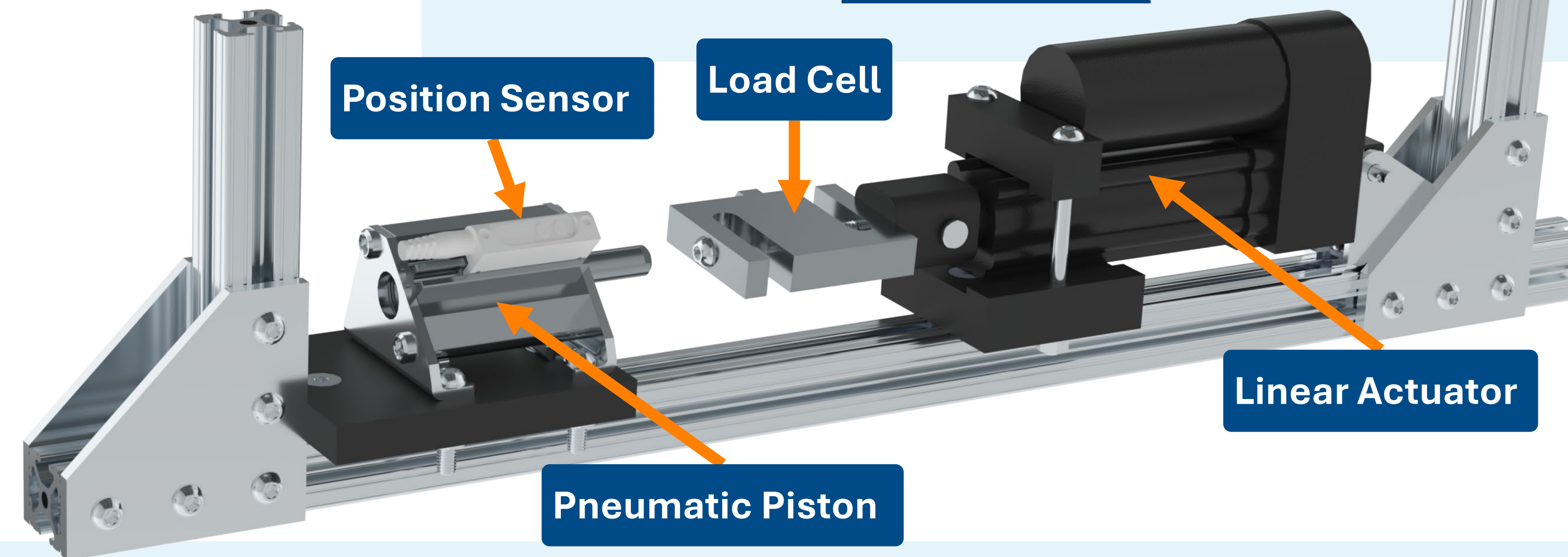
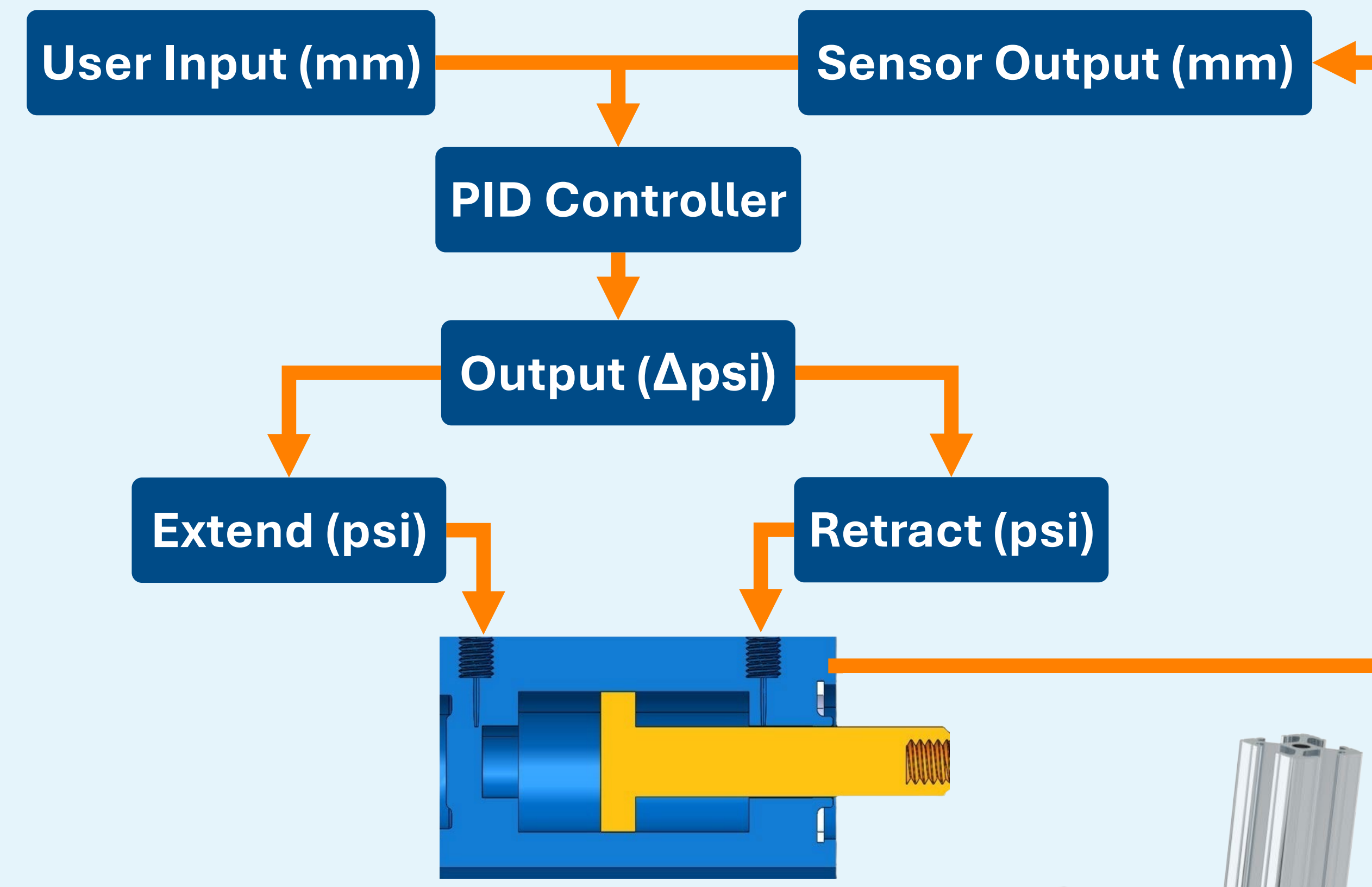


Background:

- Medtronic’s robotic system allows for minimally invasive surgeries to be more readily available, which results in faster recovery for patients.
- The system uses an instrument drive unit to control surgical instruments, increasing the weight on the robotic arm.
- Their desire is to reduce the weight by relocating actuation away from the robotic arm.
- This project explores pneumatic actuators as an alternative to motor-driven systems.



Dual Regulator Control Loop:



Key Results:

- Dual Regulators vs Enfield Valve:
 - Enfield valve has better tracking response.
 - Enfield valve has higher positional accuracy.
 - Dual regulators have superior load handling.
 - Enfield has control system “black box”.
- Trade-off:
 - Enfield valve for speed & accurate position.
 - Dual regulators for positioning while resisting load.
- Cost of Enfield: \$1050.00
- Cost of Dual Regulators: \$600.00

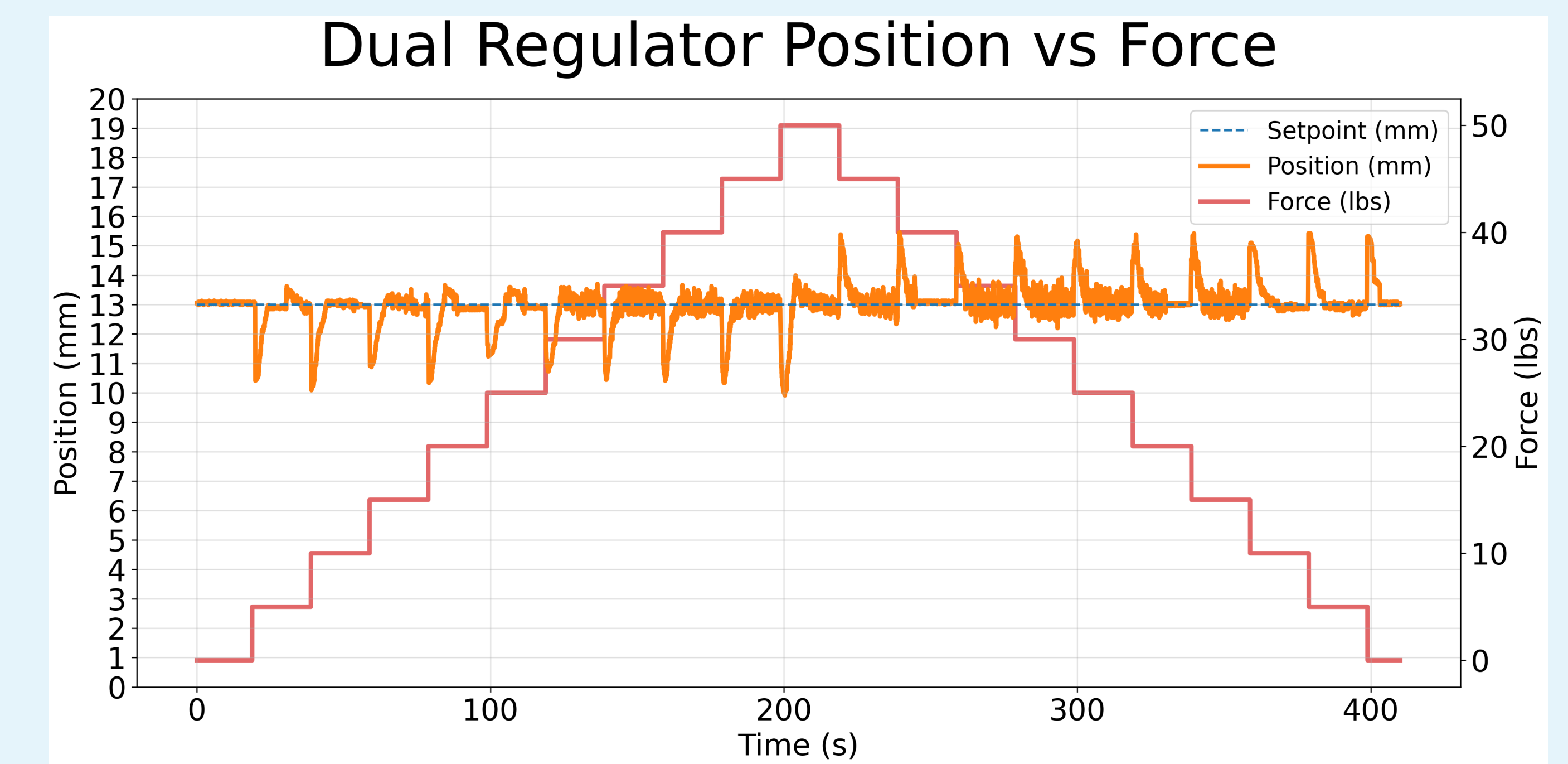
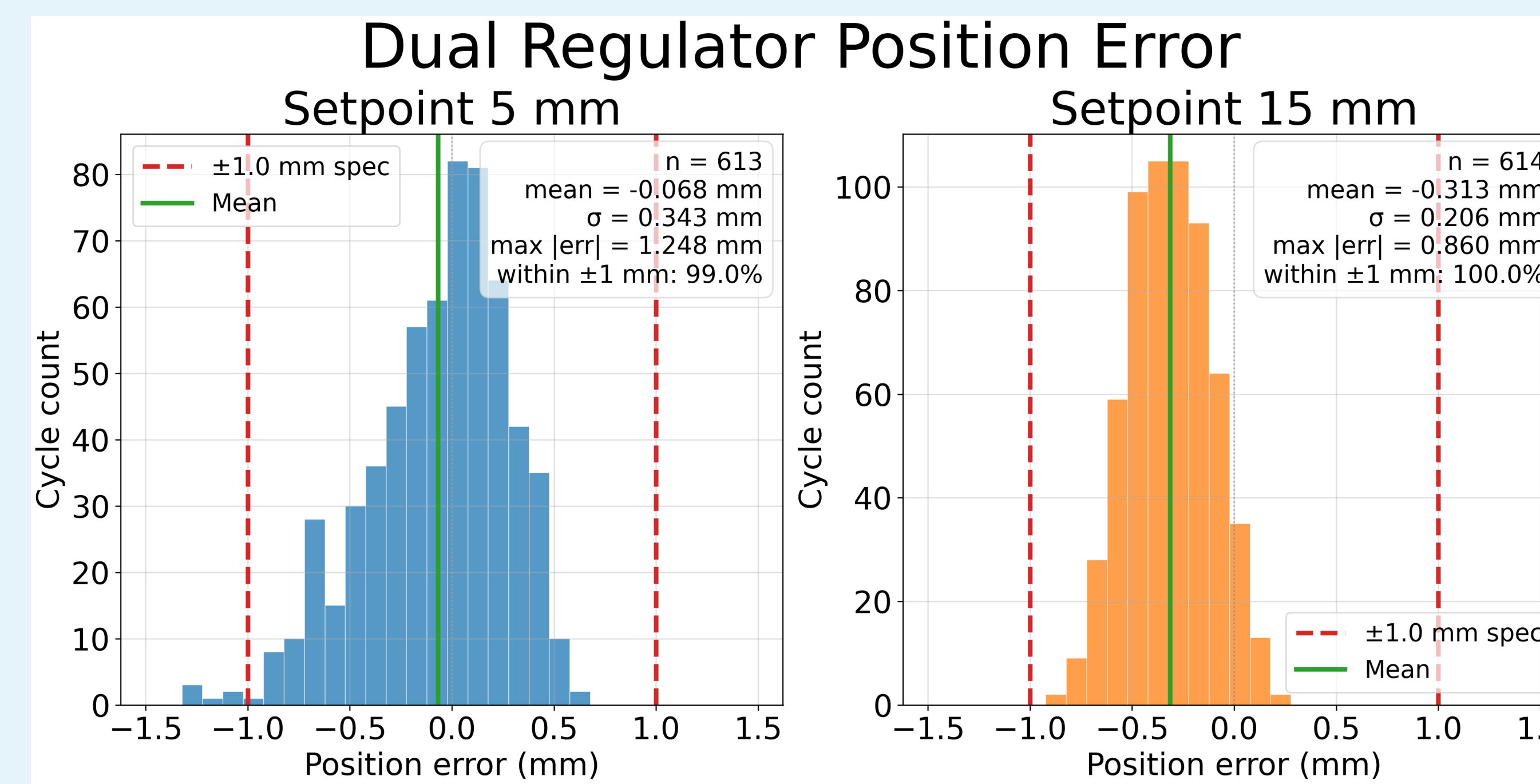
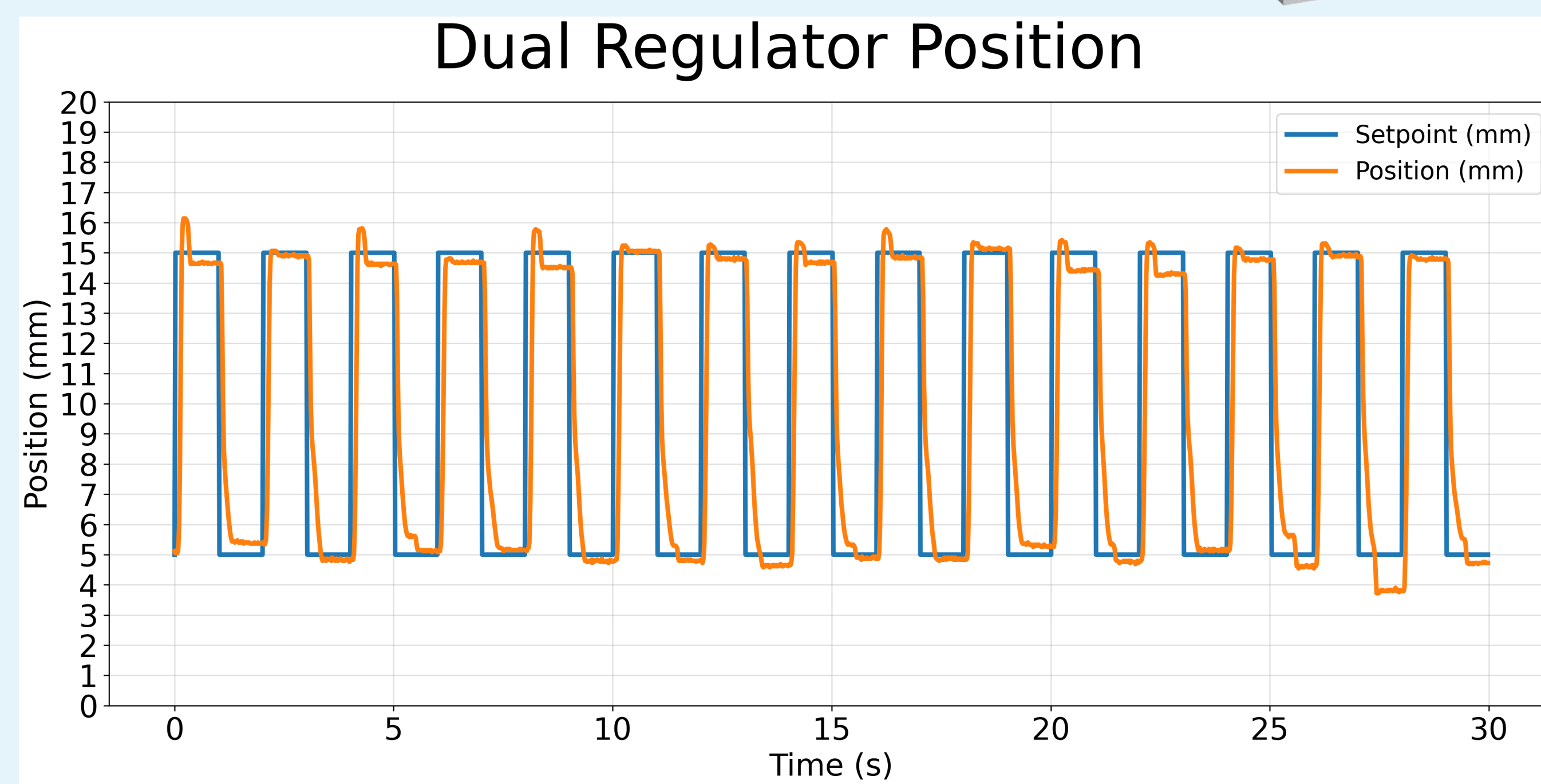
Requirements:

- ✓ Bench-top proof-of-concept system
- ✓ Less than 100 ms response time
- ✓ Less than 1 sec move & settle time
- ✓ ±1 mm positional accuracy
- ✓ Maintain ±0.5 mm under 0 - 50 lbs load
- ✓ Distal size ≤ 2× Medtronic’s instrument gearbox footprint (4.6 × 3.56 in)
- ✓ Output: 0 - 50 lbs & 1 in linear stroke

Future Work:

- Improve controls to achieve < 1 mm accuracy and ≤ 1 sec settling time.
- Explore low friction pneumatic cylinders.
- Design a custom multi-rod pneumatic actuator compatible with Medtronic instruments.
- Reduce system noise from pneumatics for surgical environment.

Dual Regulators



Enfield Valve

