CIFellows 2020-2021

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Programmable Artificial Muscles for Modular Robots and Interactive Systems:

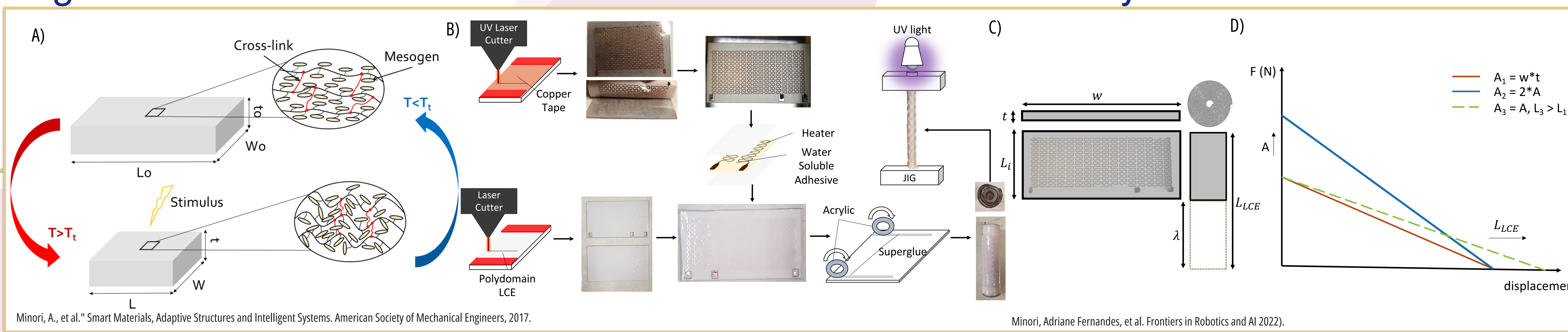


Figure 1: Programmable actuation performance of the artificial muscle liquid crystal elastomer (LCE). A) The reversible deformation of the stimuli-driven actuator can be programmed depending on the orientation of its internal molecules, mesogens. B) The actuator can be patterned into different shapes using a laminate fabrication process. C)-D)The geometry of the actuator can be customized to achieve different performances.

Power Amplification for Jumping Soft Robots Actuated by Artificial Muscles

In this work, we propose an approach to designing soft mechanisms using snap-through of shells for power-amplification of jumpers actuated by electrically powered LCE as the artificial muscle:

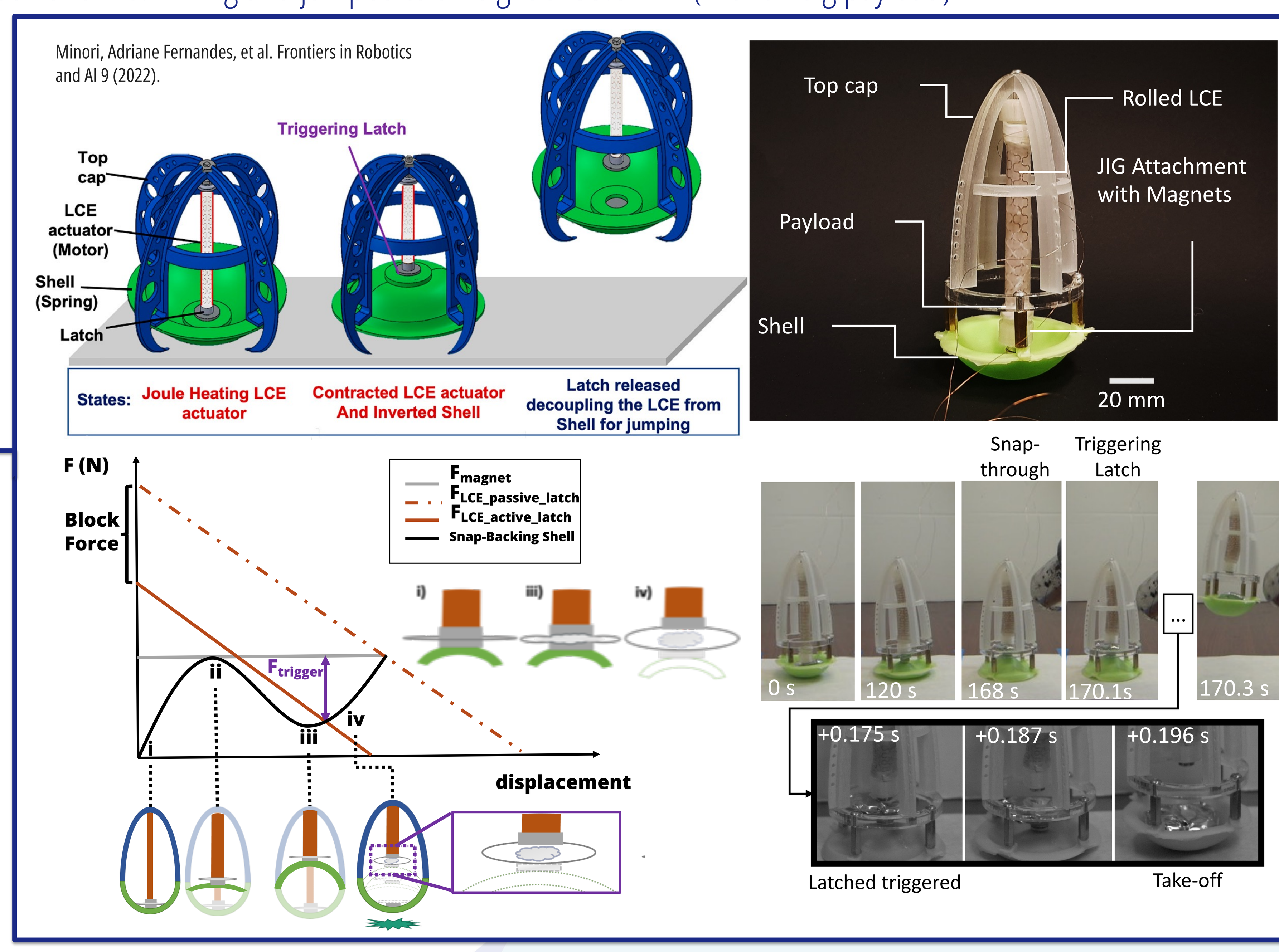
- We used the tunable geometry of a liquid crystal elastomer actuator, an elastic hemispherical shell, and a pouch motor for active latching to achieve rapid motions, like jumping, despite the actuator's slow contraction rate.
- Our system amplified the power output of the LCE actuator by a factor of 8.12 × 10^3 with a specific power of 26.4 W/kg and jumped to a height of 55.6 mm (with a 20 g payload)

Smart Materials
Artificial muscles
Shape Memory Effect Materials
Liquid Crystal Elastomers

HCI
Interactive and Reconfigurable Systems
Embodied Computing
Computational Design

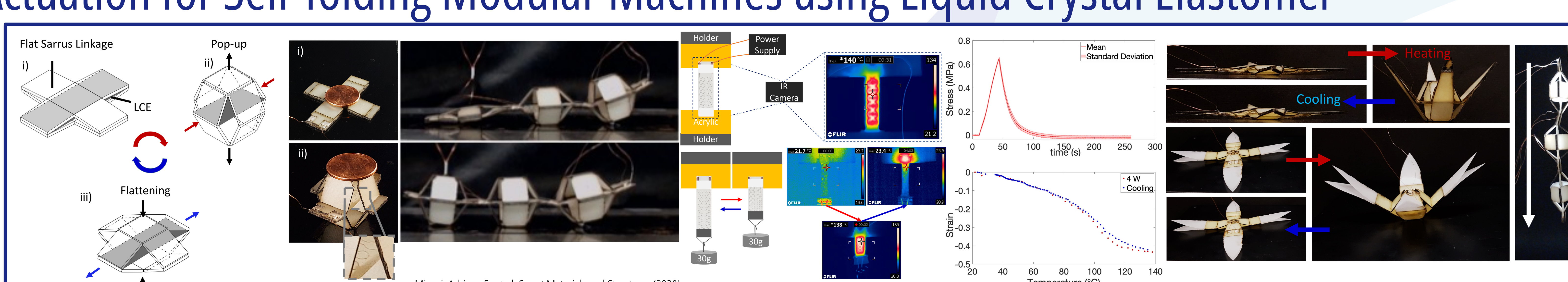
Robotics
Actuation
Rapid Fabrication
Morphing Robots
Bioinspired Robots

Figure 2: A modular soft robot with a mechanism for amplifying the power output of artificial muscles to achieve rapid motions (i.e., jumping) using a motor-spring-latch design .



Reversible Actuation for Self-folding Modular Machines using Liquid Crystal Elastomer

Figure 3: A pop-up mechanism that transmits the folding to more than one hinge and achieves reversible self-folding with a single actuation layer using a tensional actuation of the LCE



Ongoing Projects:

- Reversible Self-Locking Mechanism for Reconfigurable and Interactive Systems using Artificial Muscles (Submitted)
- Mechanically Programmed and Sustainable Robots Self-Powered by the Environment

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