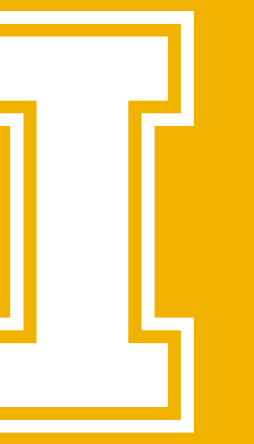
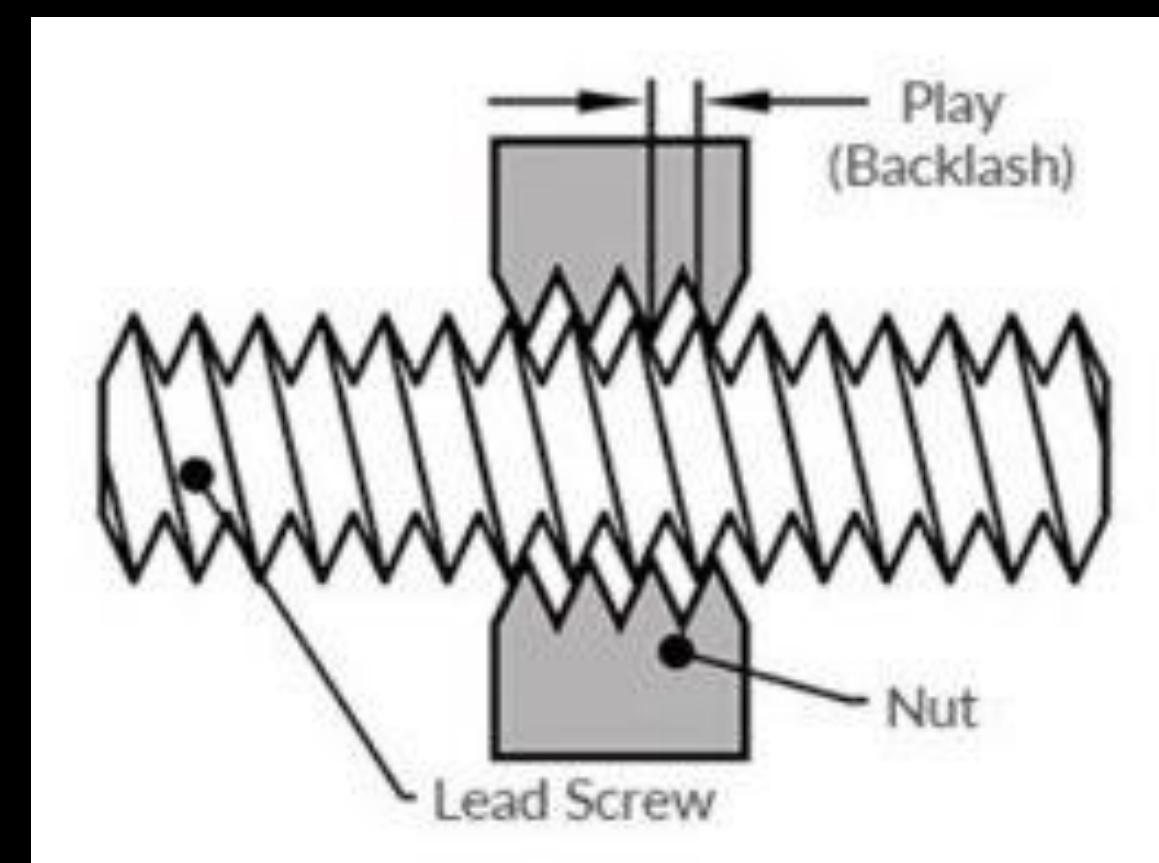


QUALITY CONTROL TESTING OF BACKLASH IN RIFLE SCOPE TURRET LEAD SCREWS



OBJECTIVE

Design, fabricate, & test an automated method to measure backlash in leadscrew threads.



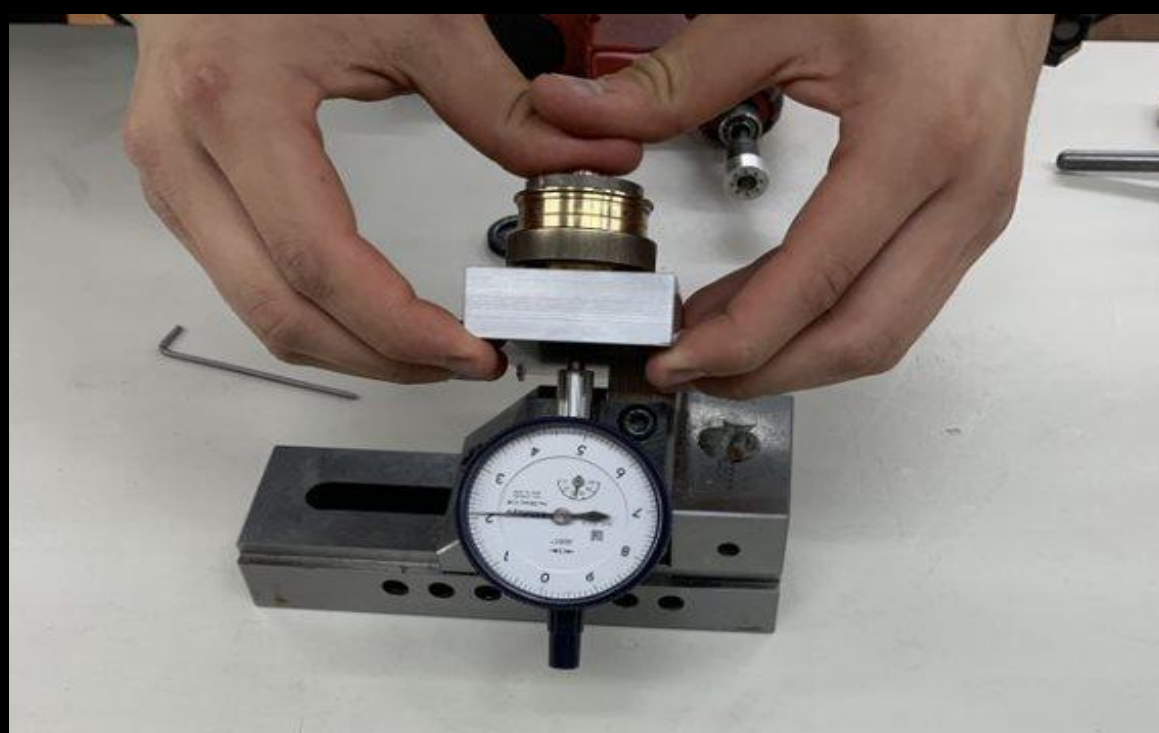
BACKGROUND

- I Fine optic adjustments for windage and elevation are made using "turrets"
- I Backlash is the clearance between mating threads
- I Backlash in the turret lead screw causes error in optic adjustments
- I Unacceptable turrets must be discovered before installation

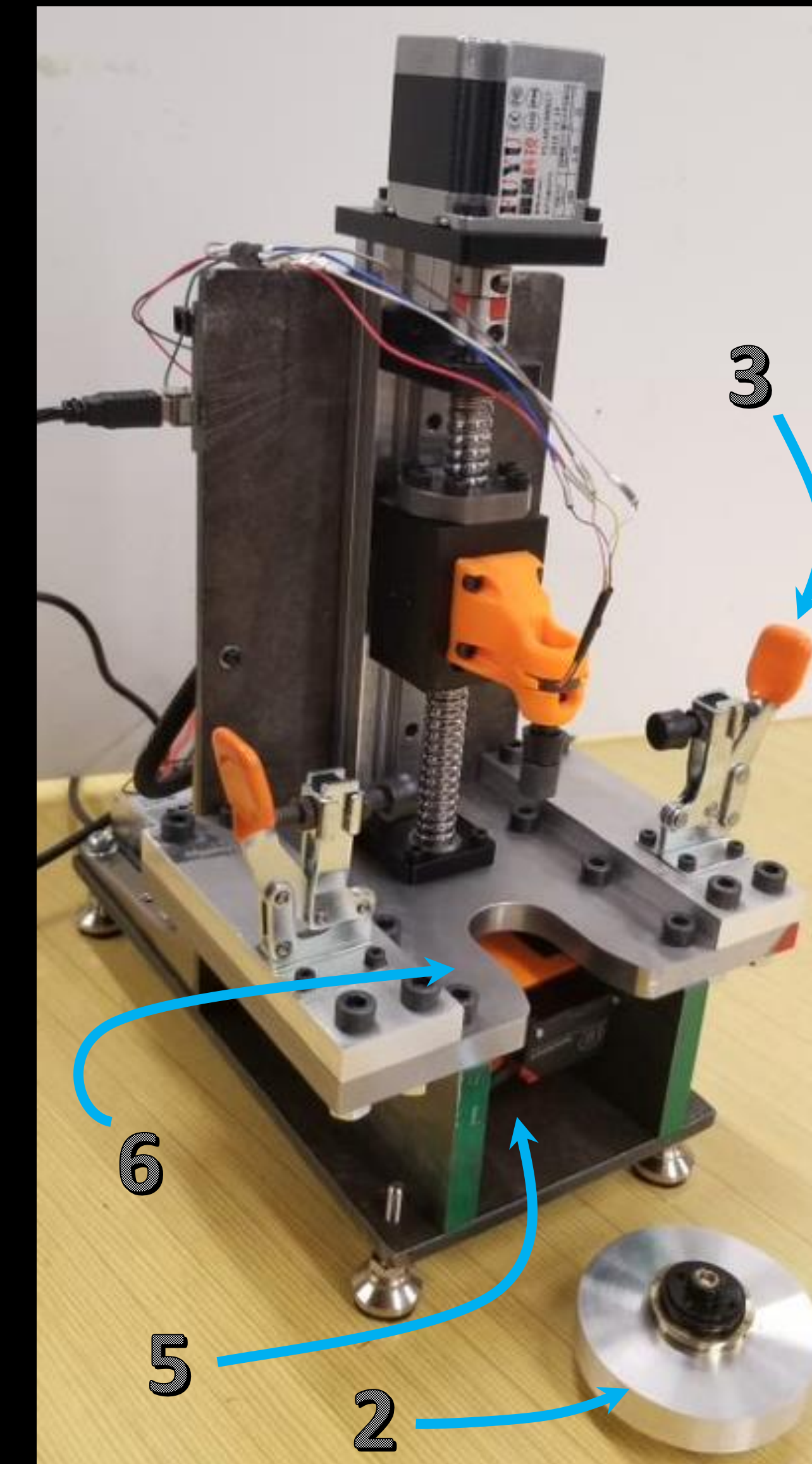
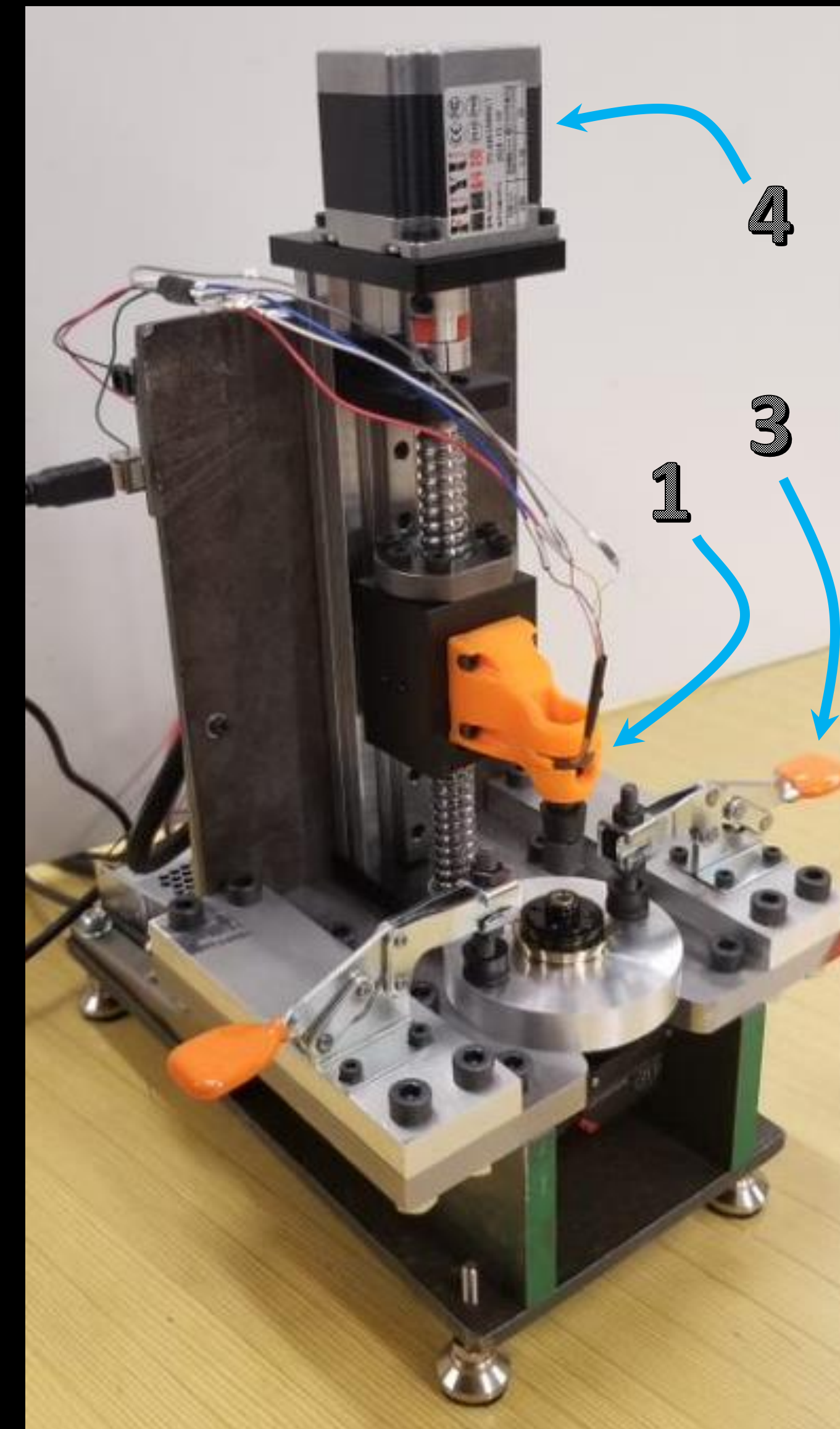
DESIGN SPECIFICATIONS

- I Machine must be free from human variability
- I Machine must repeatably apply force to the turrets
- I Machine must measure backlash in lead screw threads as accurately or more accurately than the preceding method
- I Measurements must be at least as fast as the preceding method

PRE-EXISTING TEST METHOD



The current testing method involves a mechanical indicator and pressure applied manually. This causes variability among tests and between operators.



DESIGN FEATURES

- I 1) Electronic load cell provides force application feedback ~ 10lbf
- I 2) Standardized turret adapters allow for easy fixturing and handling of various turrets
- I 3) Hold-down toggle clamps securely fixture turret adapters in position and release easily
- I 4) FUYU stepper-motor actuator applies force based on Arduino-based load cell feedback control
- I 5) Micro-Epsilon distance sensing laser accurately measures lead screw displacement
- I 6) Hardened 4140 alloy receiver plate eliminates deflection, CNC machined in-house



SPECIAL THANKS TO:

Bill Magnie, Jake Elliott, Steve Beyerlein, Tim Tilton, Ankit Gupta, and Eric Wolbrecht



Sarah Rochford – Paul Riebe – Tanner Abbott – Trent Hunter

PERFORMANCE TESTING

- I Maximum Acceptable Backlash: 3×10^{-4} in
- I System Requirements
 - Capable of reading to 1×10^{-5} in
 - System is Repeatable
- I System Capabilities
 - Variance: 1.2×10^{-5} in
 - Variance expresses required reading capability and repeatability
- I Factory Calibrated for Superior Precision and Resolution to Sub-micro-inch Level

RECOMMENDATIONS

- I Code more advanced data filtering for more accurate readings
- I Program data logging program for QC tracking
- I Incorporate a backup mechanical indicator in case of issues with the laser