x_2 - r) = 0$$

From this we can create a state-space model: