

Andrew Sabelhaus

Assistant Professor, Department of Mechanical Engineering and Division of Systems Engineering, Boston University

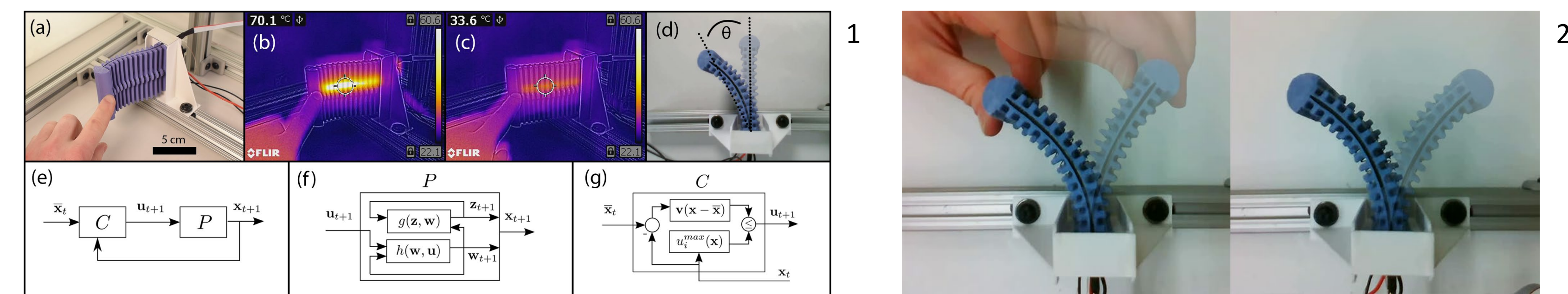
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Goal: Integrate the embodied intelligence of soft robots with artificial intelligence for deployment in the real world.

Approach: Autonomy that prioritizes safety, scalability, robustness, and practicality, rather than state tracking / performance.

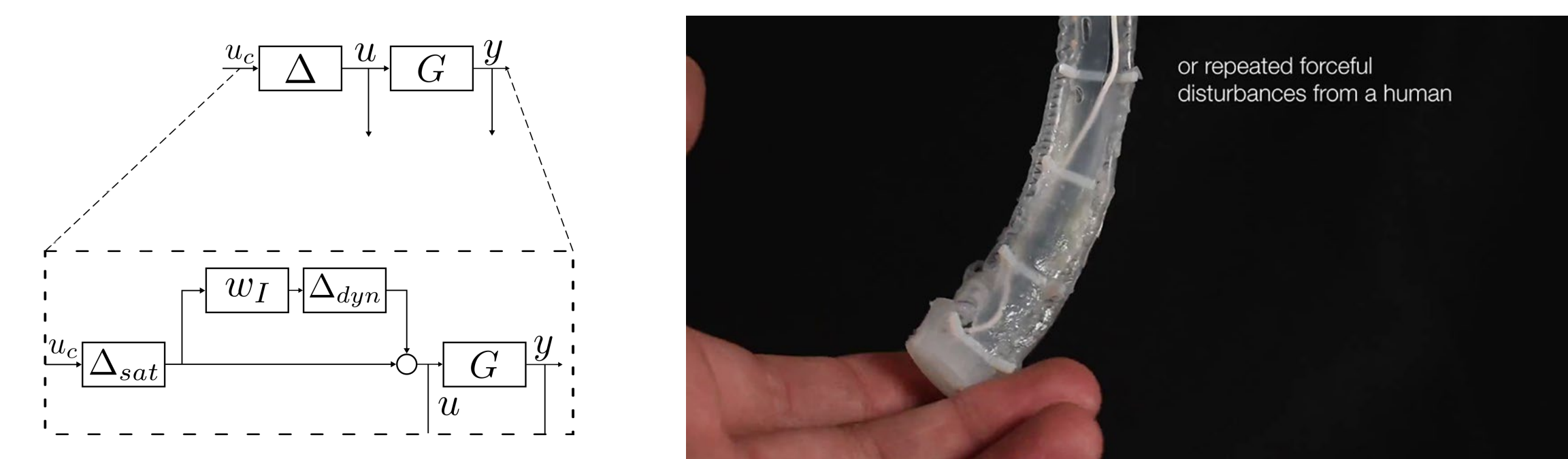
(1) Safety: Verification of interactions with environment.

Examples: Supervisory control with feedback invariance (online), trajectory optimization (offline).



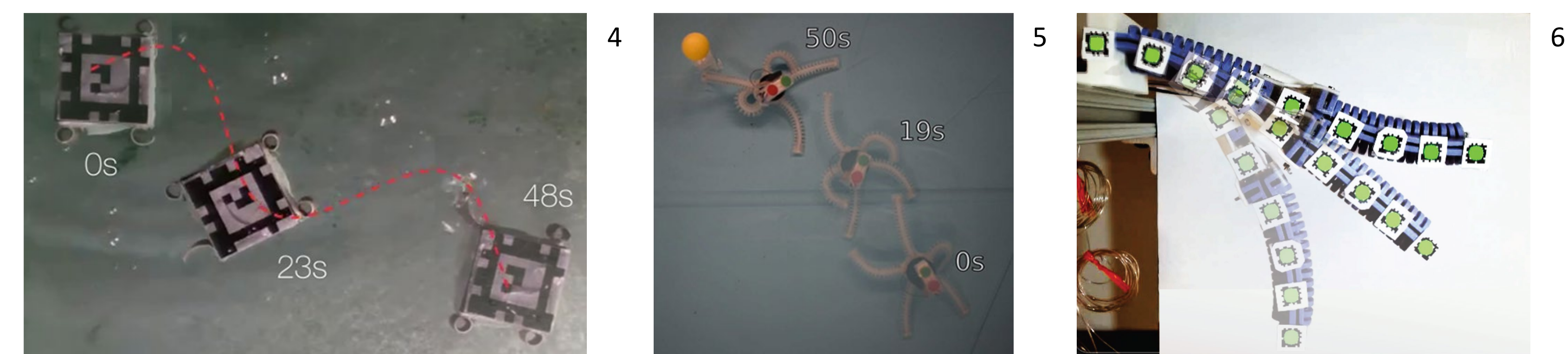
(2) Robustness: Feedback control with dynamics approximations and uncalibrated models.

Example: Linear models with softness as uncertainty.



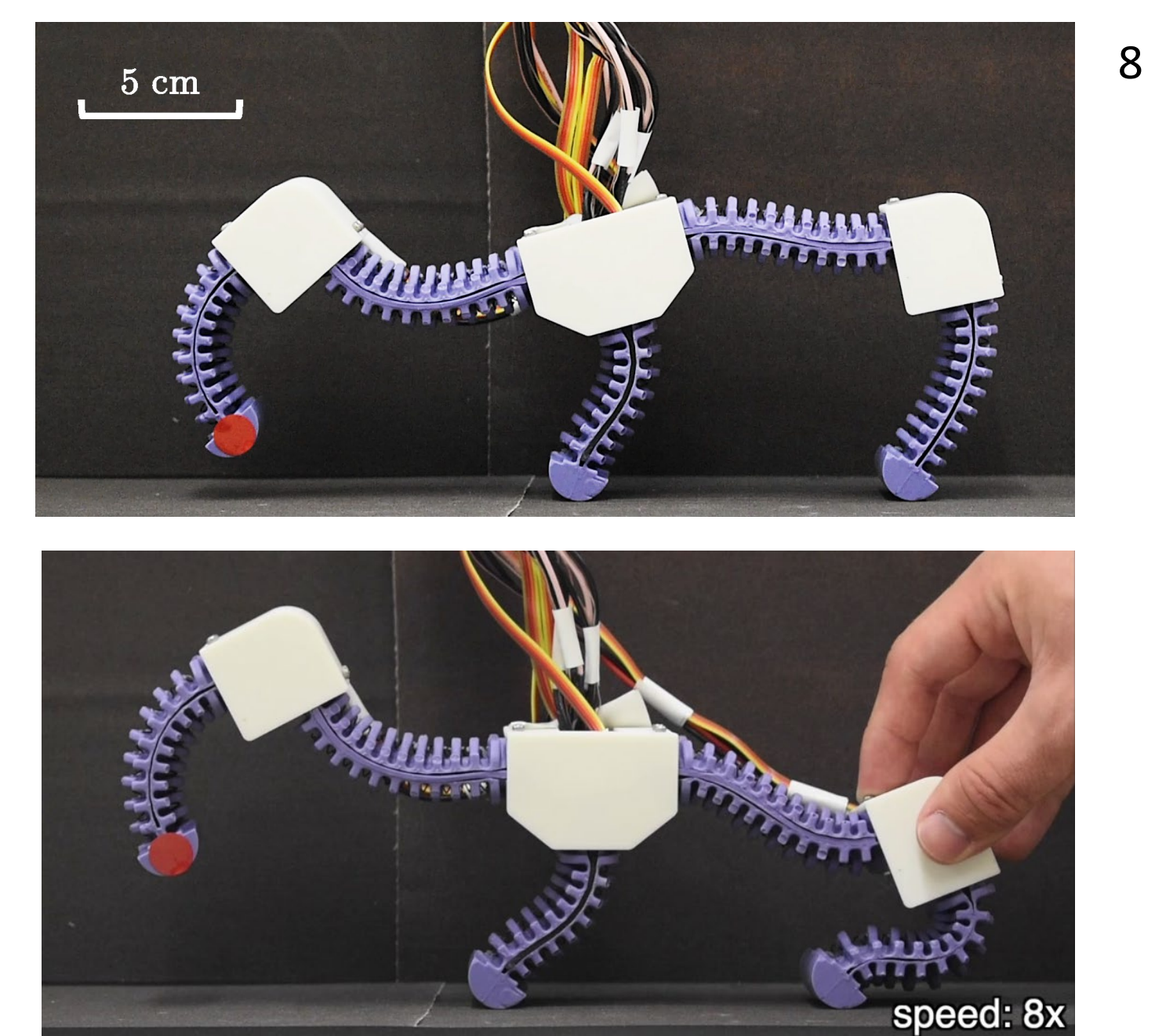
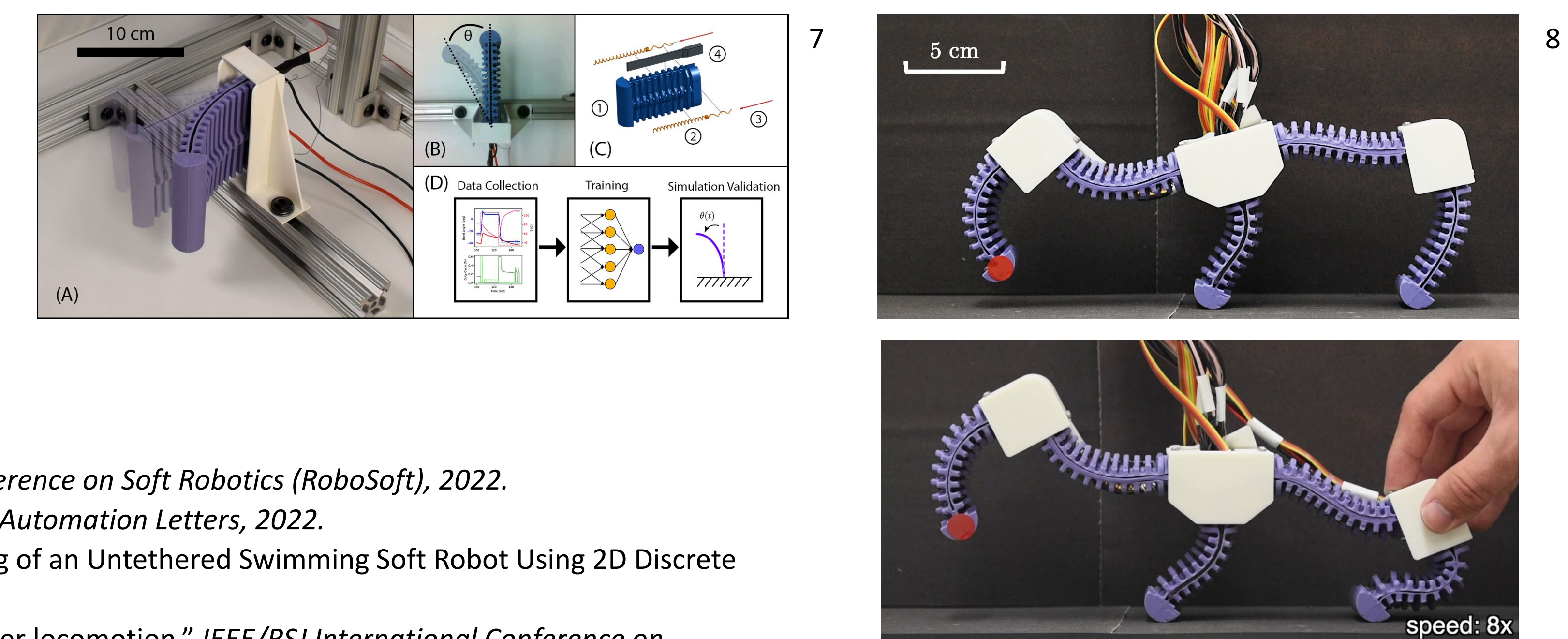
(2) Scalability: Real-time operation.

Examples: Planning at low frequencies, fast pose estimation assuming pseudo-static movements.



(4) Practicality: Design-for-control, with sufficient sensing and actuation for autonomy in untethered soft robots.

Example: Modeling and integration of artificial muscles.



1) A.P. Sabelhaus, Z.J. Patterson, A.T. Wertz, C. Majidi, "Safe Supervisory Control of Soft Robot Actuators," *Preprint, arXiv:2208.01547*
 2) A.T. Wertz*, A.P. Sabelhaus*, C. Majidi, "Trajectory optimization for thermally-actuated soft planar robot limbs," *IEEE International Conference on Soft Robotics (RoboSoft), 2022.*
 3) Z.J. Patterson, A.P. Sabelhaus, C. Majidi, "Robust control of a multi-axis shape memory alloy-driven soft manipulator," *IEEE Robotics and Automation Letters, 2022.*
 4) X. Huang, Z.J. Patterson, A.P. Sabelhaus, W. Huang, K. Chin, Z. Ren, M.K. Jawed, Carmel Majidi, "Design and Closed-Loop Motion Planning of an Untethered Swimming Soft Robot Using 2D Discrete Elastic Rods-based Physics Engine," *Advanced Intelligent Systems, 2022*
 5) Z.J. Patterson, A.P. Sabelhaus, K. Chin, T. Hellebrekers, C. Majidi, "An untethered brittle star-inspired soft robot for closed-loop underwater locomotion," *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2020*
 6) J.C. Pacheco Garcia, R. Jing, M.L. Anderson, M. Ianus-Valdivia, A.P. Sabelhaus, "A Comparison of Mechanics Simplifications in Pose Estimation for Thermally-Actuated Soft Robot Limbs," *Under Review.*
 7) A.P. Sabelhaus, R.K. Mehta, A.T. Wertz, C. Majidi, "In-Situ Sensing and Dynamics Predictions for Electrothermally-Actuated Soft Robot Limbs," *Frontiers in Robotics and AI, 2022*
 8) R. Jing, M.L. Anderson, M. Ianus-Valdivia, A.A. Ali, C. Majidi, A.P. Sabelhaus, "Safe Balancing Control of a Soft Legged Robot," *Preprint, arXiv:2209.13715*