Neuromechanical Implications of Postural Changes to Motor Learning and Performance

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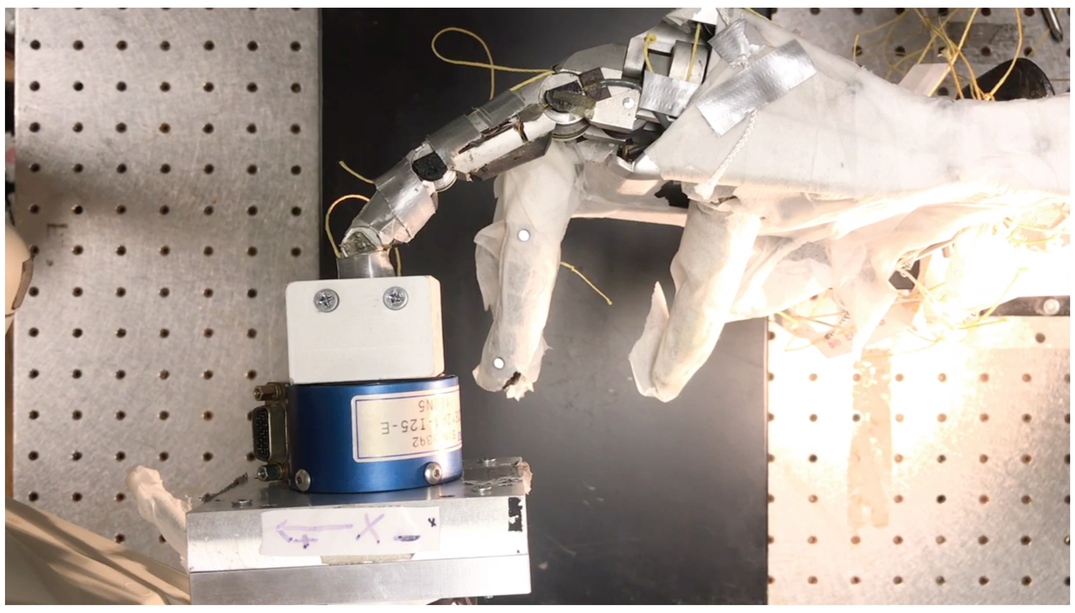
Question

Given a tendon driven limb with a workspace defined by its revolute joints, what is the effect of posture on the learnability of force control?

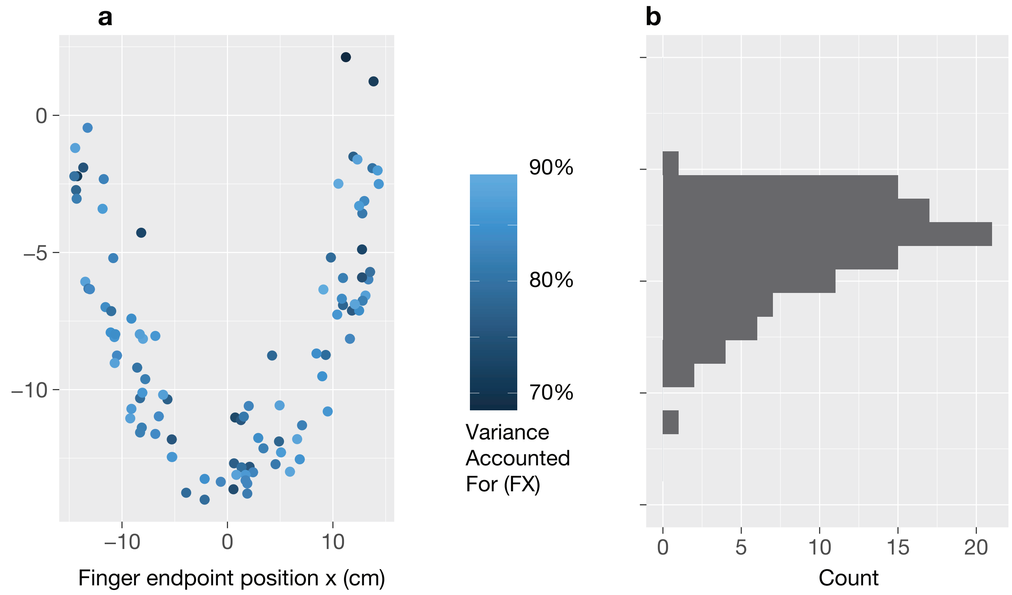


Experiment/Method

We wind up tension on cables that are tied directy to cadaveric tendons. The cable bends around the pulley where we measure cable force.

7 motors wind up 7 tendons, producing 3D robotic fingertip force. With 100 positions and 100 forces per posture, we recorded the tensions applied (x), and record the fingertip forces (b). We then solve for A in Ax = b with linear least-square regression at each posture, and evaluate fit with variance-accounted-for.

Results



(a) We found no relationship between tension-force model performance and the finger posture.
(b) Linear static models have an exceptionally high performance distribution across 100 postures.

Discussion

If this analysis proves similar in a cadaveric finger, it would help us pinpoint the exact measure of variability that comes from a musculoskeletal plant, and the remaining variance stemming from neurological noise.
Furthermore, it better helps us classify the types of variance observed across feasibility spaces [1].

Opportunities

-Applying this experimental paradigm to human and primate cadaveric fingers, and deformable robots.
-Identifying how muscles have to behave to transition between contact forces and movements.
-Producing higher fidelity models of the statics and dynamics of tendon driven systems..

Additional References available upon request:

1. Valero-Cuevas, FJ, Fundamentals of Neuromechanics, Springer-Verlag London, 2016.
2. Valero-Cuevas, F, Cohn, B, Yngvason, H, & Lawrence, E, J Biomech, 48(11), 2887-2896, 2015.
3. Inouye J, Kutch J, Valero-Cuevas FJ "Optimizing the topology of tendon-driven fingers: Rationale, predictions and im-

For questions or to request project updates:

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