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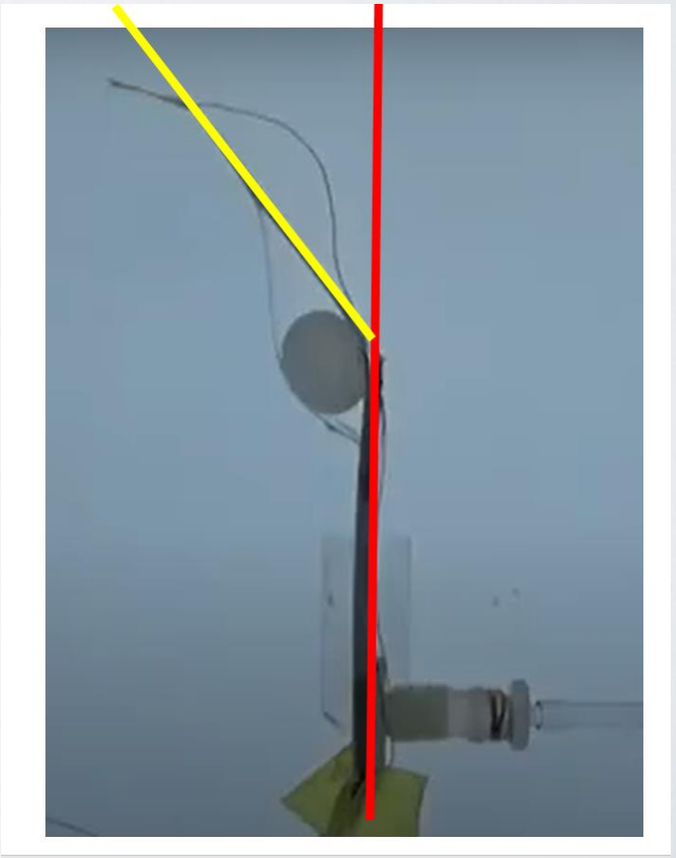
Novel soft robotic finger model driven by electrohydrodynamic (EHD) pump

Key words:

Theoretical modeling; Robotic fingers; EHD drive



Exposure scenarios

Intentional Application

- Precision grasping in robotics
- Complex robotic hand operations
- Promoting human-robot collaboration

Methods

- The manufacturing process of the robotic finger involves the assembly of a single-layer actuator, an EHD pump, and the injection of a conductive fluid .
- A physical model of the EHD pump-driven robotic finger was developed, connecting the EHD pump system and the finger dynamics. All calculations and demonstrations were performed using Mathematica 12.3 with symbolic computation techniques .
- The finger powered with a comb electrode acts as a pump that can manipulate a rubber sheet, causing the PP sheet to inflate like a balloon. This behavior is governed by a series of mathematical relationships and boundary conditions .
- The deflection angle of the robotic finger in relation to various parameters and the expansion behavior of the rubber sheet was calculated. The deflection angle can be deduced from the applied voltage.

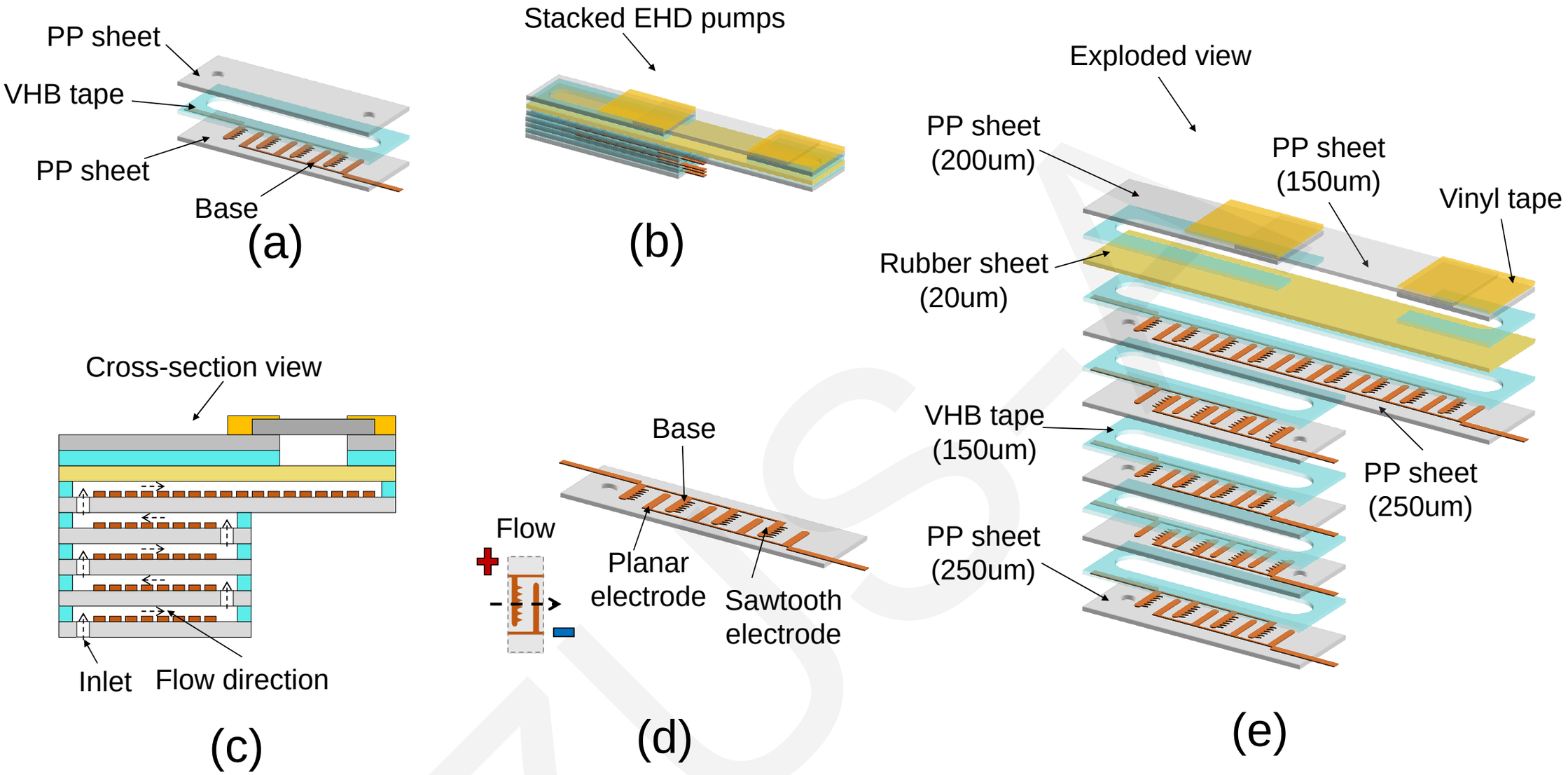


Fig. 1 Stacked EHD pump structure and breakdown of a single EHD pump: (a) layered construction of a single EHD pump; (b) stacking configuration of EHD pumps; (c) illustration of electrolyte flow direction; (d) electrode design; (e) exploded view of stacked EHD pumps and finger actuators.

Perspectives and Research Priorities

Research Priorities:

- Soft robotics focuses on designing robots using compliant materials to mimic natural organisms and integrate various driving sources.
- EHD pump-driven actuators offer advantages like flexibility, noiseless operation, and lack of mechanical wear, leading to advancements in soft robotics.
- Mathematical modeling is crucial for understanding the deflection angle and behavior of robotic fingers in soft robotics applications.
- Integrating EHD pumps with robotic fingers can enhance structural convenience and system efficiency, as demonstrated in a comprehensive mathematical model.