Actuation Design for Loop Snare Operation in Eye Surgery

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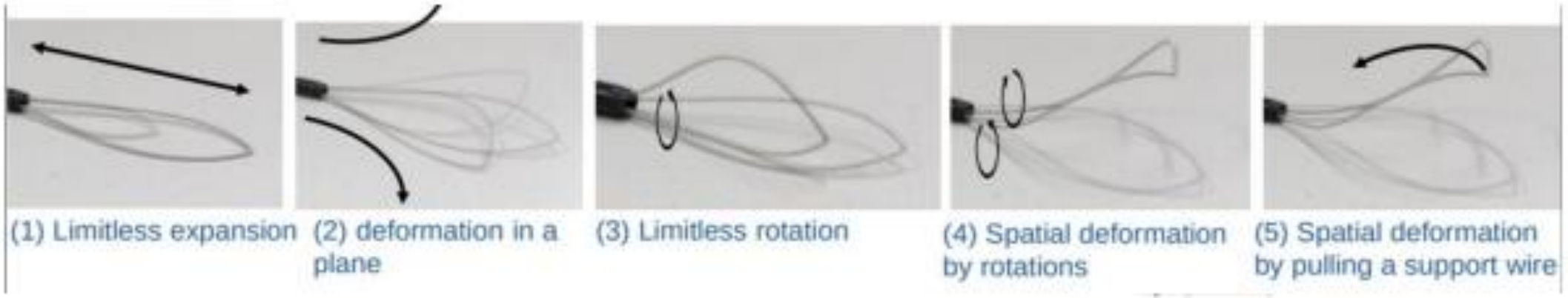
Contents

Snare – Background Info

Surgical Snares

- Grabbing tasks inside of the body
- Moving through difficult bends in anatomy
- Cheap, light-weight, durable



Project Goal

Actuation part of Surgical Snares Robot.

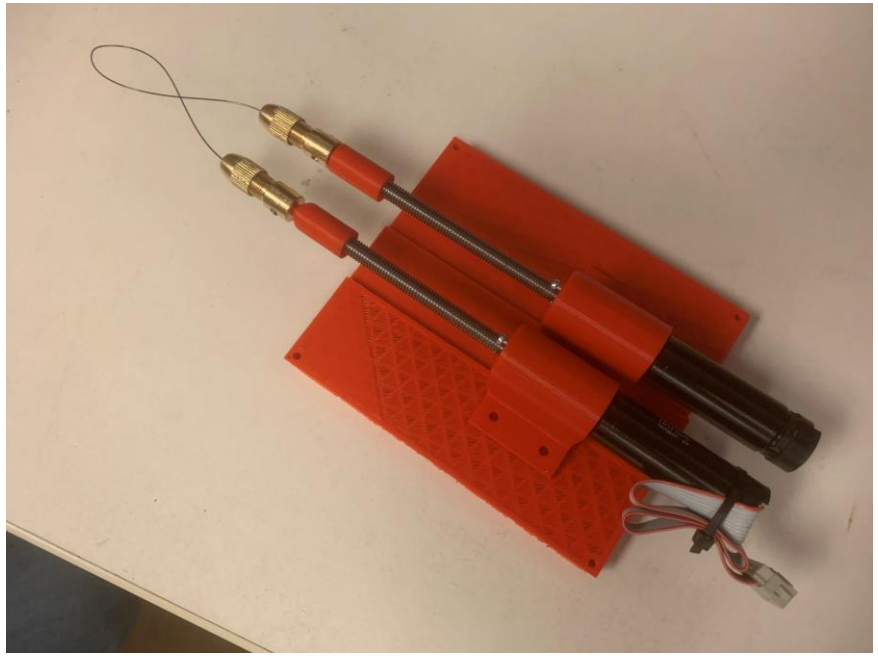
- Control of 2 motors that bend the snare loop up and down.
- Control of linear actuator to bend the snare loop left and right.

Develop a hardware platform and basic control interface is be needed to control the loop snare in desired shape and physical parameters.

- Test platform of a proof-of-concept prototype.
- Based on the suggestion and recommendation from Dr. Mandeep Singh, build the housing of the motors and linear actuator.

Current State of Project

- Update design for proof-of-concept prototype in SOLIDWORKS.
- Rapid prototyping the proof-of-concept platform.
- Started in designing the housing for the Expected prototype, which added linear actuator.

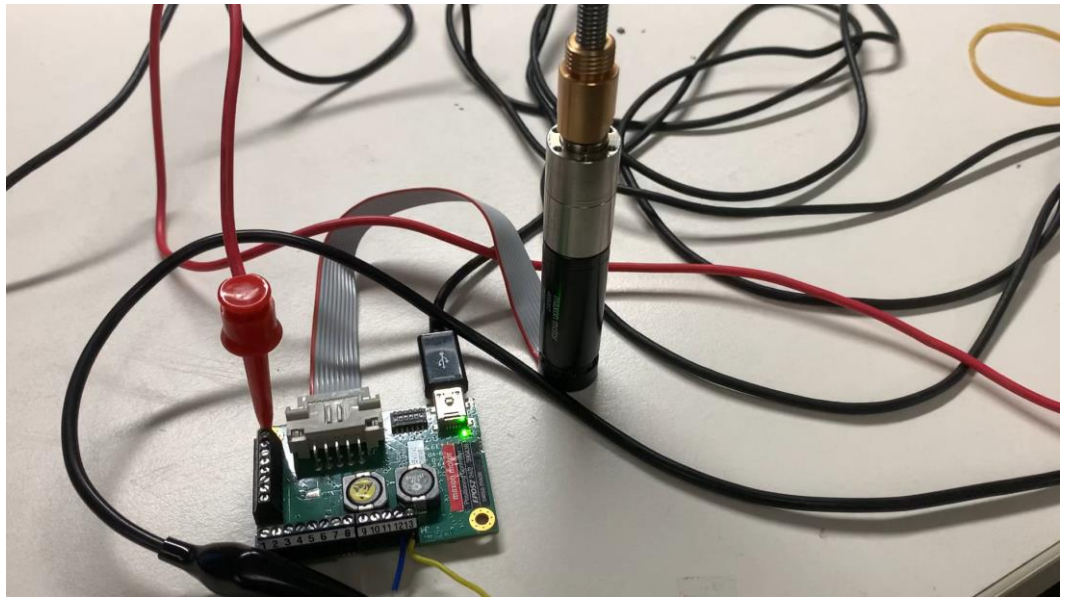


Current proof-of-concept prototype

Current State of Project

Waiting for the EPOS4 to arrive (will be discussed in dependencies).

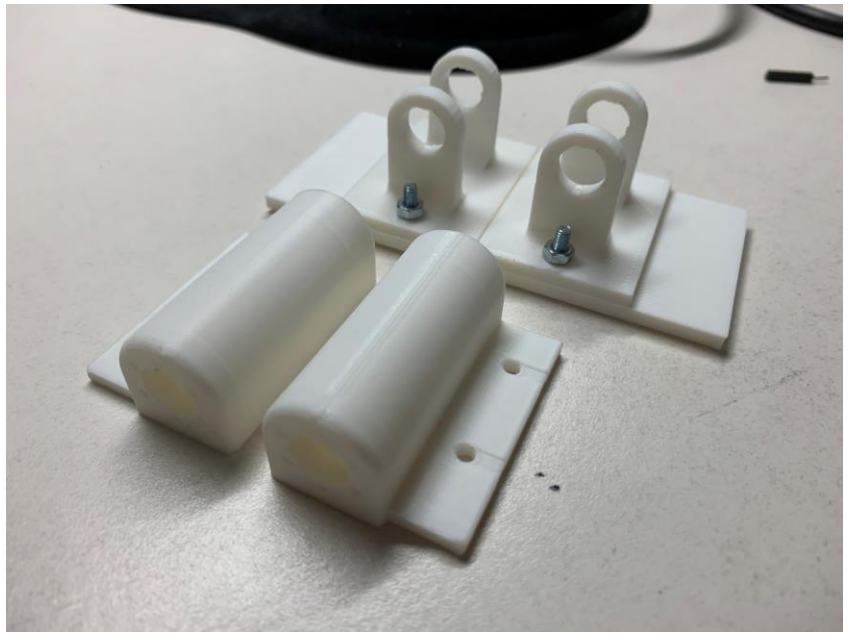
Control the motor with EPOS2 controller and experiencing with functions built in the EPOS Studio.



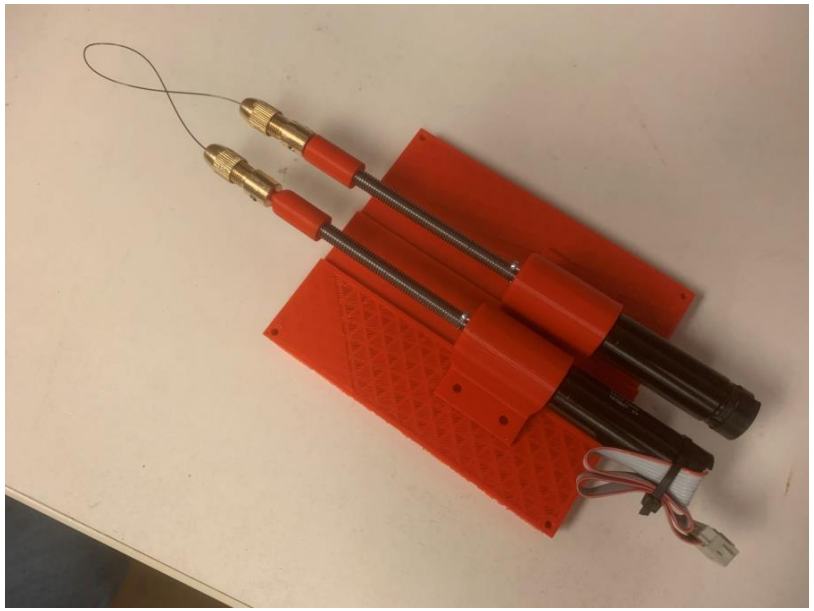
Testing functions in EPOS Studio

Technical Approach

- Current iteration focused on building better housing for proof-of-concept prototype.
- Future updates to models will depend on Dr. Singh's suggestion and recommendation.
- Newer parts will be made by 3D printer.



Original Design of proof-of-concept prototype

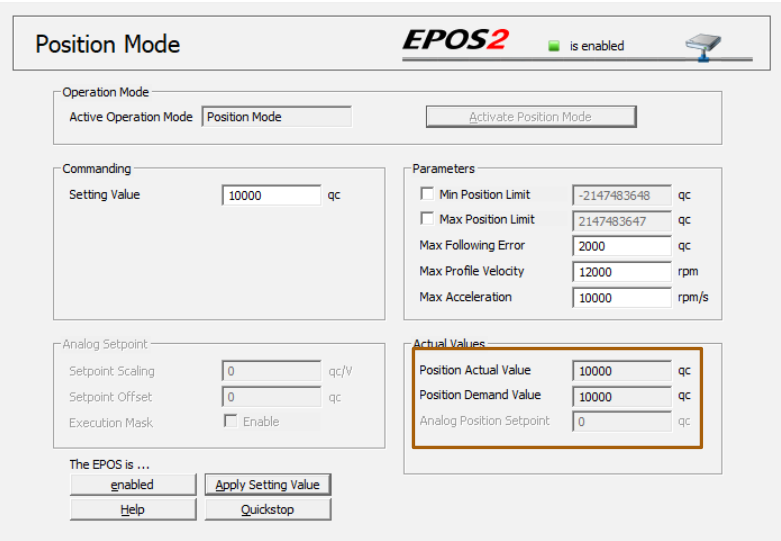


Current Design

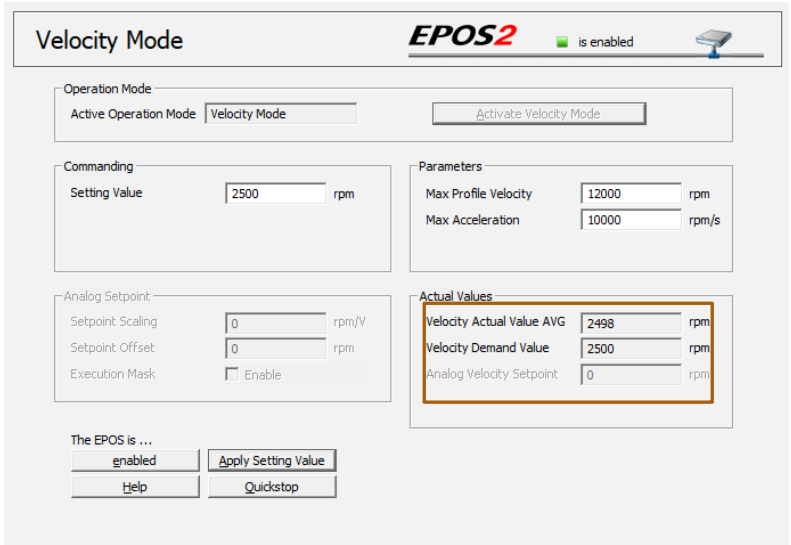
Technical Approach

Apply control algorithms for the loop:

- Control algorithms can be applied using the EPOS studio
- Linear actuator will be considered after proof-of-concept.



Example of Position control



Example of Velocity control

Deliverables

Minimum:

- Design and construct a hardware platform for the snare within design constraints
- Proof-of concept prototype test in gel ball

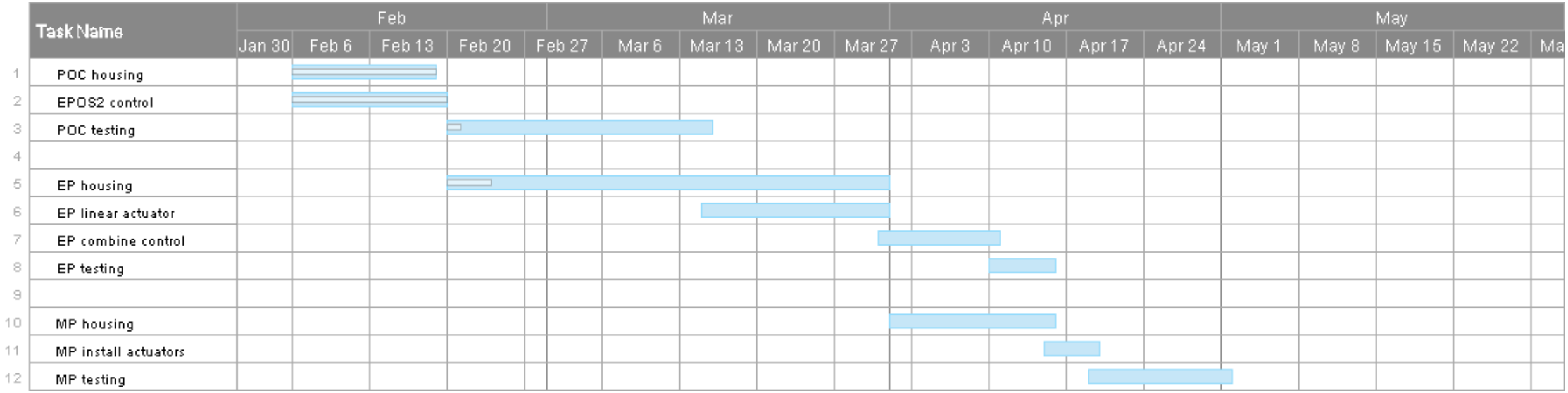
Expected:

- Based on the proof-of-concept prototype, modification on the design and add the linear actuators to the new prototype.
- Implement a control logic on motors and linear actuator using buttons (might change based on suggestion form Dr. Singh)

Maximum:

- Combine all the function obtained above into a new chassis that can operate easily.

Timeline& Milestones



POC: Proof-of-concept
EP: Expected prototype
MP: Maximum prototype

Timeline& Milestones

Milestones	**Expected Date**
POC prototype	03/15/2022
Expected prototype	04/15/2022
Maximum prototype	05/01/2022

POC: Proof-of-concept

Dependencies

	Current Status	Alternate Plan	Needed by	Effect
EPOS4	Ordered	Use a second EPOS2 motion controller	03/15/2022	Delay in using the actual controller to shrink the design
EPOS2	Obtained	N/A		
Second EPOS2	Not started	Depends on the arrival of EPOS4	03/15/2022	Depends on the arrival of EPOS4
POC* prototype	Obtained	N/A		
Linear actuator	Not started	N/A	03/31/2022	Delay in building the second prototype with left/right controlling logic
Wire for loop	Obtained	N/A	looped wire for POC by 02/28/2022	No preshaped wire: limited bending in up/down
Metal parts	Obtained for POC*	N/A	EP** by 03/31/2022	Delay in finishing prototype of Expected deliverable
Maxon motor	Obtained	N/A		
EPOS Studio	Obtained	N/A		
Linux	Obtained	N/A		
ROS	Obtained	N/A		
9-24V Power Supply	Obtained	N/A		
3D Printer	Obtained	N/A		
Solidworks	Obtained	N/A		

*POC: Proof-of-concept
**EP: Expected prototype

Project Management

Project meeting with mentors on Friday 4 pm.

Meeting with Dr. Mandeep Singh will depend on his availability.

Project files are shared in the OneDrive including the CAD files, FEA, etc.

Reading List

Cehajic-Kapetanovic J, Singh MS, Zrenner E, MacLaren RE. Bioengineering strategies for restoring vision. *Nature biomedical engineering*. January 2022. doi:10.1038/s41551-021-00836-4