Automation of Vascular Interventional Surgery

2018 Jan 3 Michael Lee & Emily Hsu & WJ SUN

OVERVIEW

- Motivation
- System Architecture
- Surgeon side
- Patient side
- Future Works

VASCULAR INTERVENTIONAL SURGERY

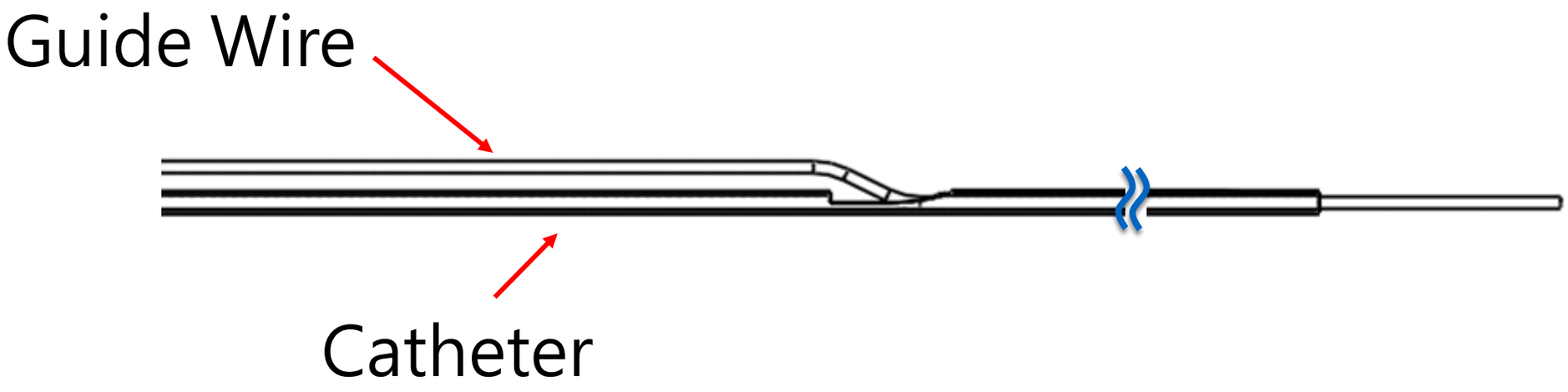
KEY *ISSUE* in SURGIAL PROCESS

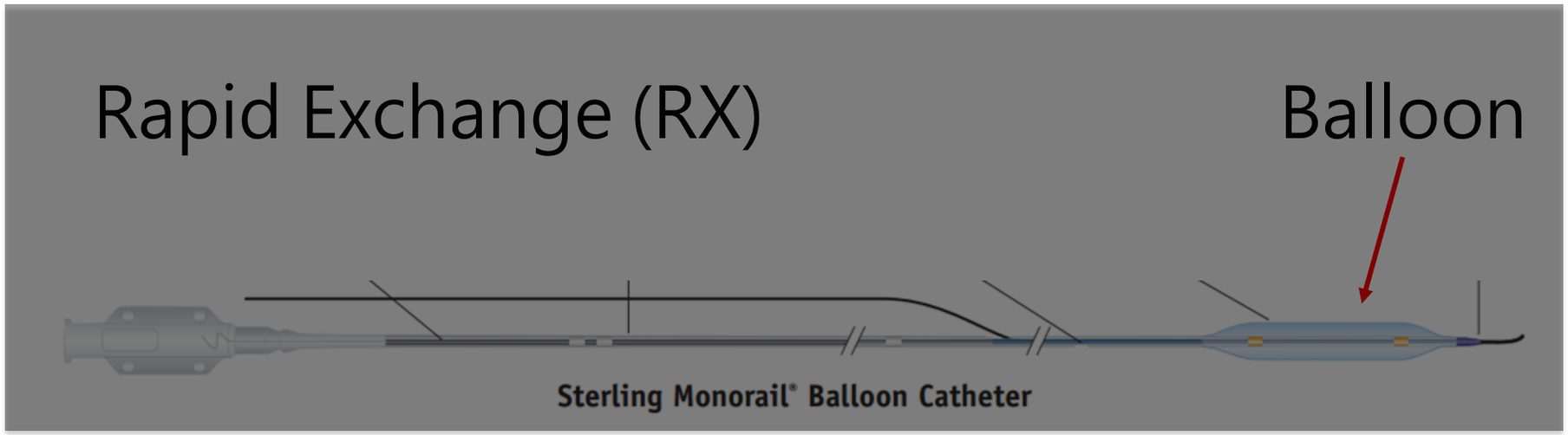
Radiation

lead clothing up to 5 kilograms

Automation can reduce the radiation dose of the surgeon

Current Status: Inspection Catheter





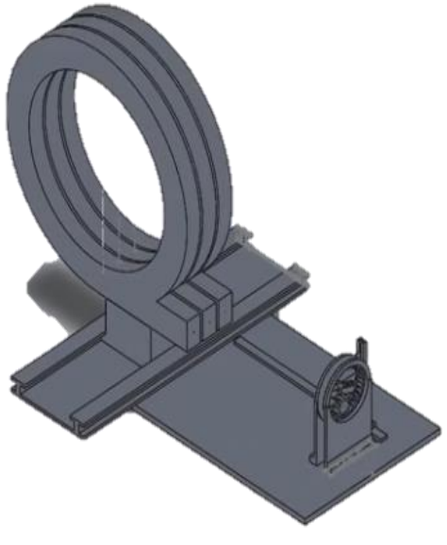
SYSTEM ARCHITECTURE

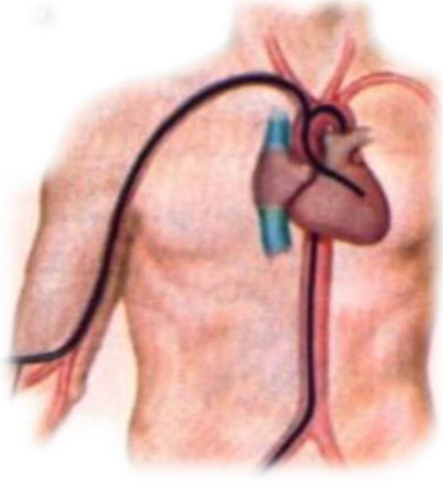
controller

server

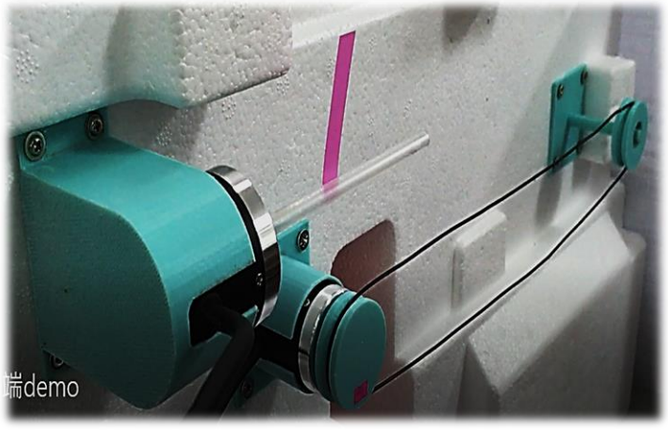
user interface

Patient (Slave) Side



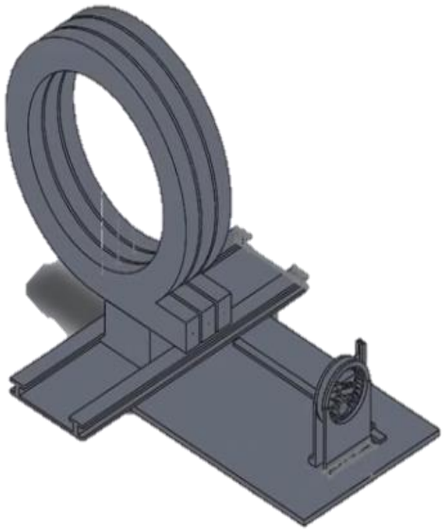


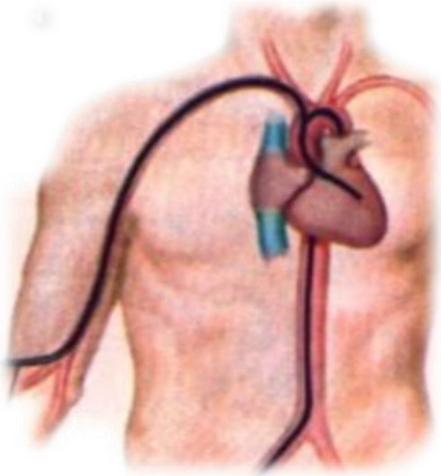
Surgeon (Master) Side



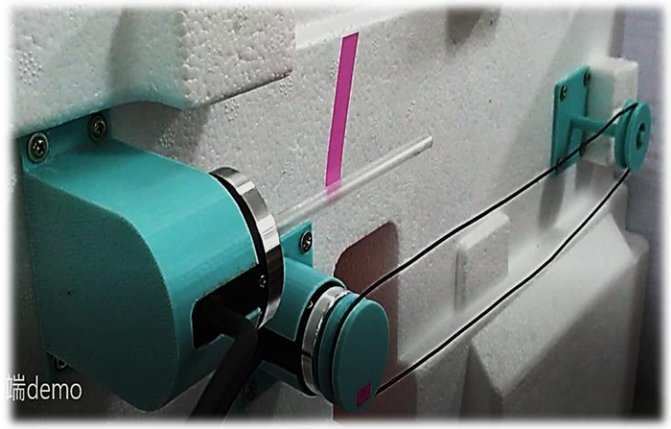
MASTER – SLAVE INTERACTION

Patient (Slave) Side





Surgeon (Master) Side



Translational, Rotational Motion

Motion Command
by Manipulating catheter

Force Measured
shear stress on blood vessel

Simulate Force Feedback

SURGEON SIDE BRAKE

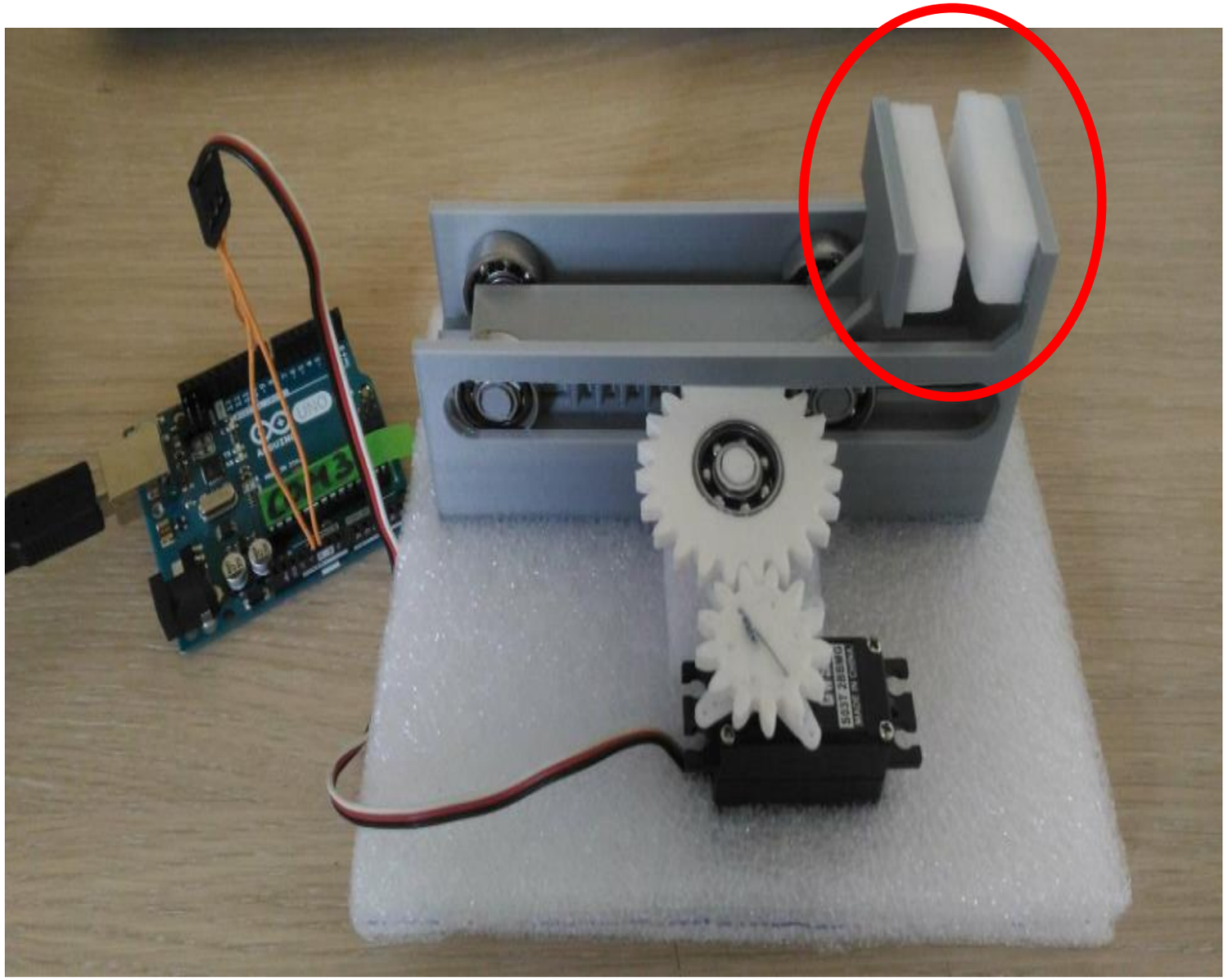
Design Target

get force feedback from patient side, and realize the force environment on the surgeon side.

Experiment Target:

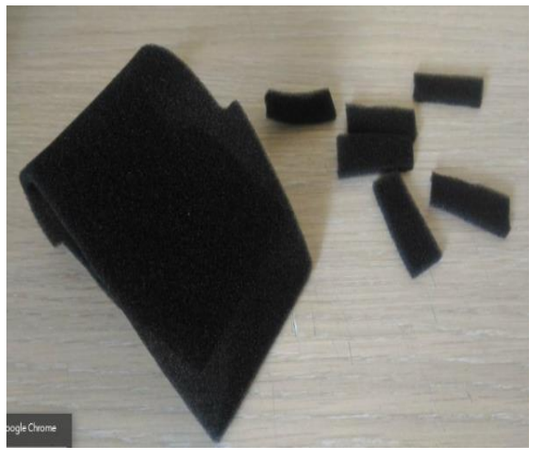
plot the friction curve of different brake materials, and find the suitable operation region of realizing force feedback.

SURGEON SIDE BRAKER MECHANISM

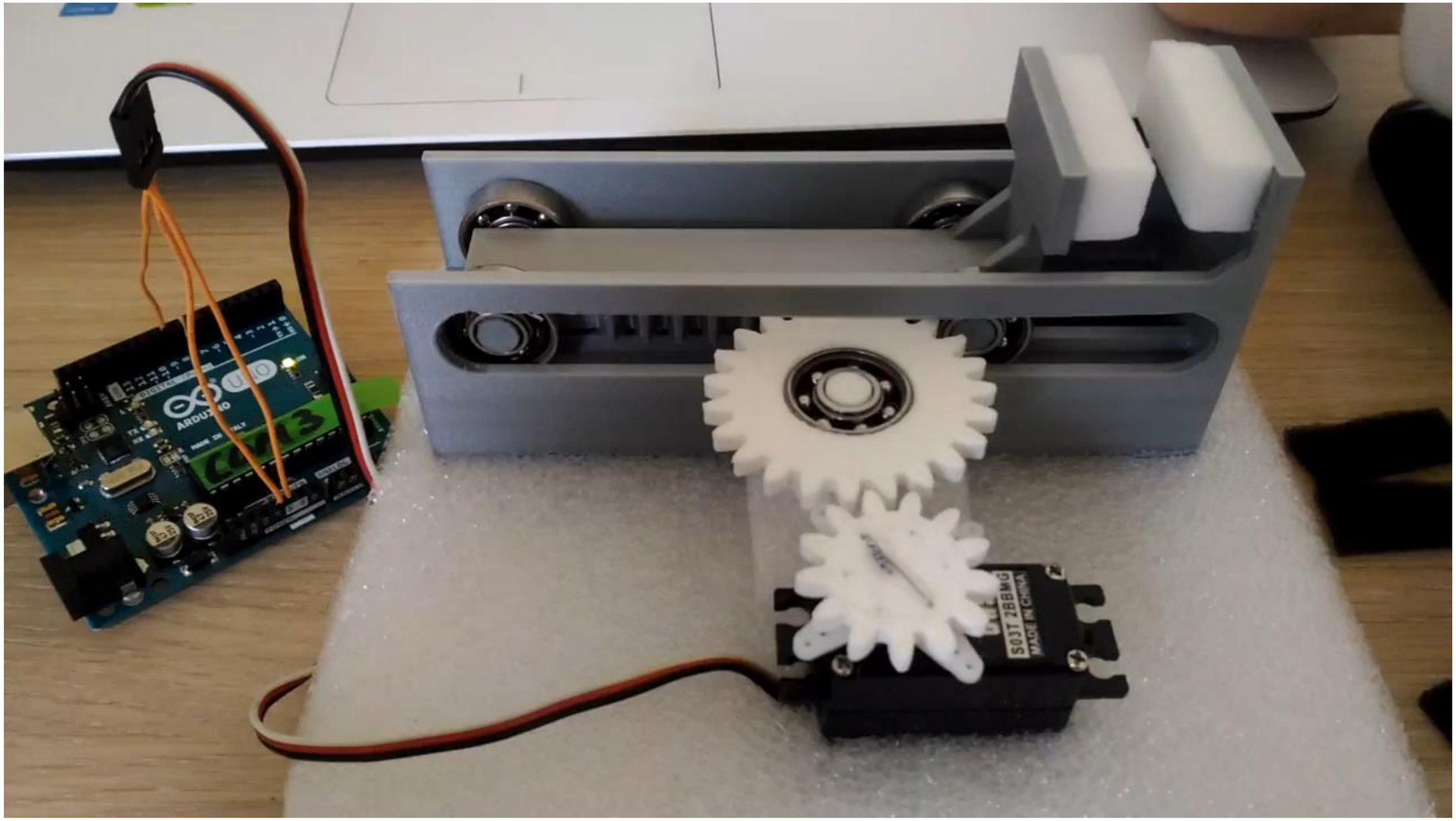


Technology sponge

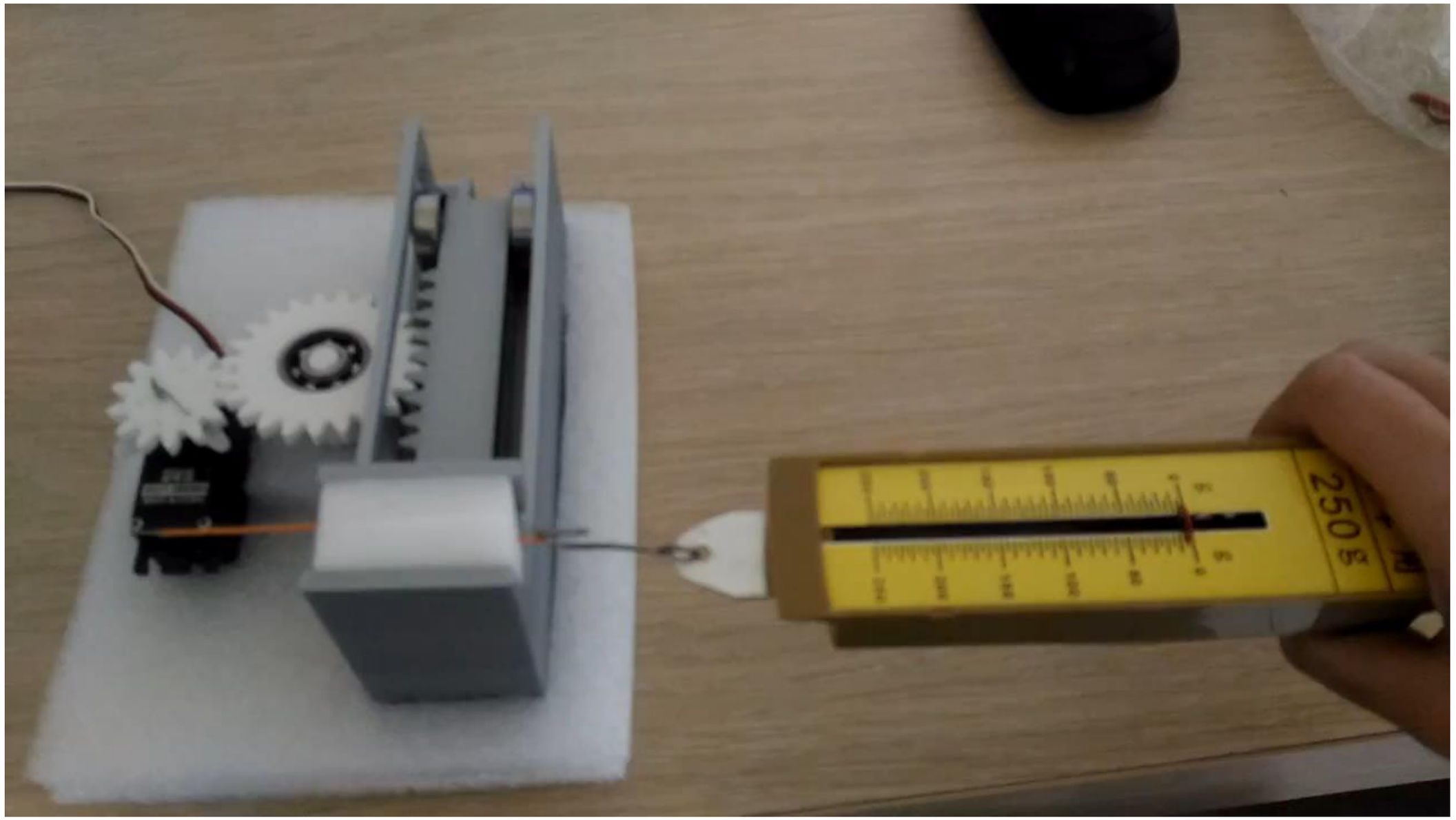
Low density sponge



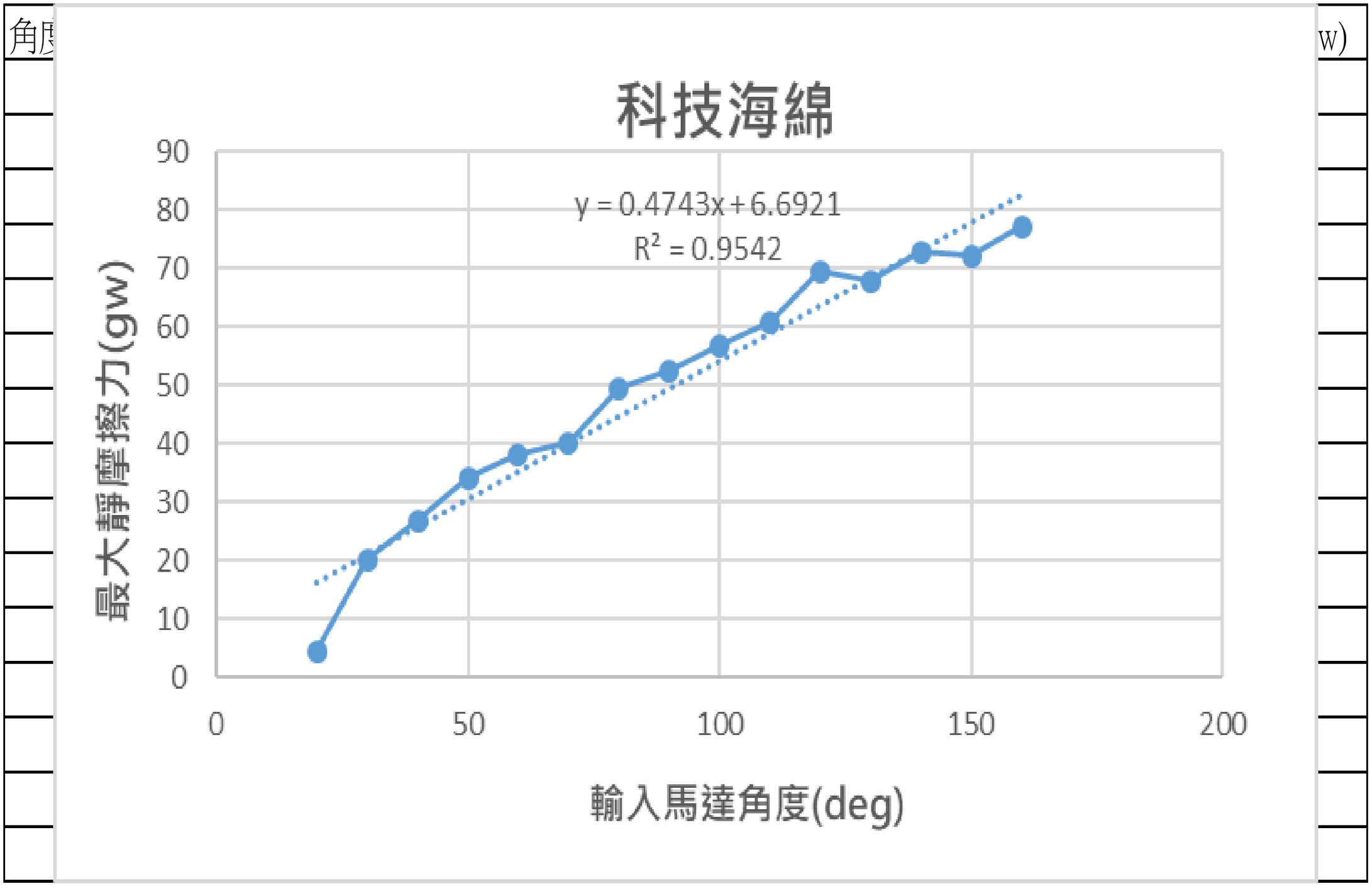
POSITION CONTORL OF SERVO MOTOR



Friction Force Measurement

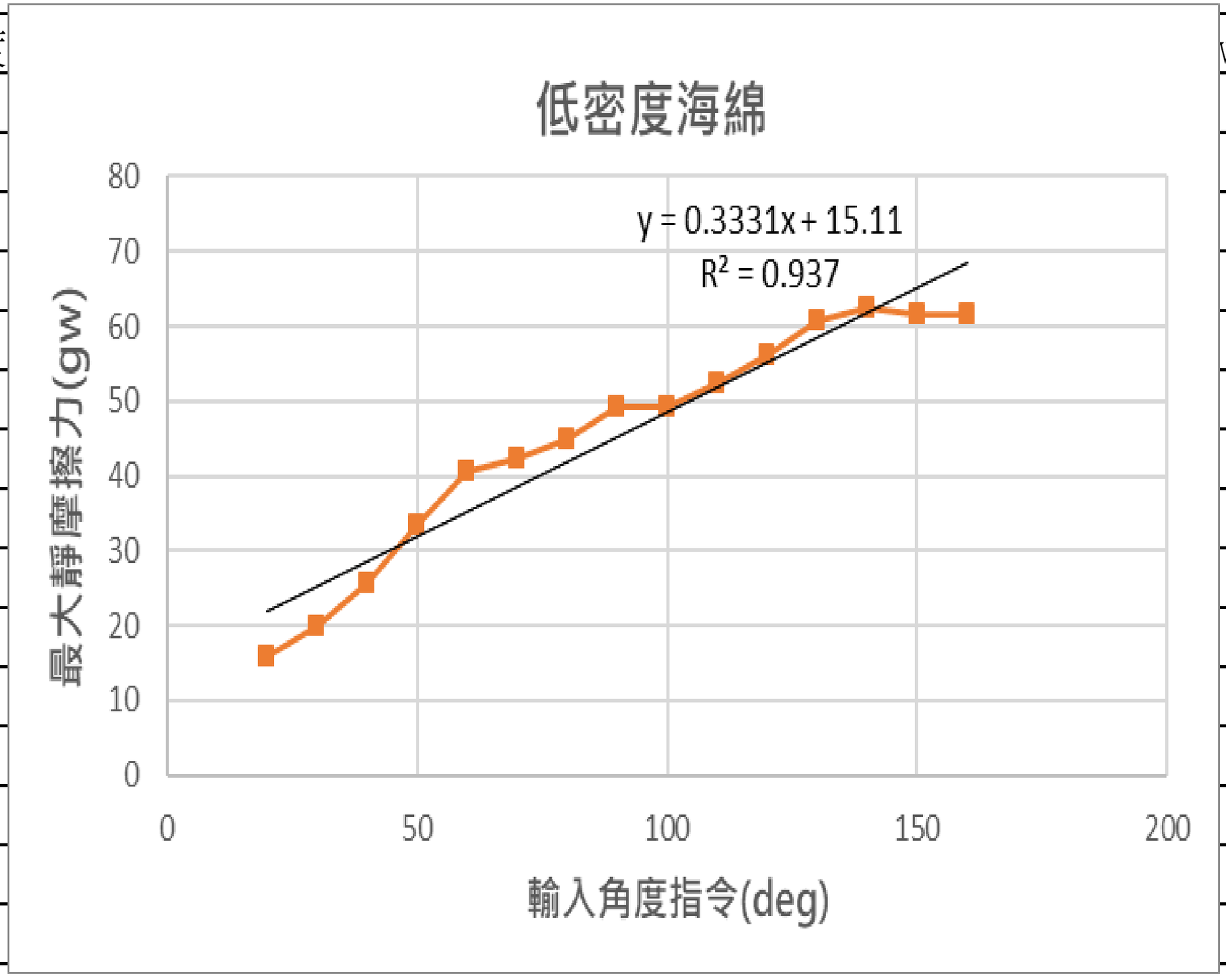


TECHNOLOGY SPONGE

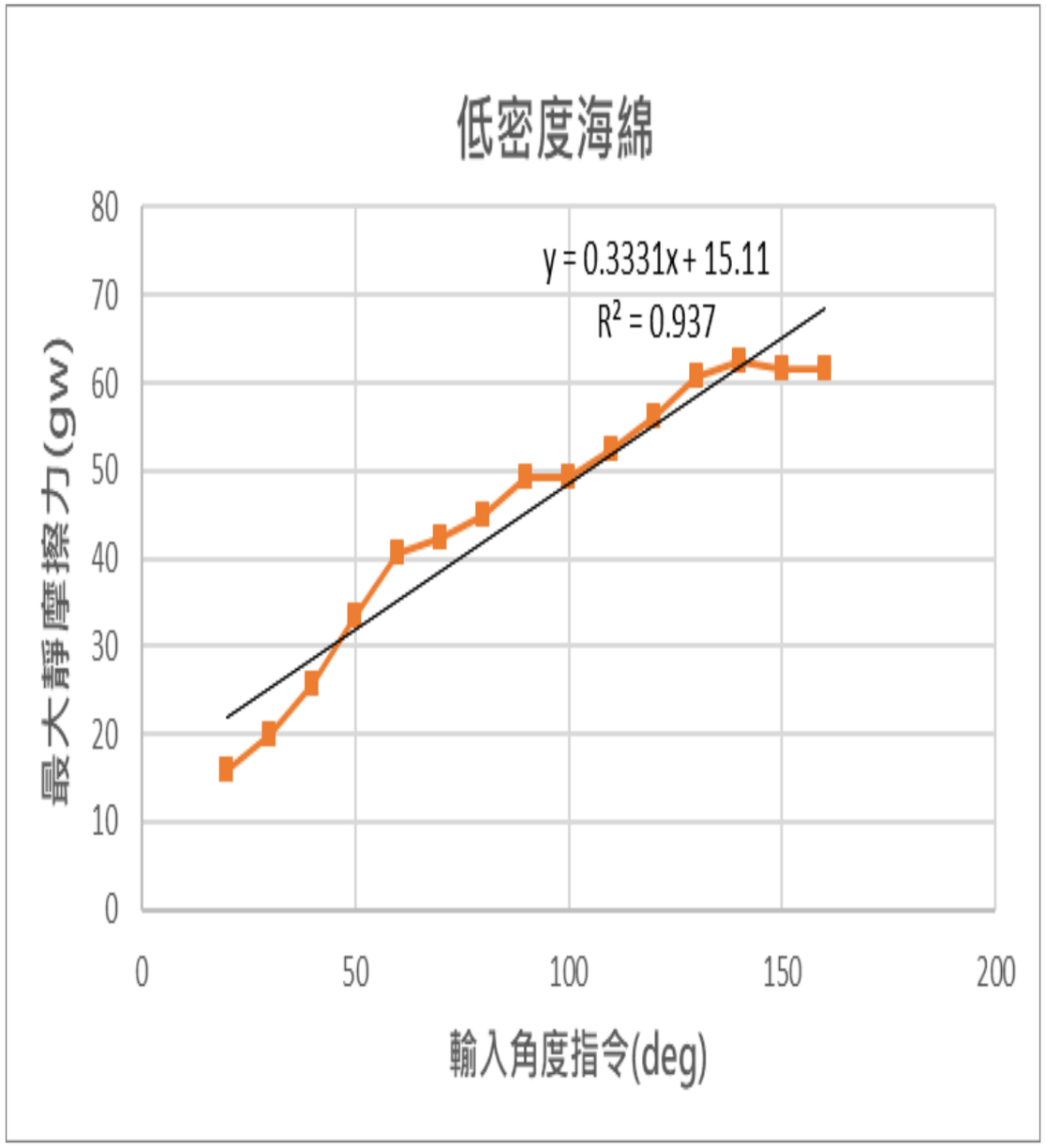


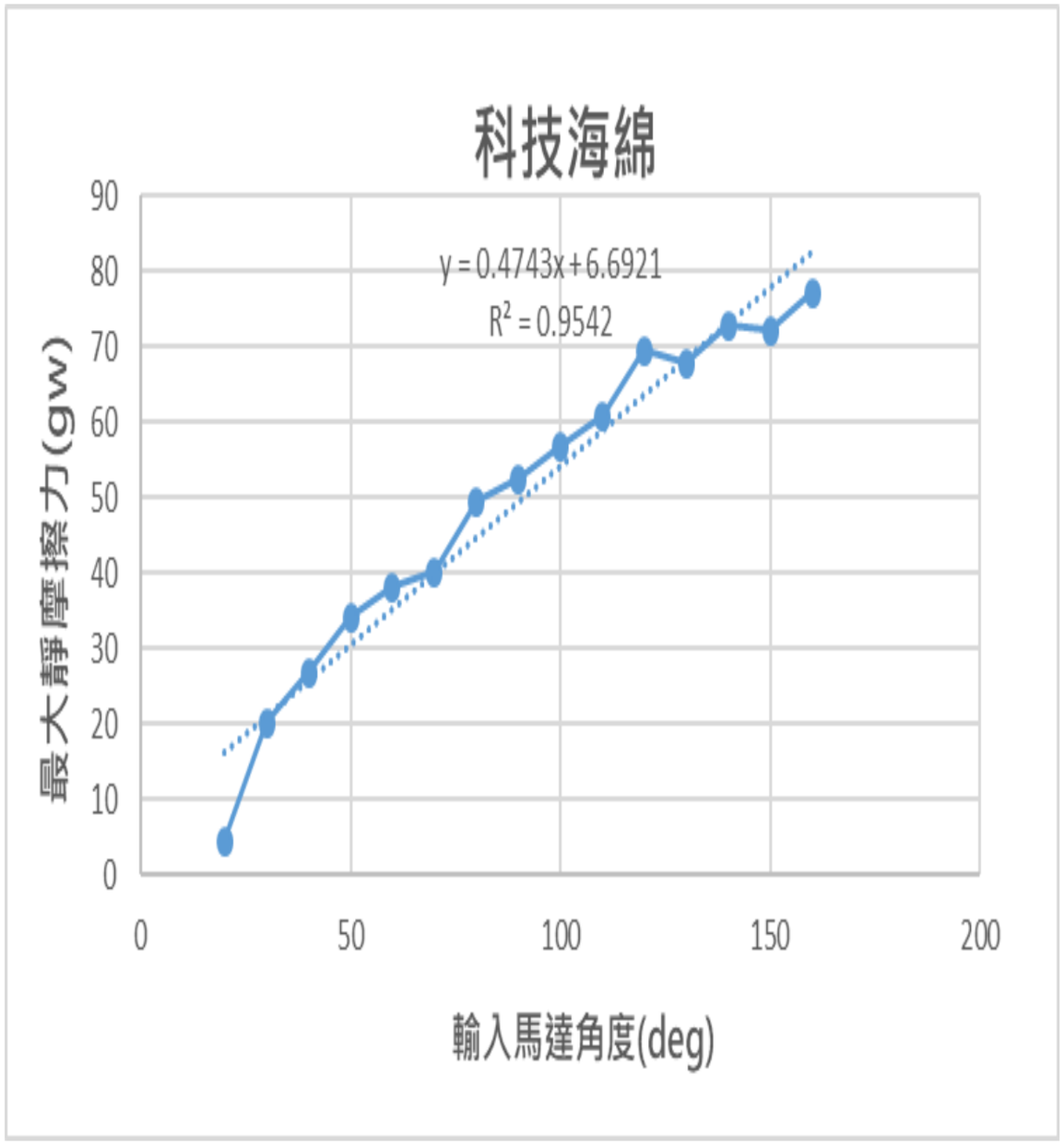
LOW DENSEITY SPONGE

角度	w)	平均(gw)
		16.00
		20.00
		25.67
		33.33
		40.67
		42.33
		45.00
		49.33
		49.33
		52.33
		56.00
		60.67
		62.33
		61.67
		61.67



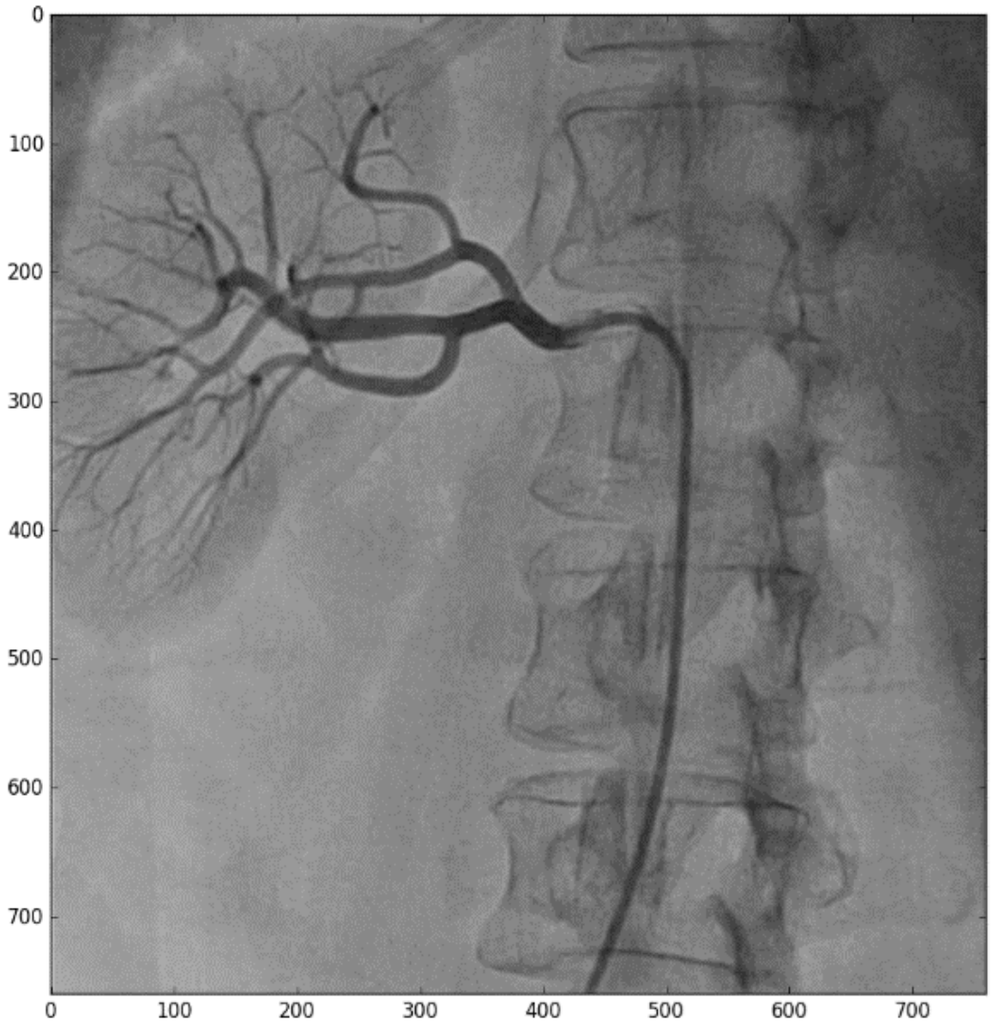
COMPARE SPONGE

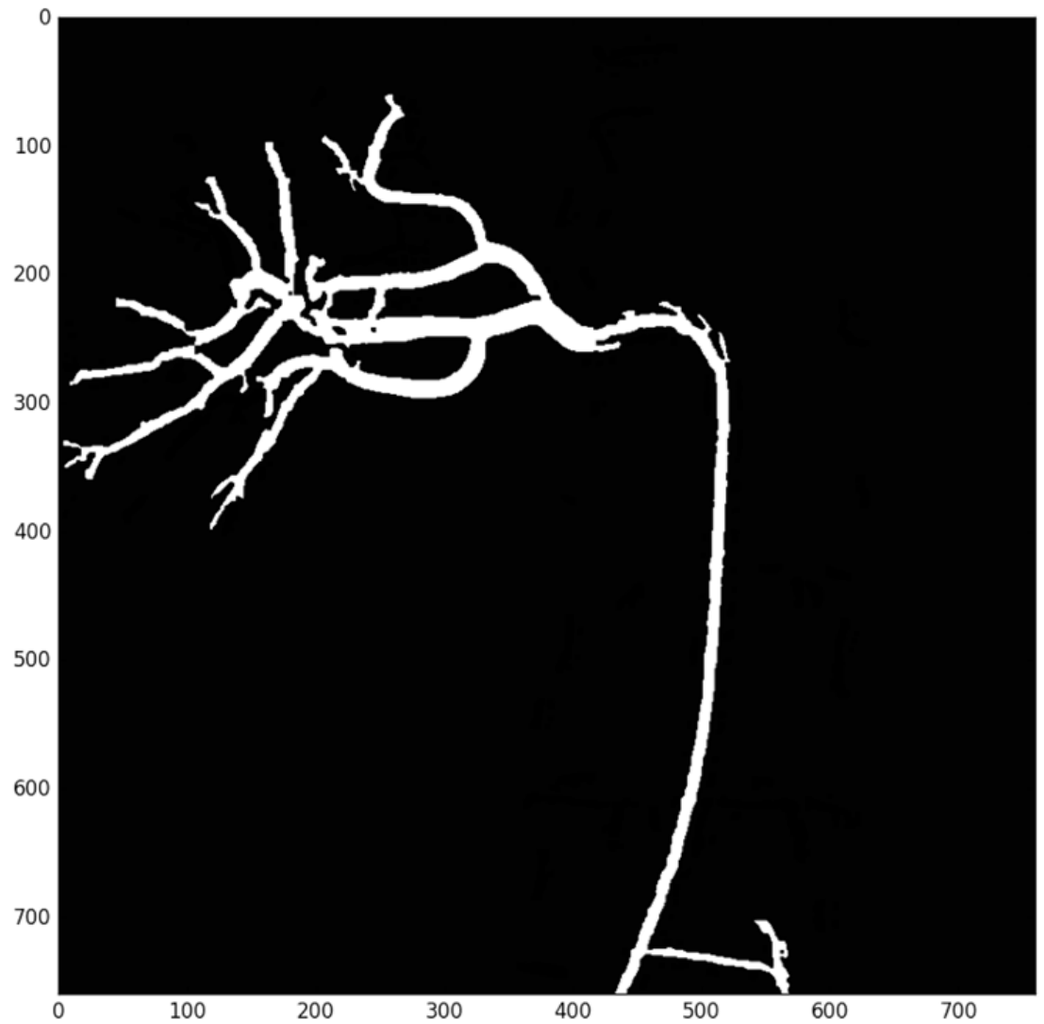




Vessel Segmentation

Identify blockage in blood vessels

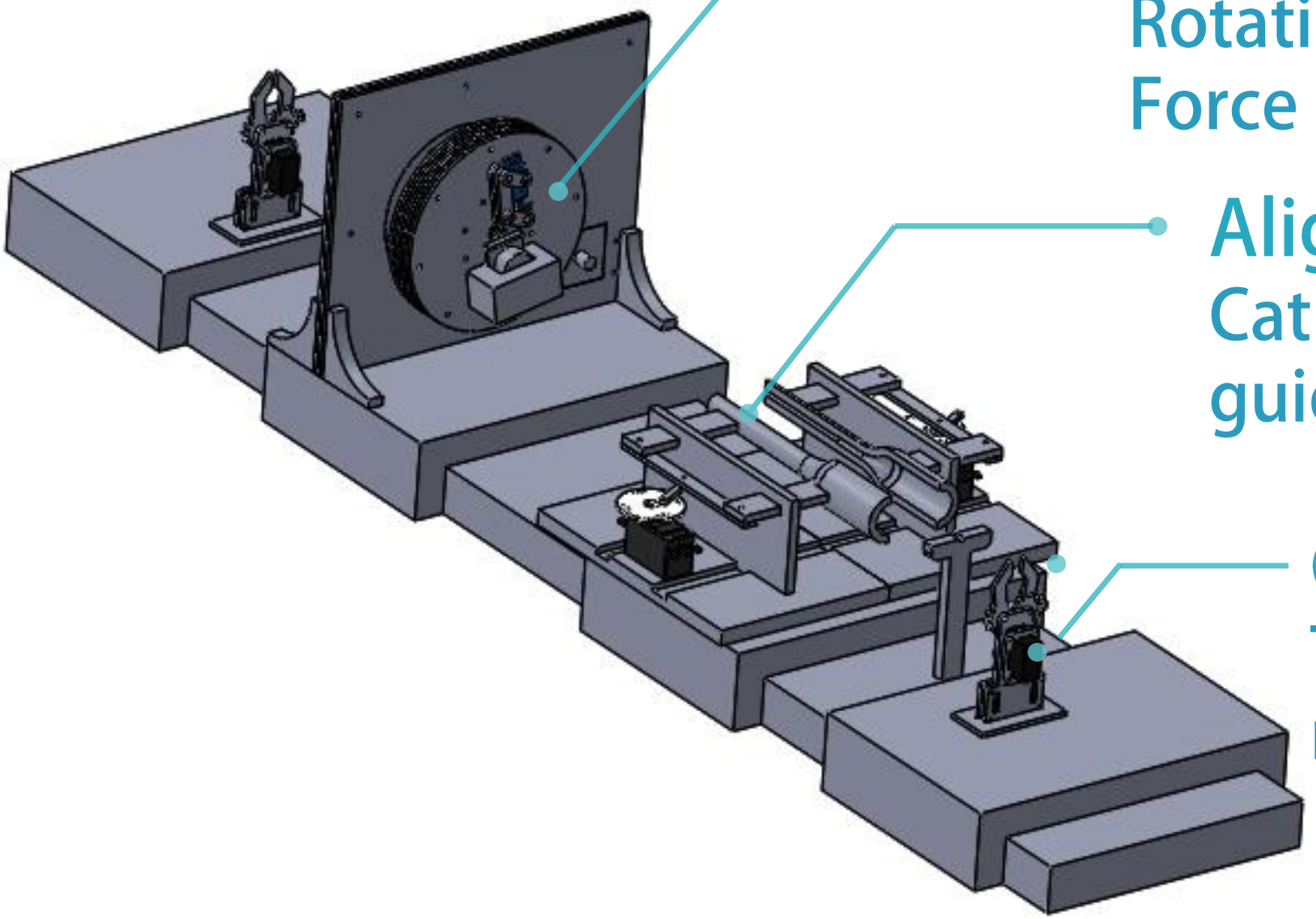




Patient Side Functions

1. Design of mechanism
2. Implementation of mechanism
3. Issues

System Overview Patient Side

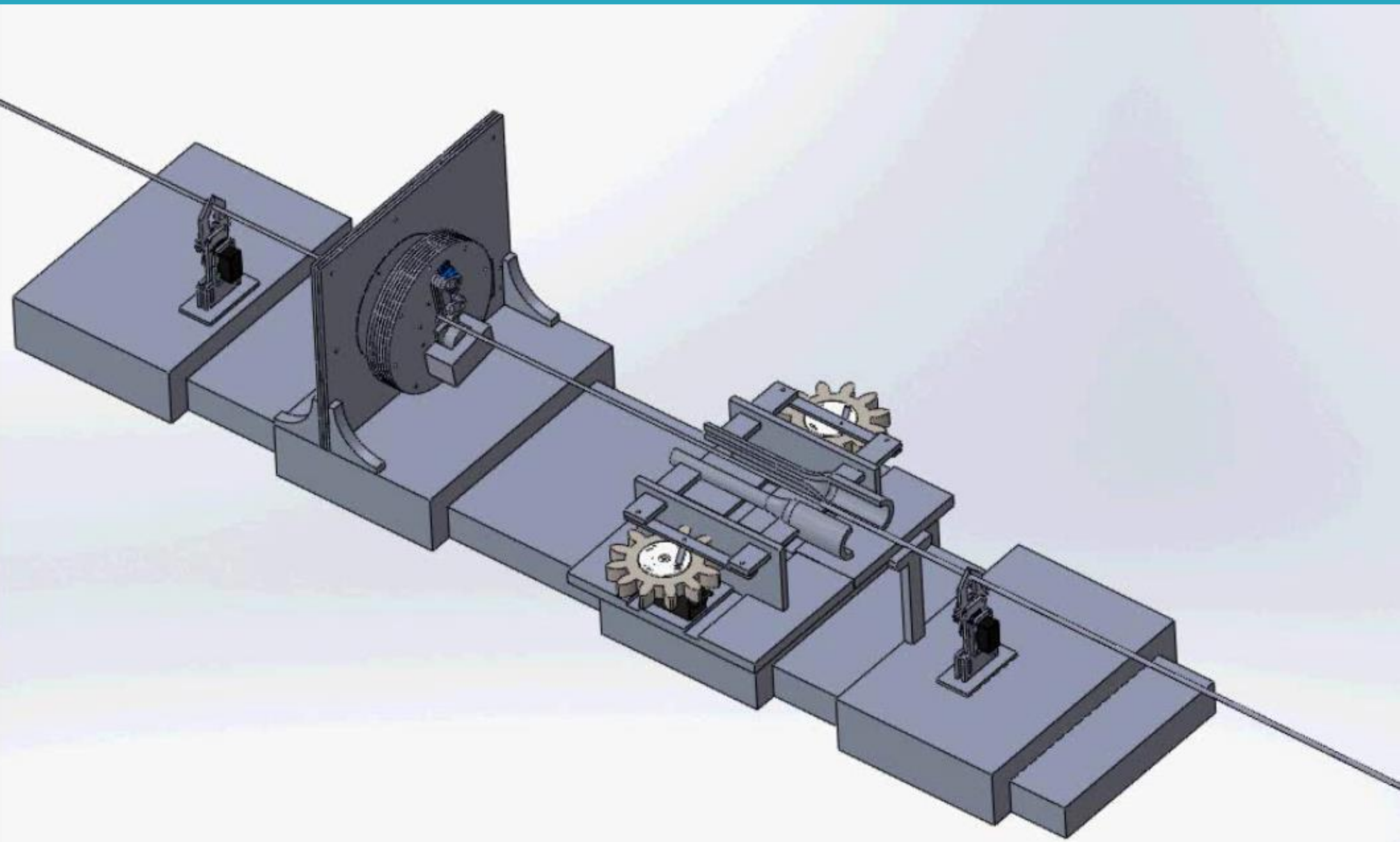


Rotor/Load Cell
Rotational motion
Force sensor

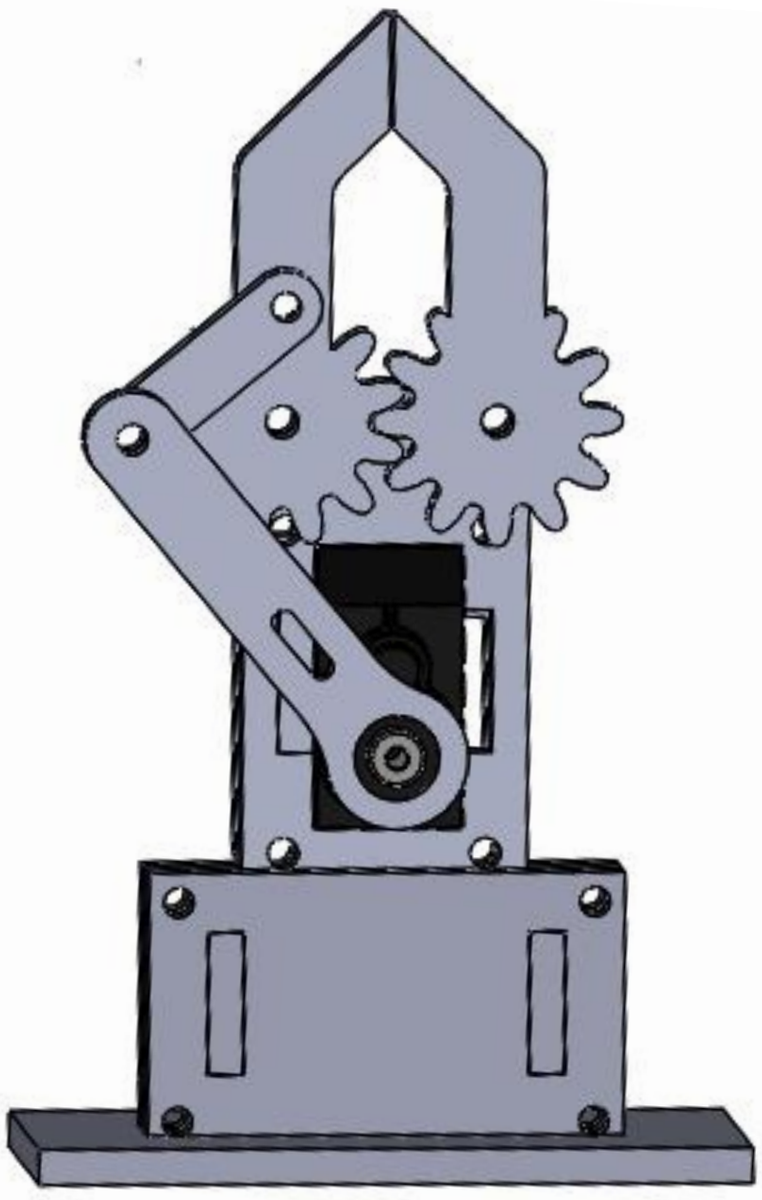
Aligner
Catheter over guide wire

Gripper
Translational motion

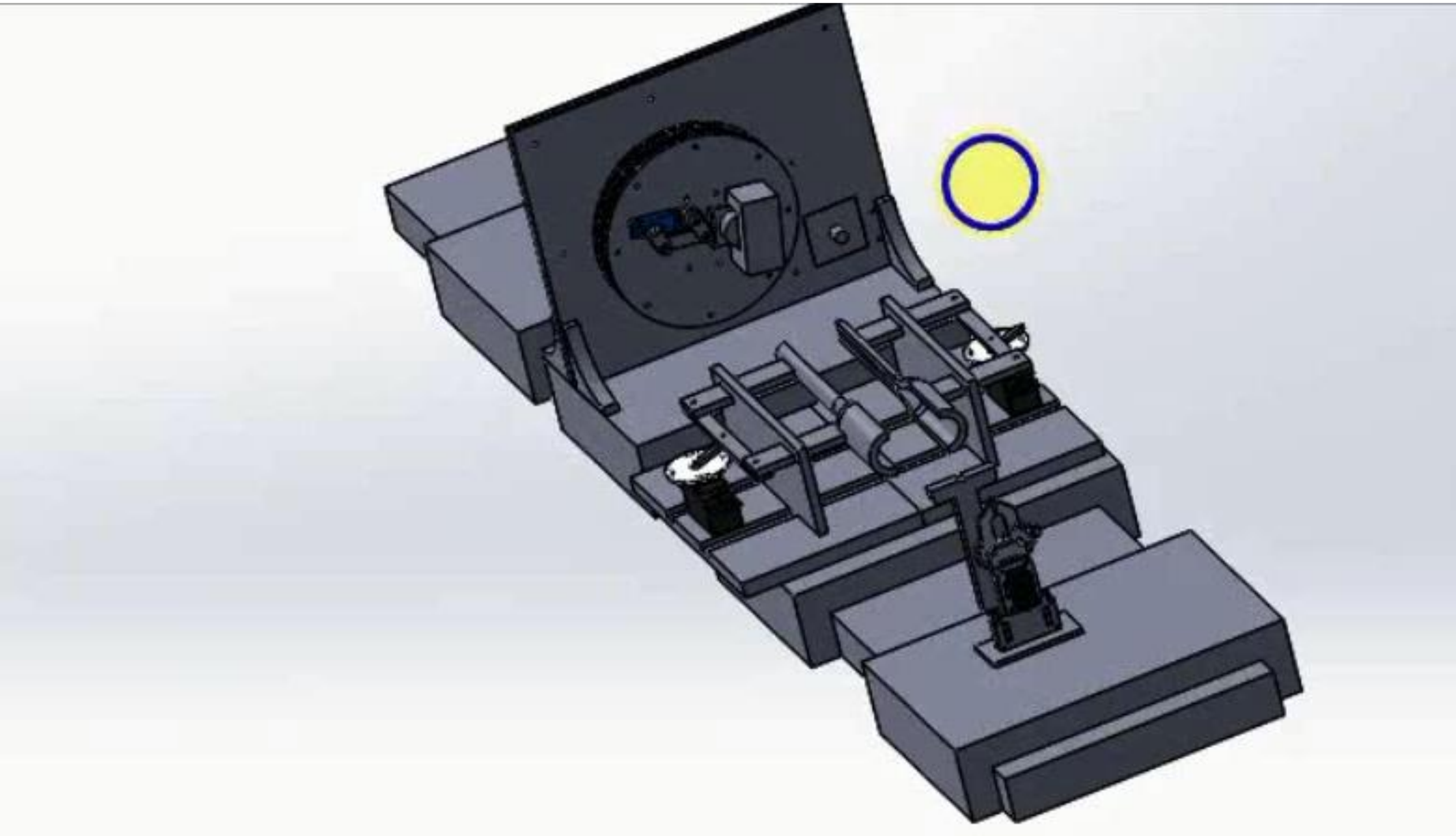
DESIGN DEMO



IMPLEMENTATION OF GRIPPER



DESIGN OF ROTOR



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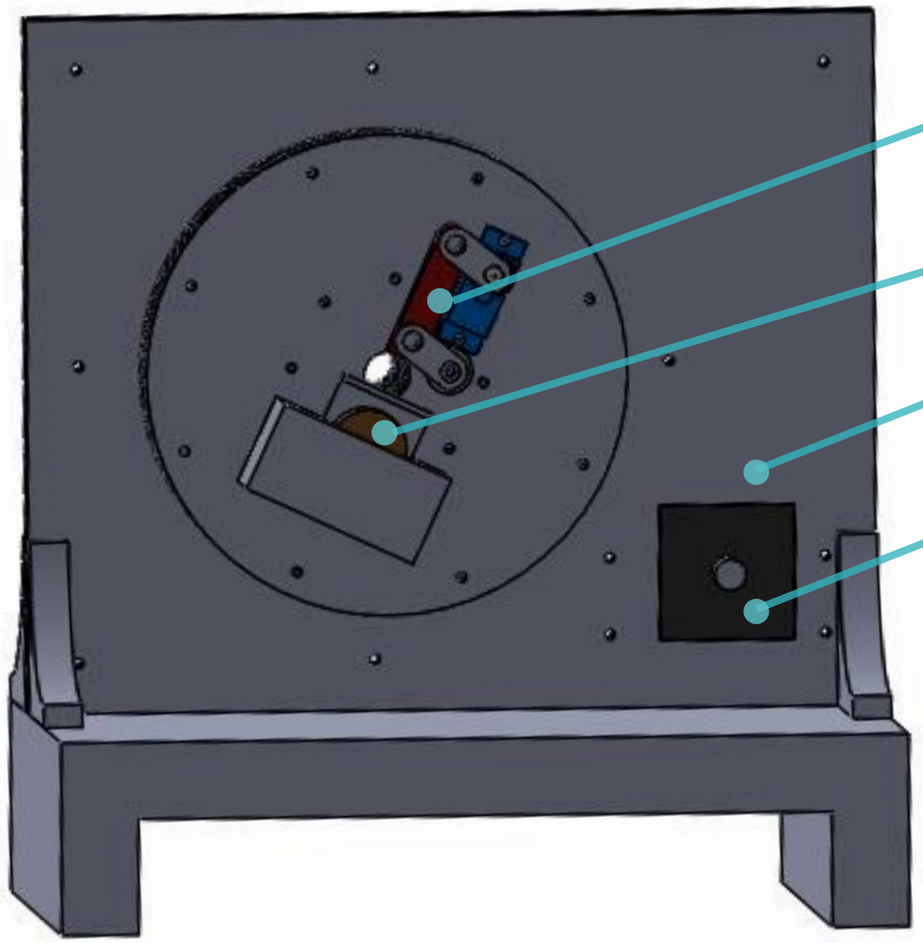


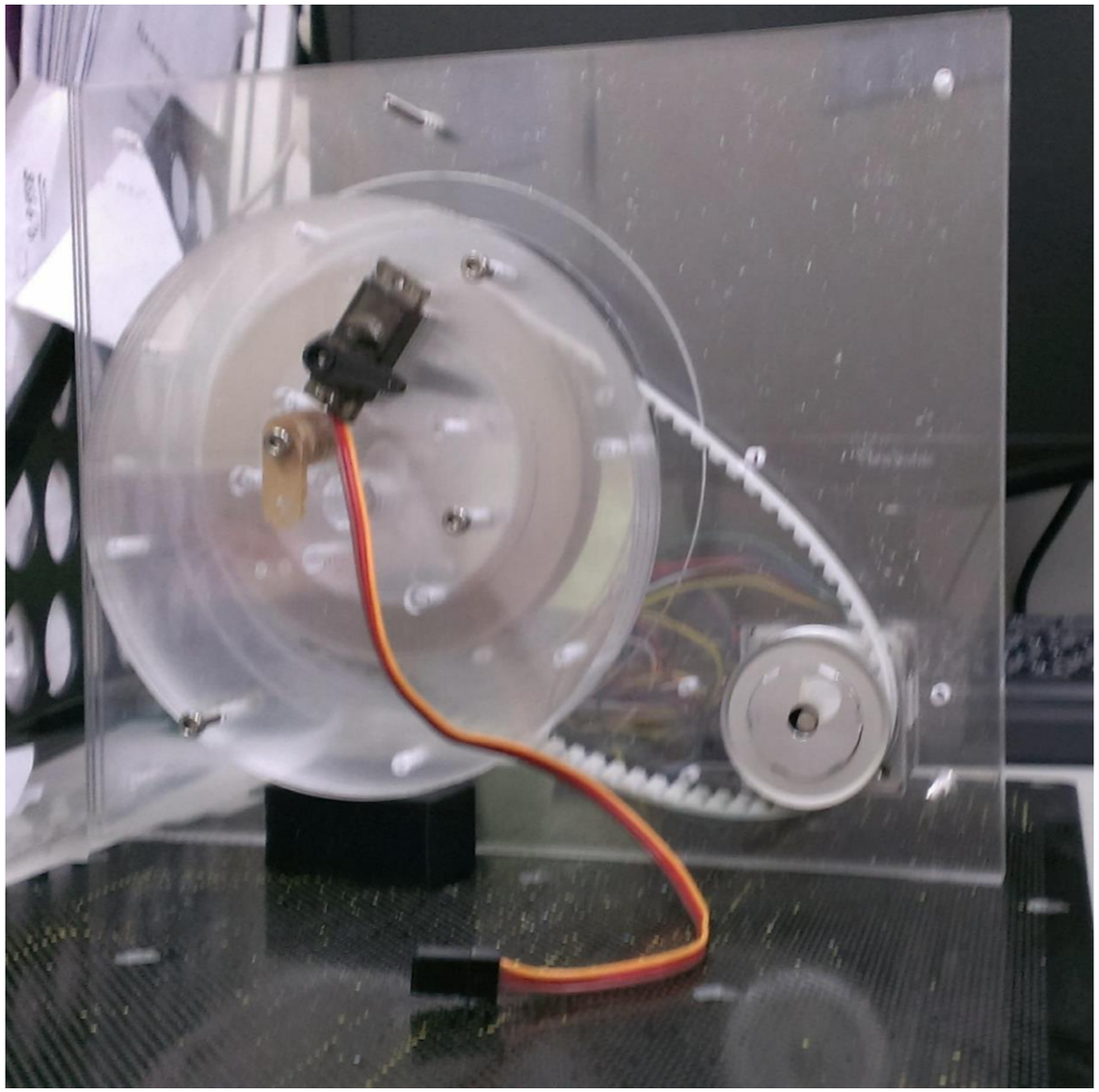
Holder

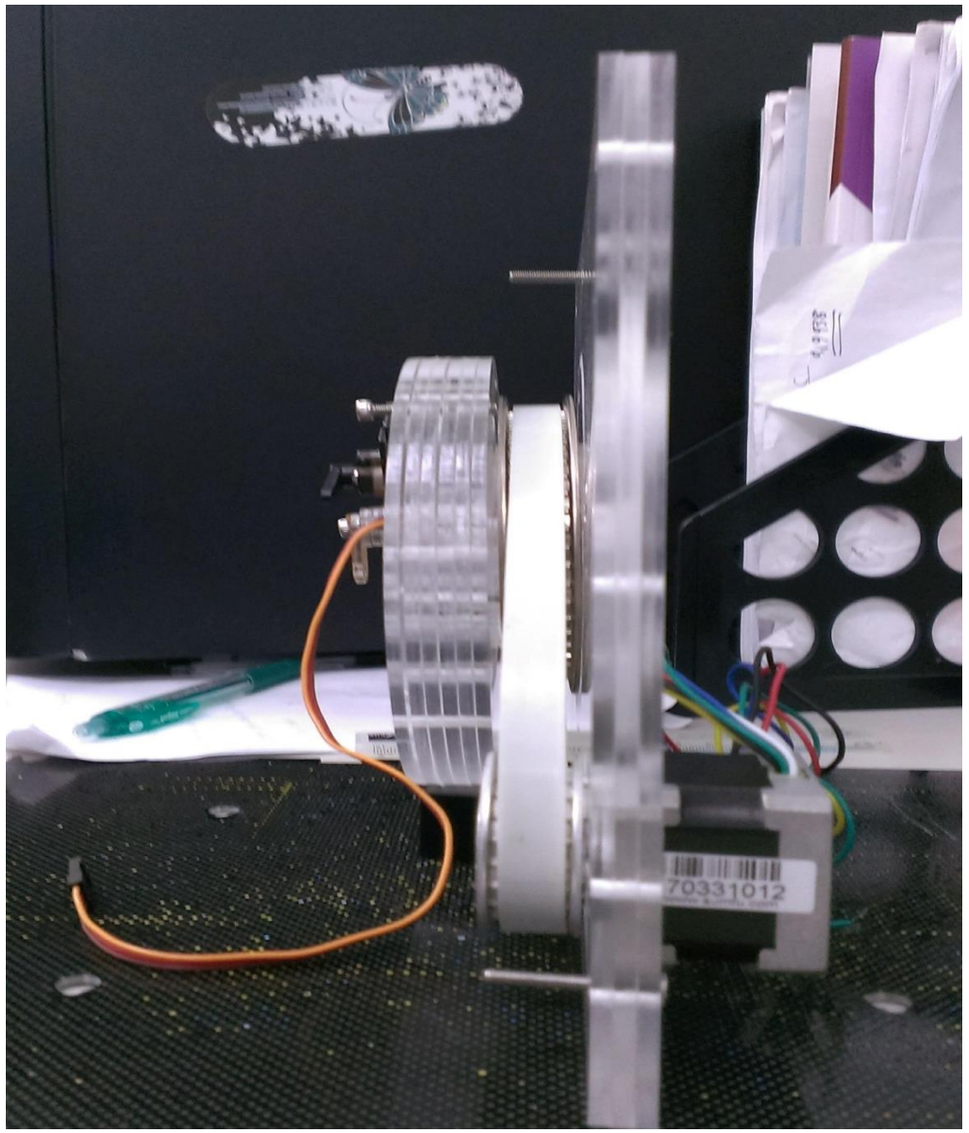
Load Cell

Driven Plate

Driving Motor

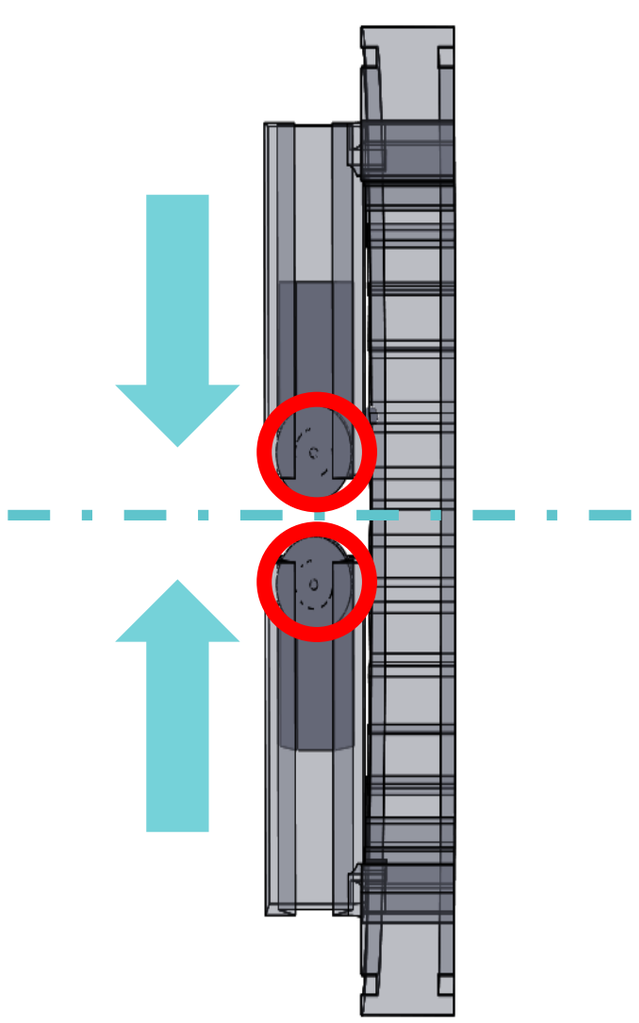
DESIGN OF ROTOR

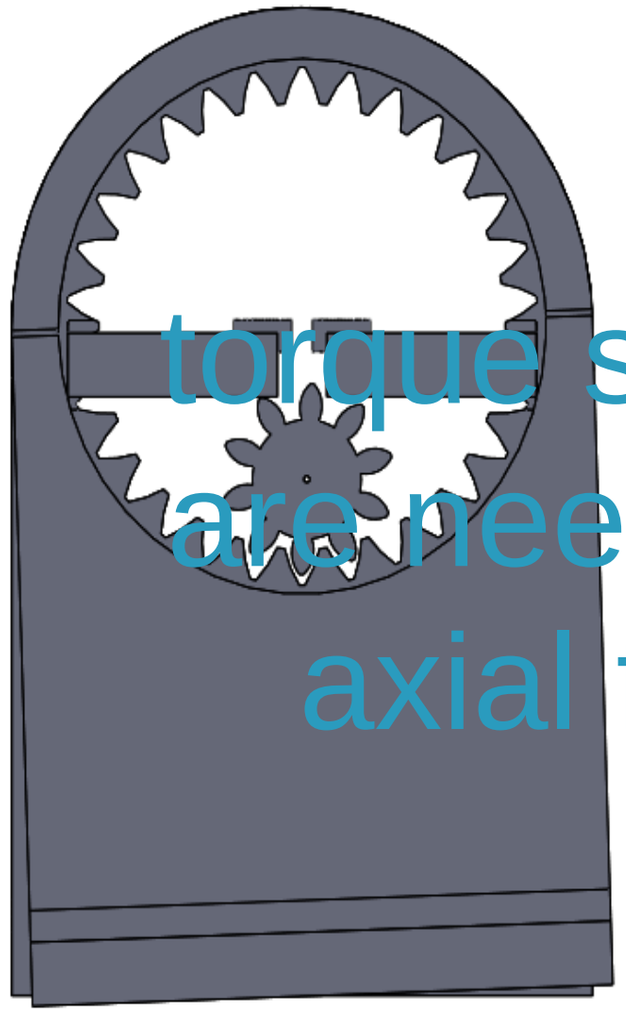




Bearing is needed to overcome friction

PREVIOUS MANIPULATOR DESIGN

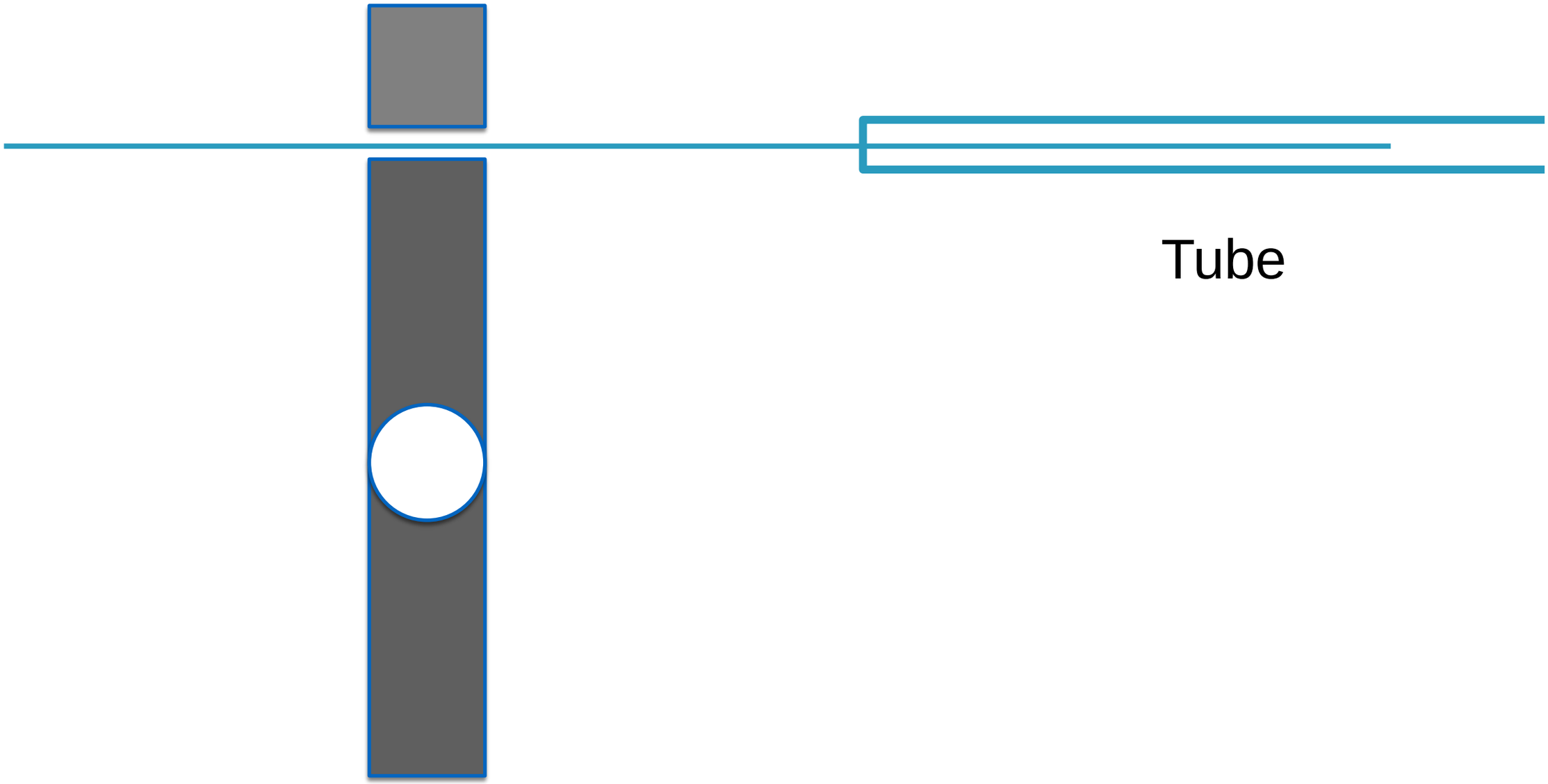




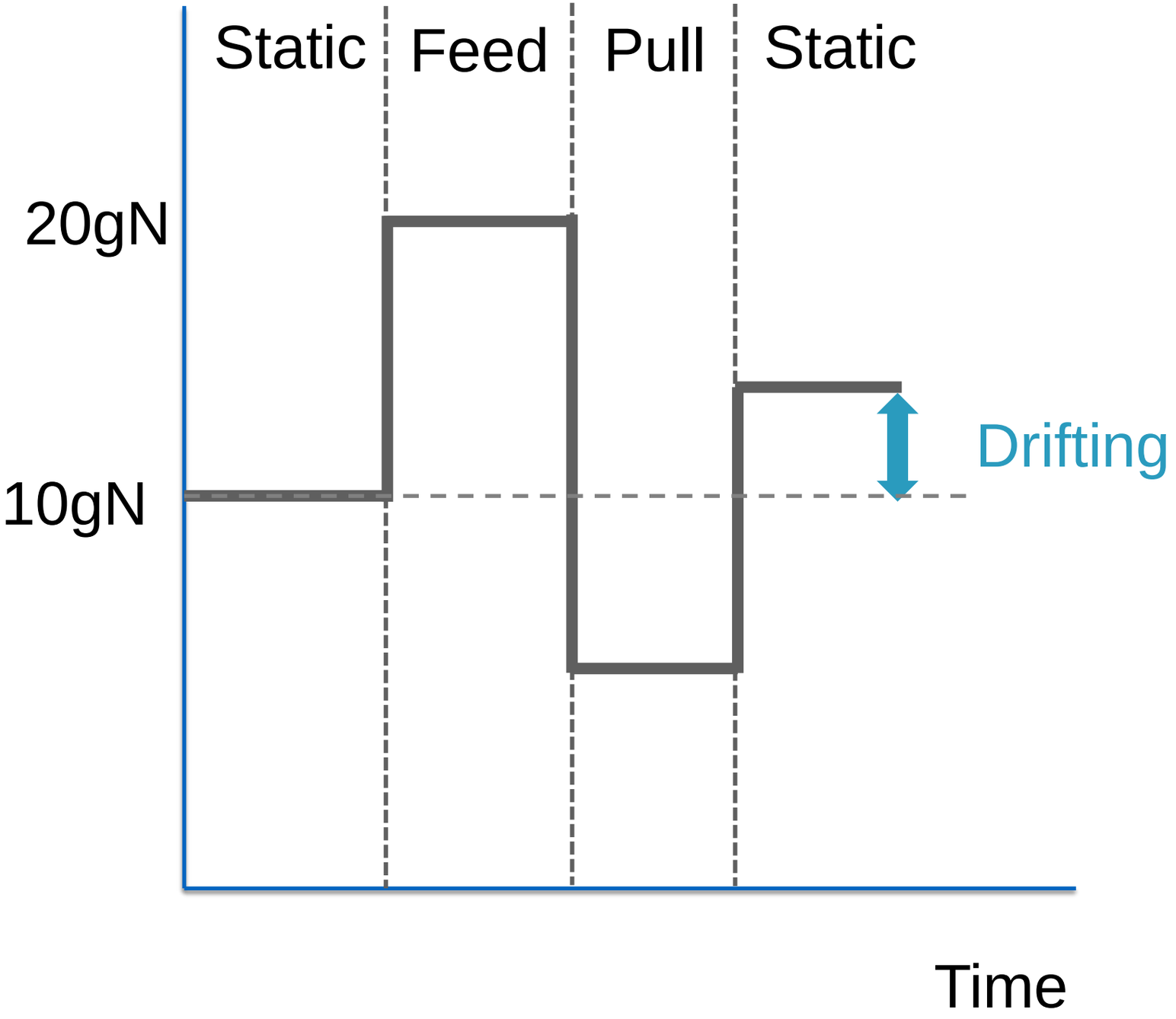
torque sensors are needed for axial force

Getting Axial Force Feedback is Hard

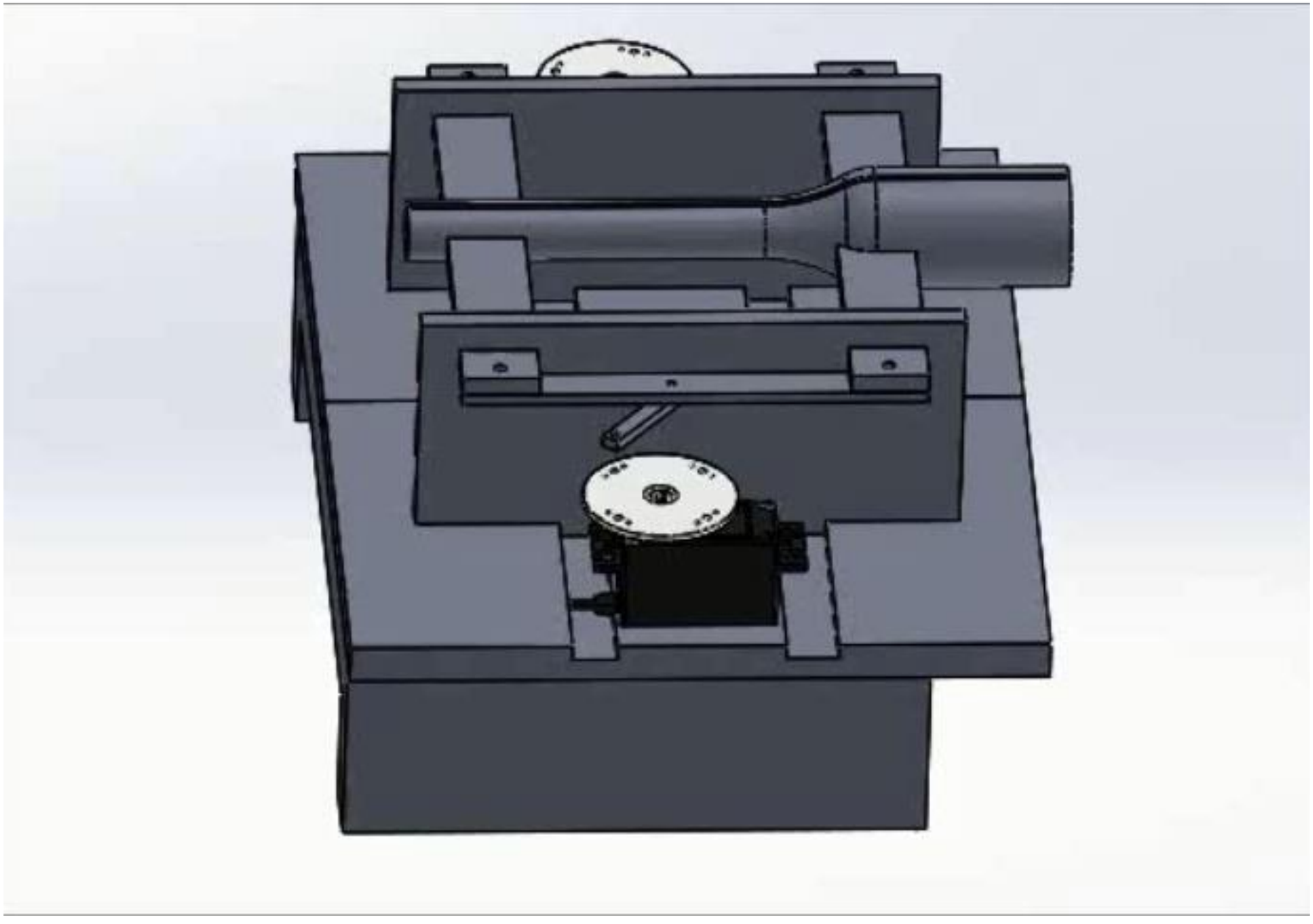
EXPERIMENT OF LOAD CELL



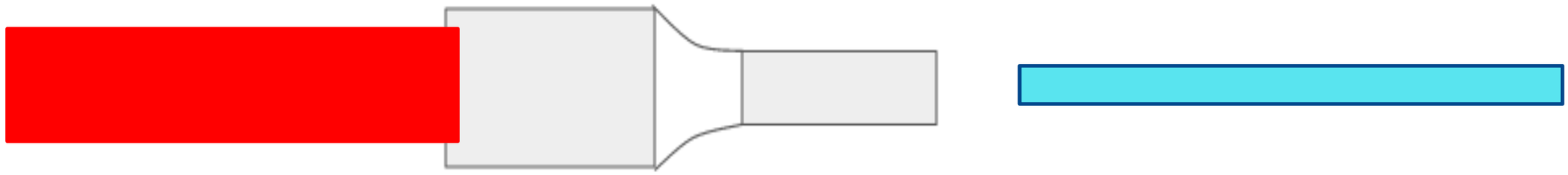
EXPERIMENT OF LOAD CELL



CONECPT DESIGN OF ALINGER



CONECPT DESIGN OF ALINGER



FUTURE WORKS

Testing more kinds of brake materials
Improve position control of the brake

Select suitable bearing and load cell for the design

The idea of aligner need to be verified