# Upper Body Motion Mechanism

**Jacob Bernard (RBE), Ryan Kievra (RBE)**
**Advisor: Professor Mahdi Agheli (RBE/ME)**

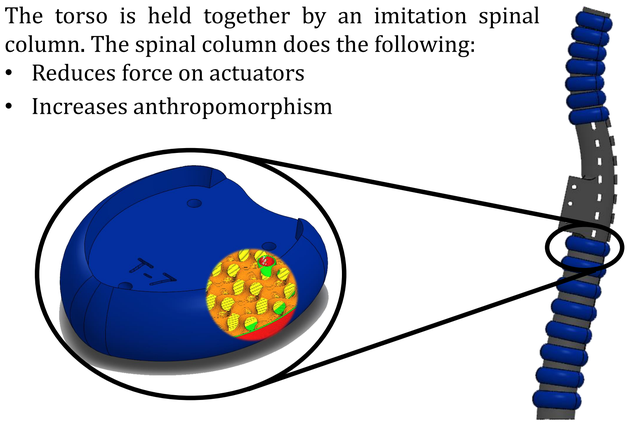
## Abstract

Humanoid robots can potentially replace humans in hazardous environments. If these robots can imitate humans with precision, they can also be utilized in a variety of other fields where they can collaborate with humans. The objective of this initiative was to create a novel torso mechanism that could be utilized in a humanoid robot. The newly created mechanism can move in flexion/extension, lateral flexion, and rotation, much like a human torso. It also includes a unique imitation spine that lessens the force on the torso actuators while contributing to the robot's anthropomorphism.

## Spinal Column

The torso is held together by an imitation spinal column. The spinal column does the following:

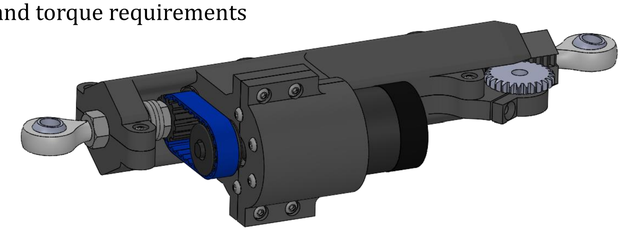
- Reduces force on actuators
- Increases anthropomorphism

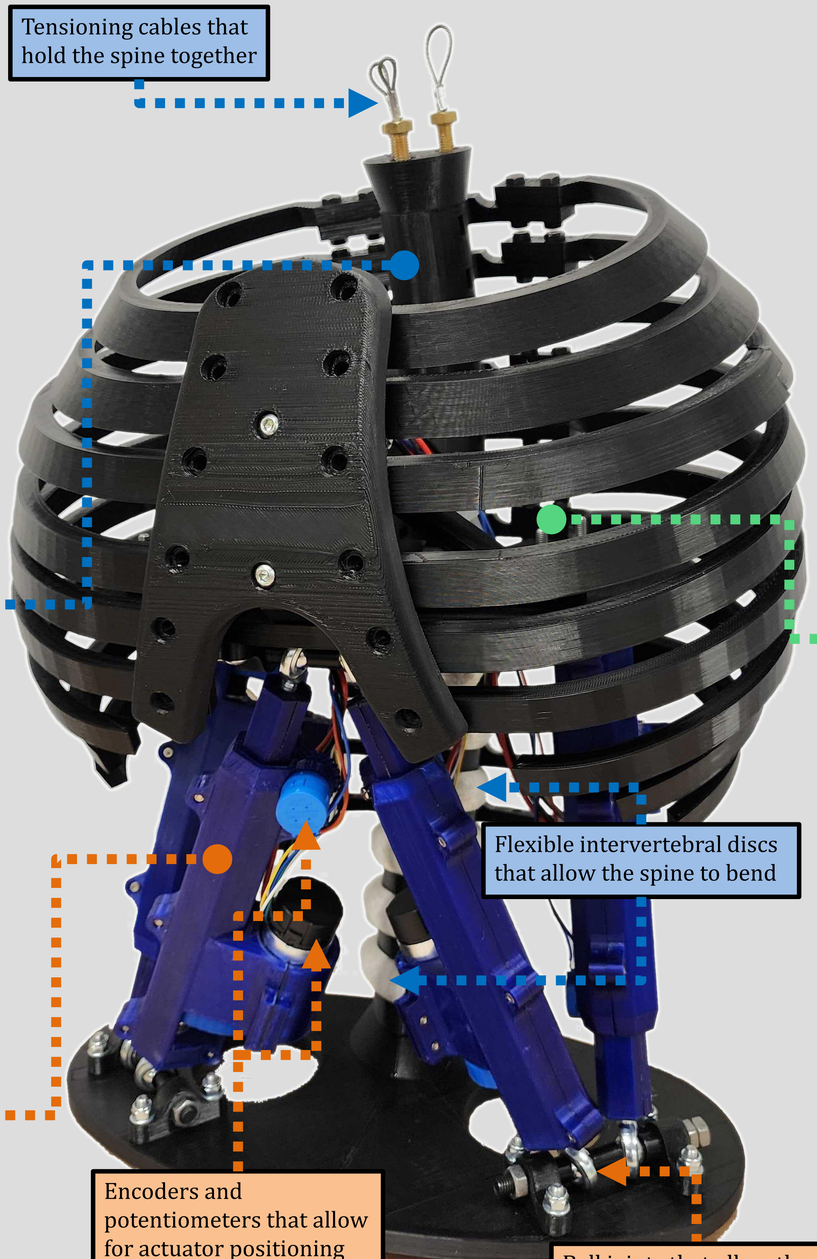


## Actuation

To keep the costs of the project low, custom linear actuators were created.

- The body, rod, and belts are 3D printed
- A swappable brushed DC motor is used for flexibility with power and torque requirements





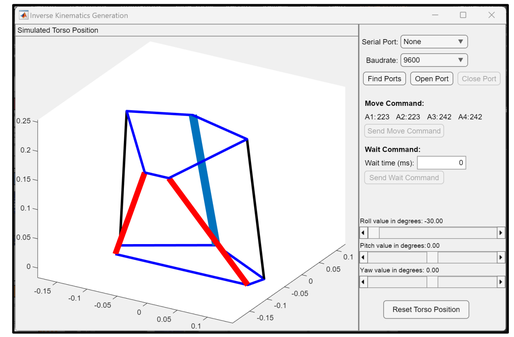

## Objectives

- Flexion/extension, lateral bending, rotational bending that is comparable to a human
- Matches a human likeness under clothing

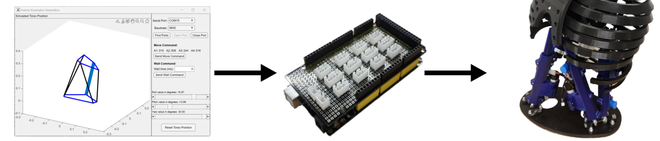
## Control

A MATLAB program was created to allow a host computer to the movement of the torso robot.

- Can quickly and accurately control the torso's roll, pitch, and yaw angles
- If a movement is impossible for the torso to perform, the GUI highlights the actuator that is preventing the position in red




**Communication Path:**



Actuator lengths are calculated in MATLAB and sent over USB.

The microcontroller reads the commands sent over USB and moves the actuators accordingly.

Actuators are controlled through PWM and move to the required position.

## Results

The torso mechanism has the following mobility:

- Flexion/extension range of -20 to +28 degrees
- Lateral flexion range of ±14 degrees
- Rotational bending range of ±40 degrees