

Dexterous Compliant Manipulation using Delta Arrays

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Motivation

This project focuses on building dexterous manipulators consisting of arrays of three degrees-of-freedom parallel delta robots. We use compliant materials to manufacture parallel mechanisms to enhance safety when assisting and interacting with humans.

Challenges

- Modeling and control of compliant linkages
- Implementation of sensors into the structure
- Coordination between individual mechanisms
- Mapping from high-level task objectives to low-level control policies
- Incorporating human signals to improve comfort and ease of use

Scientific Impact

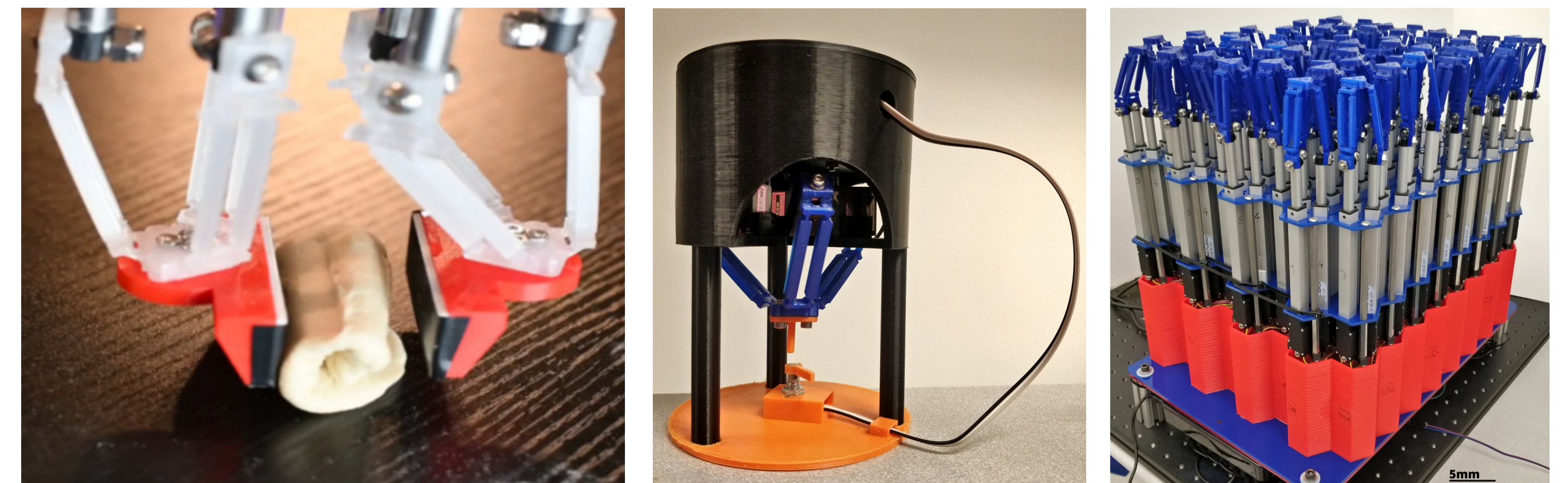
- Human-centered design of compliant robots with embedded sensors using different modalities
- Transferrable control approaches and a unified framework for coordination strategies within robot arrays
- Democratization of manipulators for research settings through low-cost and accessible design and manufacturing system

Broader Impacts

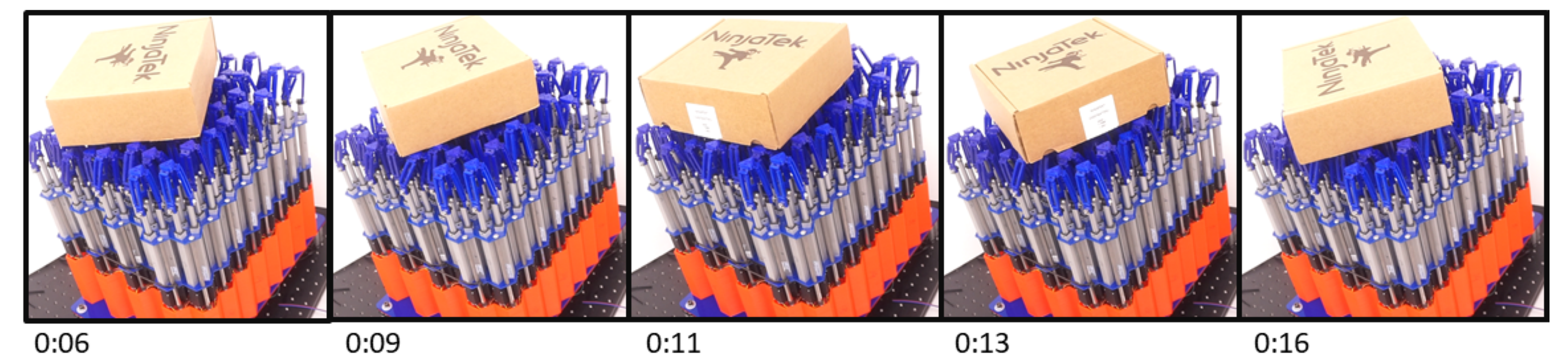
- Easy and accessible techniques to lower barriers to entry
- Human-centered approach to assistive feeding models
- Educational robot to teach kinematics, soft robotics, manipulation, and learning

New Contributions

- A low-cost, educational manipulation platform for a broad range of capabilities and robust functionalities
- Demonstration of coordinated distributed manipulations including translation, alignment, and prehensile squeezing



Left: Delta fingers rolling dough. Middle: DeltaZ educational robot with a potentiometer mounted on the base. Right: Delta array consisting of 64 delta robots providing 192 degrees of freedom.



A box object is rotated by delta arrays while the position on the array stayed same, with the time stamp in seconds below.