

Y-Zipper: 3D Printing Zipper Mechanism for Linking, Deforming and Stiffness Controlling

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Idea from Patent of Bill Freeman 1988



United States Patent [19] **Patent Number:** **4,757,577**
Freeman [45] **Date of Patent:** **Jul. 19, 1988**

[54] **MULTI-WAY SLIDE FASTENER AND STRUCTURAL SUPPORT**
 [76] Inventor: William Freeman, 23 Warwick Rd. #1, Brookline, Mass. 02146
 [21] Appl. No.: 903,218
 [22] Filed: Sep. 2, 1986
 [51] Int. Cl.⁴ A44B 19/02
 [52] U.S. Cl. 24/382; 24/411
 [58] Field of Search 24/382, 383, 386, 387, 24/399, 403, 411; 52/108

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Primary Examiner—Victor N. Sakran

16 Claims, 4 Drawing Sheets

Attorney, Agent, or Firm—Cesari & McKenna

[57] ABSTRACT

This invention relates generally to fasteners, and more particularly to slide fasteners, commonly known as zippers, and a method of forming the same, which may be used to fasten three or more sets of links together, as well as, to provide a collapsible, rigid support for loads which may be applied axially and laterally to the fastened together links. The invention is easily stored and uses a single slider for interlocking the separate sets of elements in a simple and effective manner. The tapes have multiple links secured thereto and extend orthogonally therefrom. The slider has guideways through which the links may pass. The tapes and the links are passed downward through the slider element to thereby intersperse and interlock the links and thus the tape. The opposite movement through the slider causes the links to be separated and disjoined. The invention also includes a slide fastener having three tapes with essentially standard slide fastener links attached thereto and a slider which intersperses the links to join the tapes in a columnar fashion and which effectively disjoins the links.

U.S. Patent Jul. 19, 1988 Sheet 1 of 4 **4,757,577**

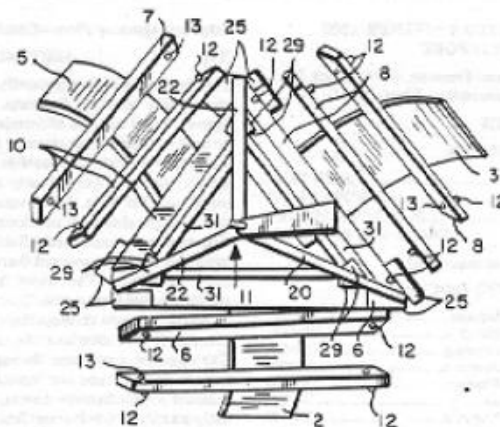


FIG. 1



William T. Freeman

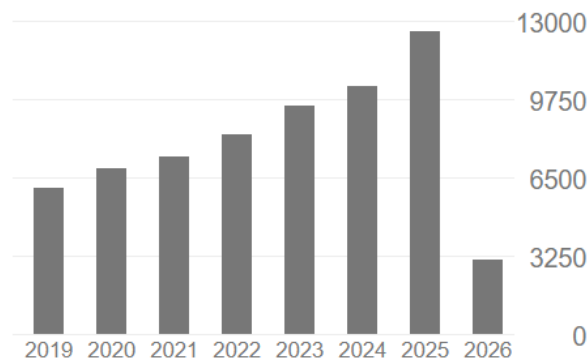
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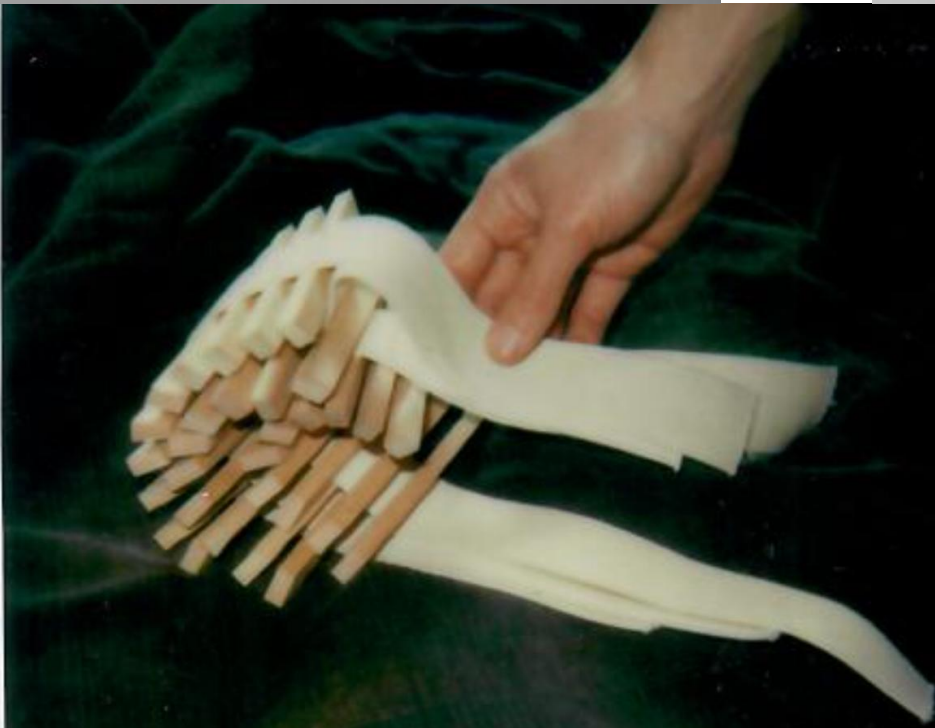
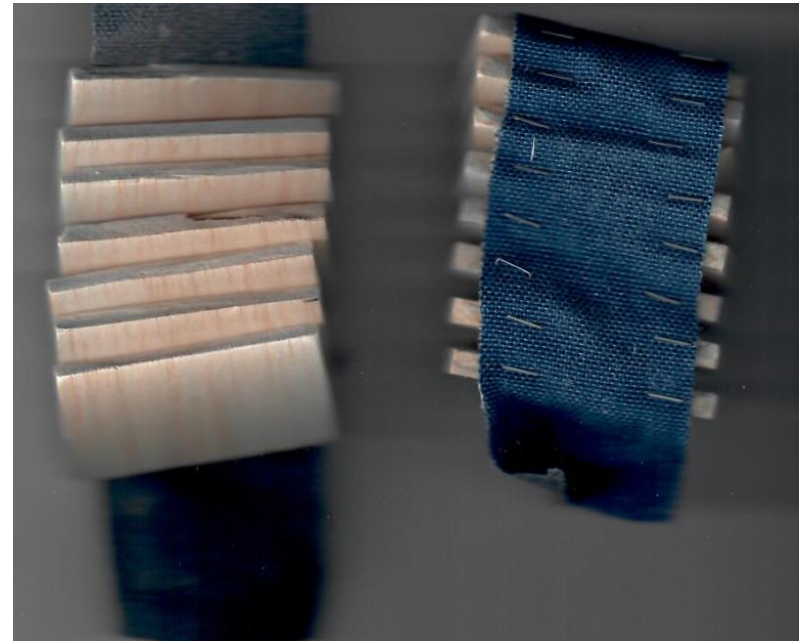
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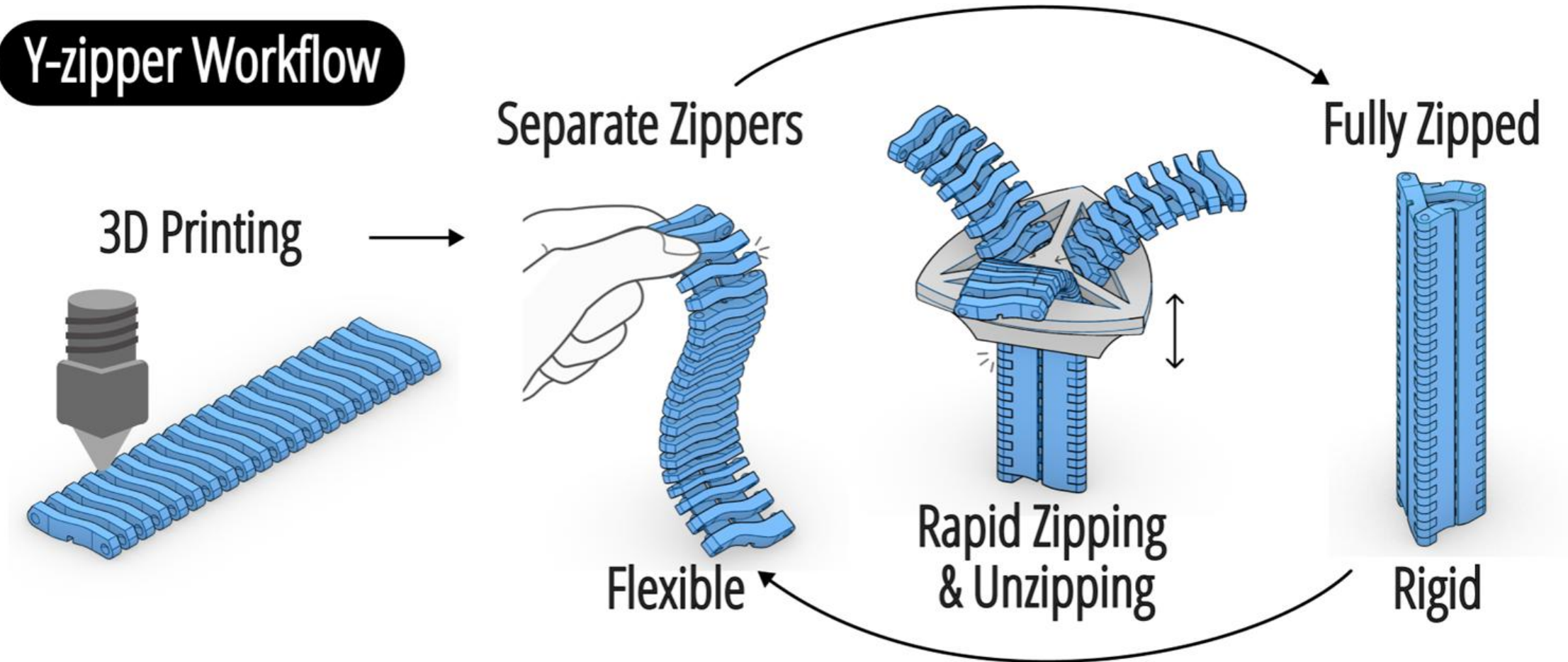
Based on funding mandates



Y-zipper introduces a novel **Flex-Rigid Transition Mechanism** that enables three **Flexible** zipper strips to interlock into one **Rigid** rod-like form



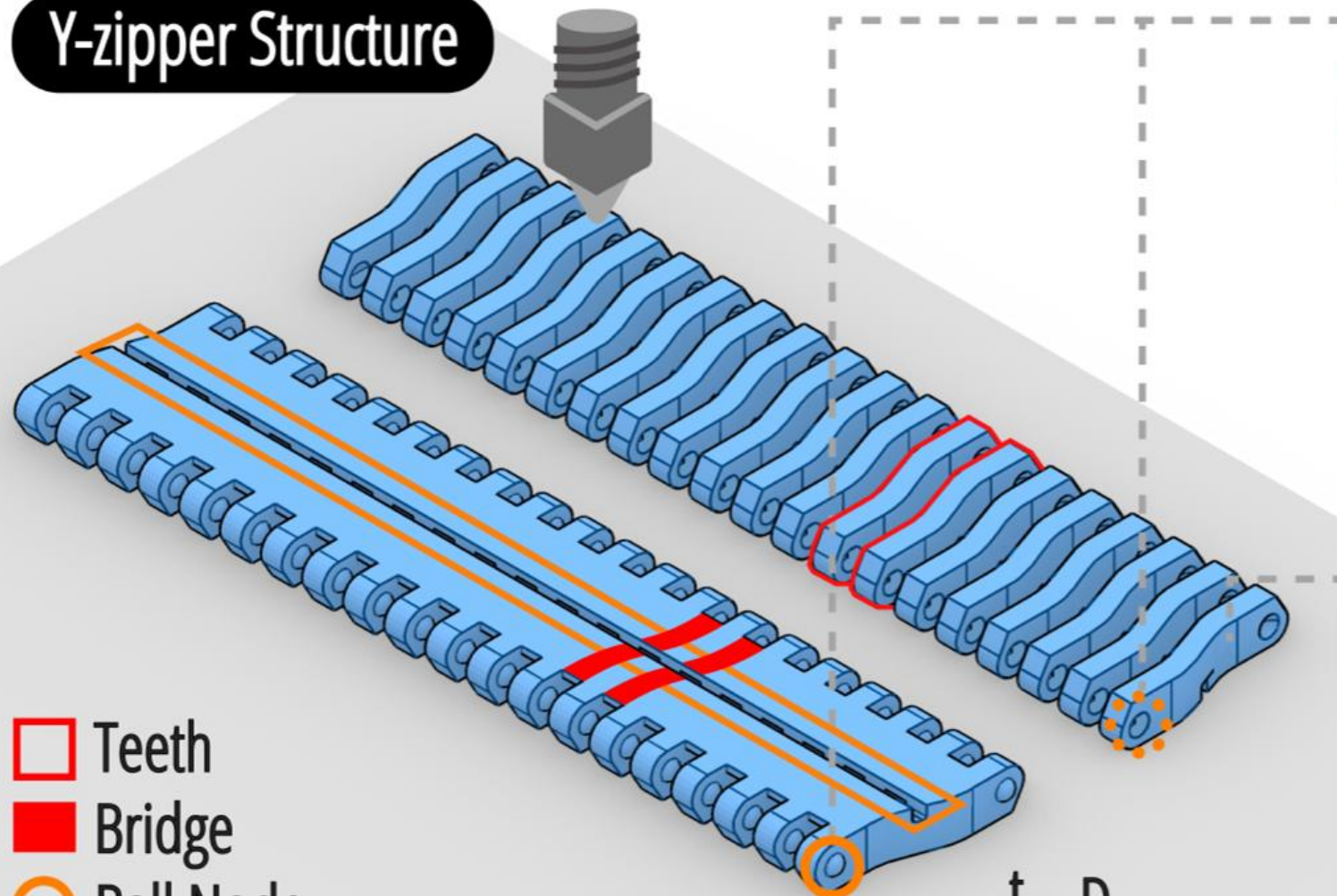
Y-zipper Workflow



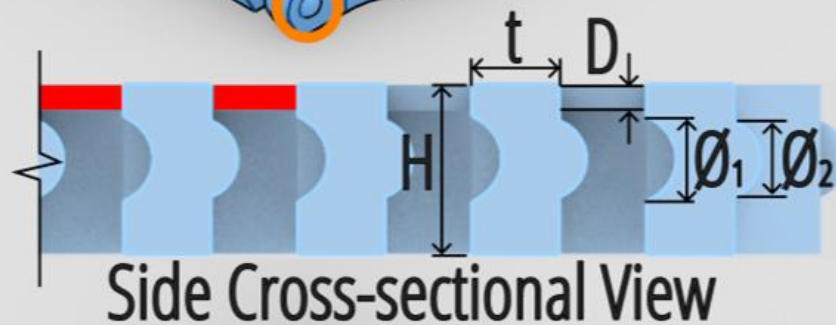
Contributions:

- **Controllable Soft–Rigid Transition:** Enables rapid switching from a flexible to a rigid state
- **Fast Actuation for Construction:** Achieves shape change and locking within seconds
- **Reversible and Reusable:** Supports multiple switching cycles

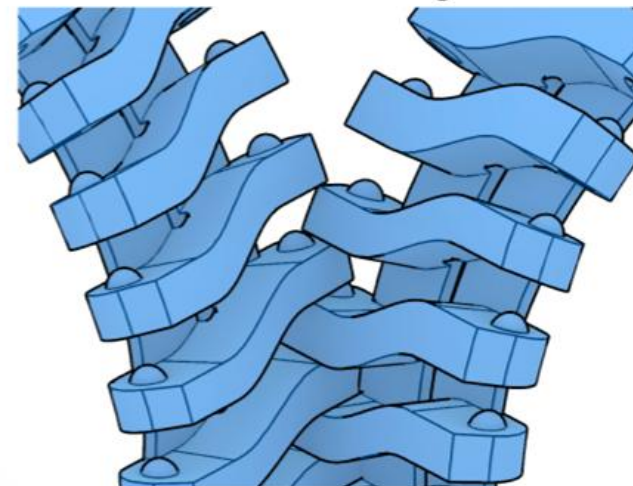
Y-zipper Structure



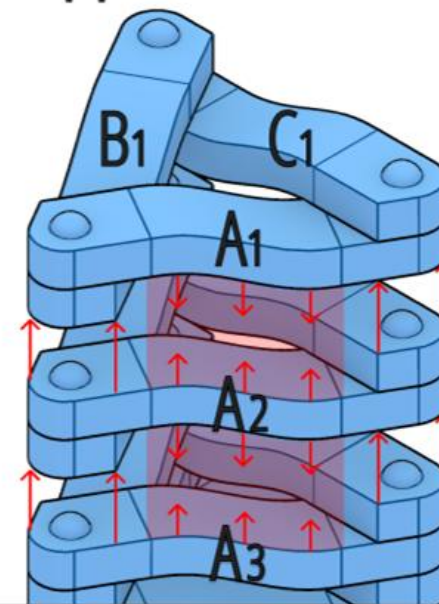
- Teeth
- Bridge
- Ball Node
- Ball Socket
- Guide Rail



Ball & Socket Joint

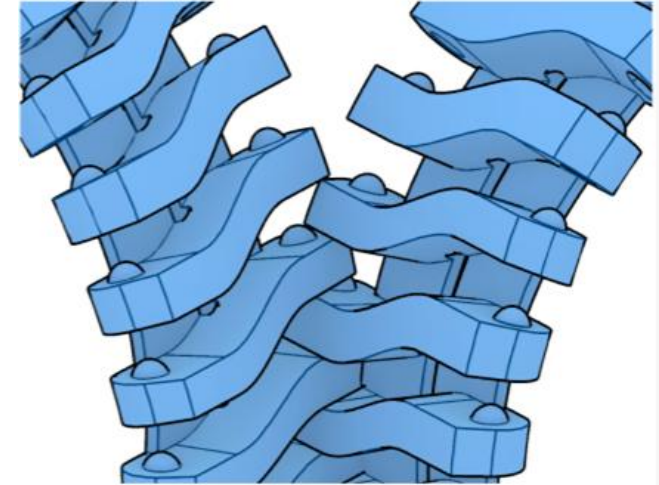


Support Mechanism

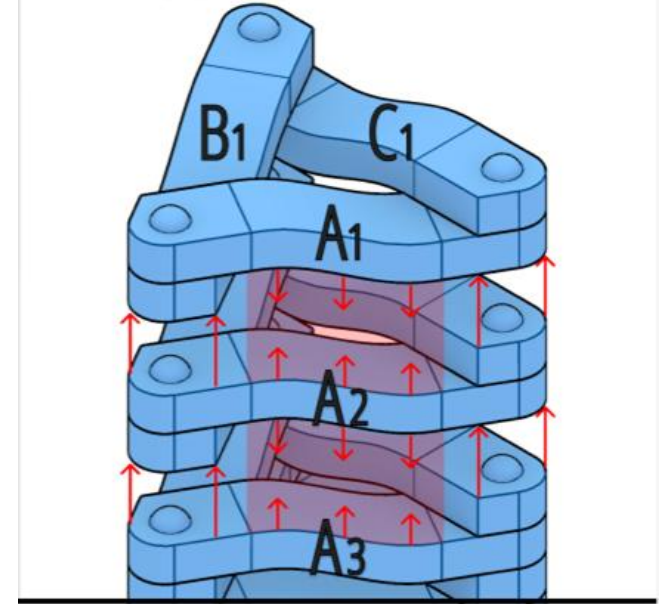




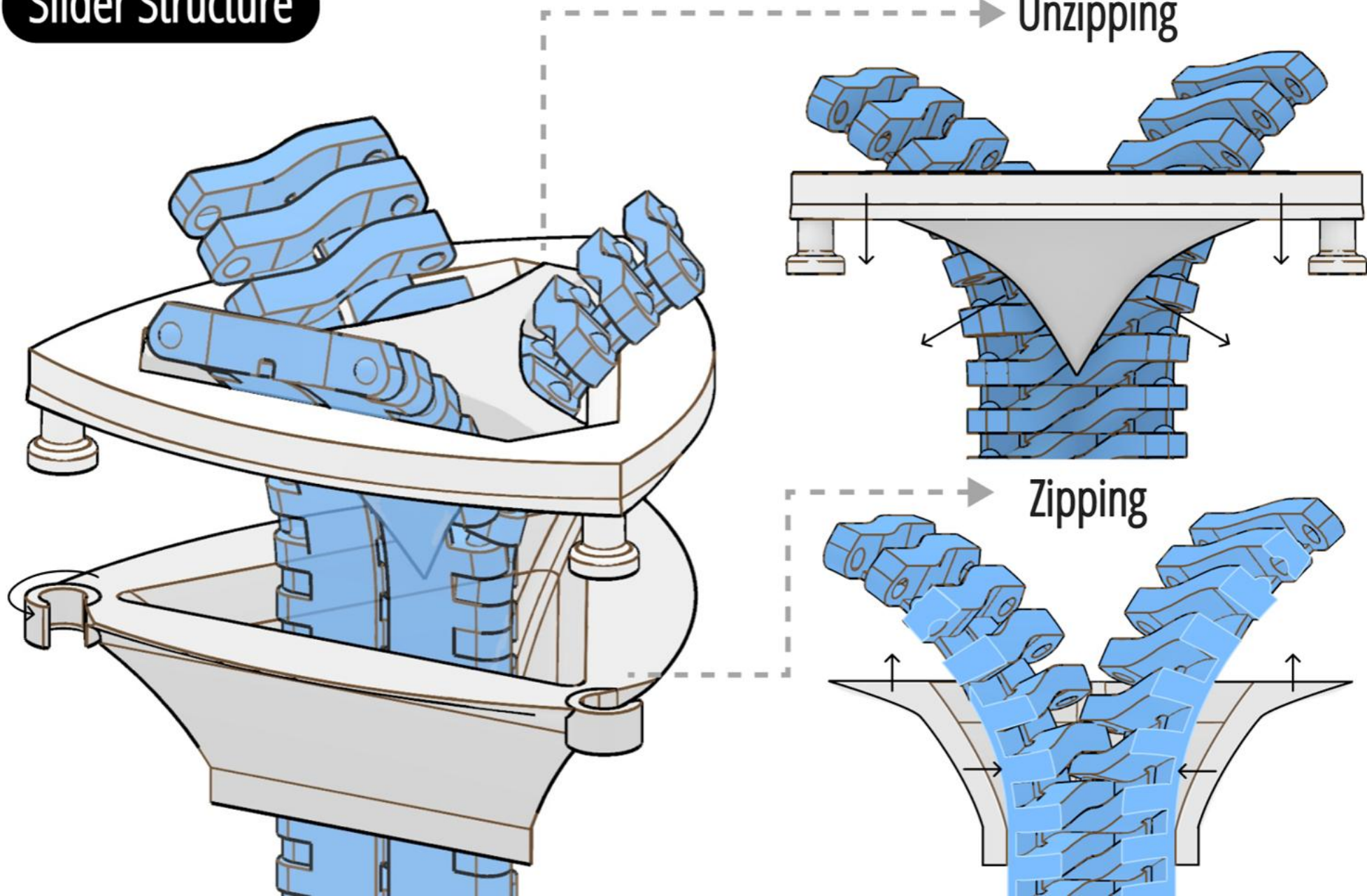
→ Ball & Socket Joint



→ Support Mechanism

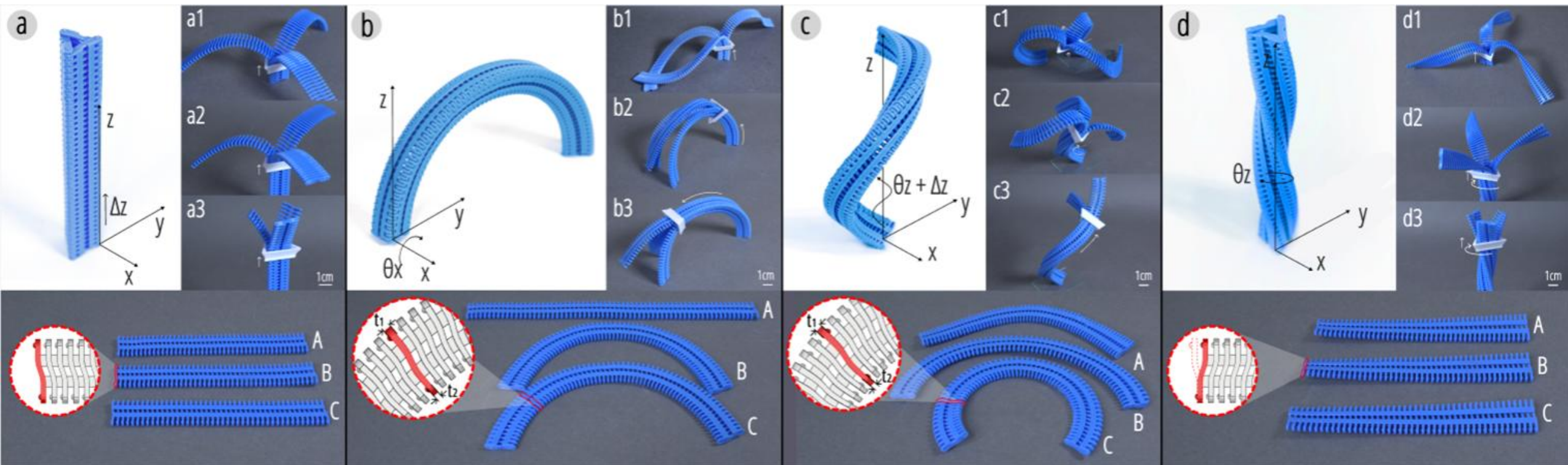


Slider Structure





Motion Primitives



Straight

Bend

Coil

Twist

We provide three more **curved primitives**, expanding the variety of shape types



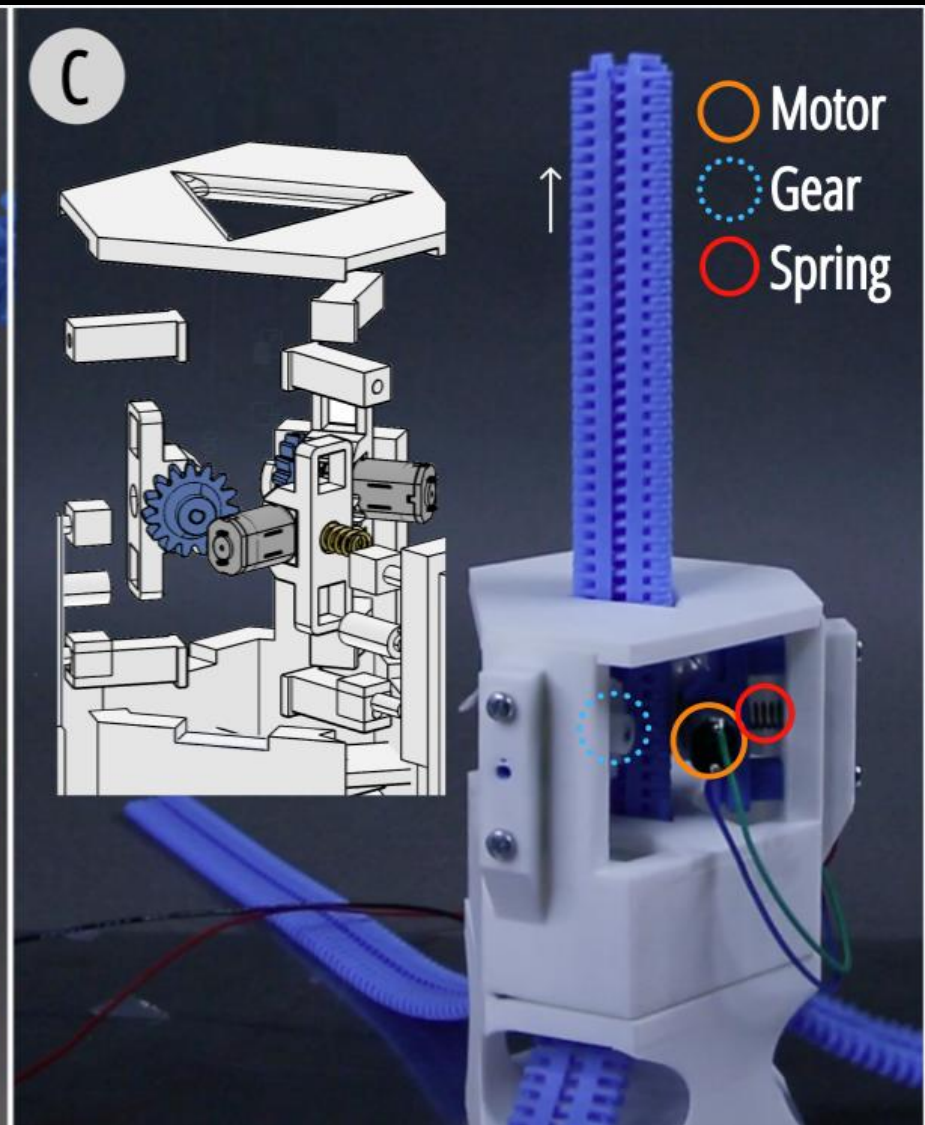
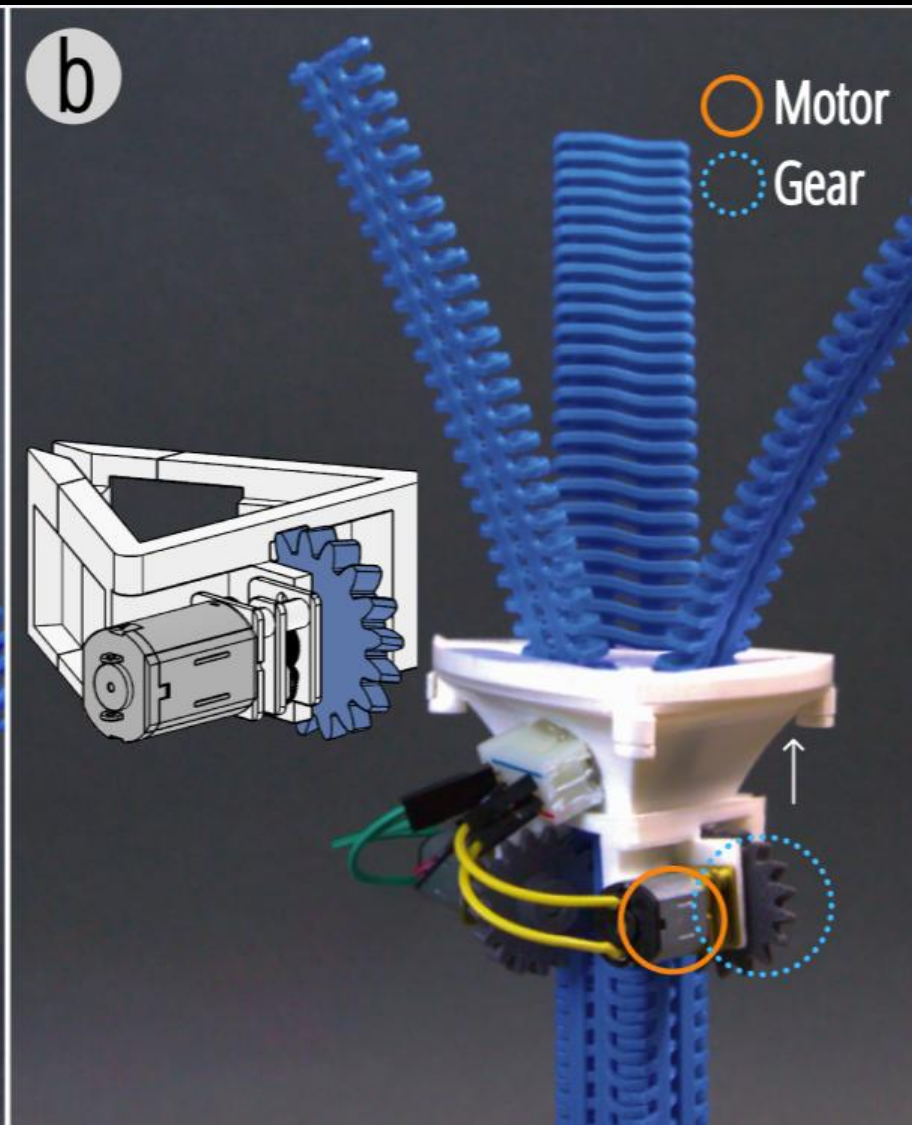
Bend

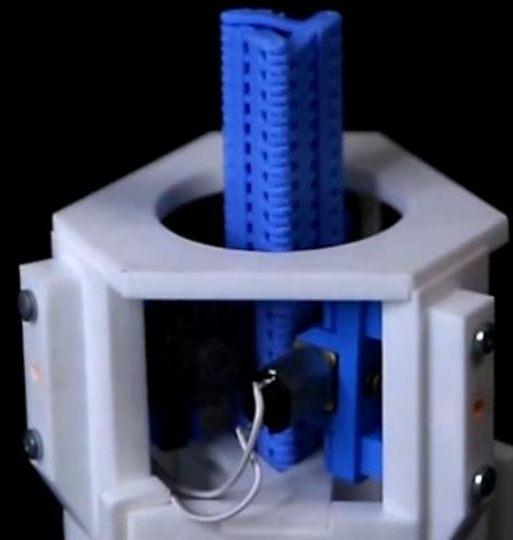
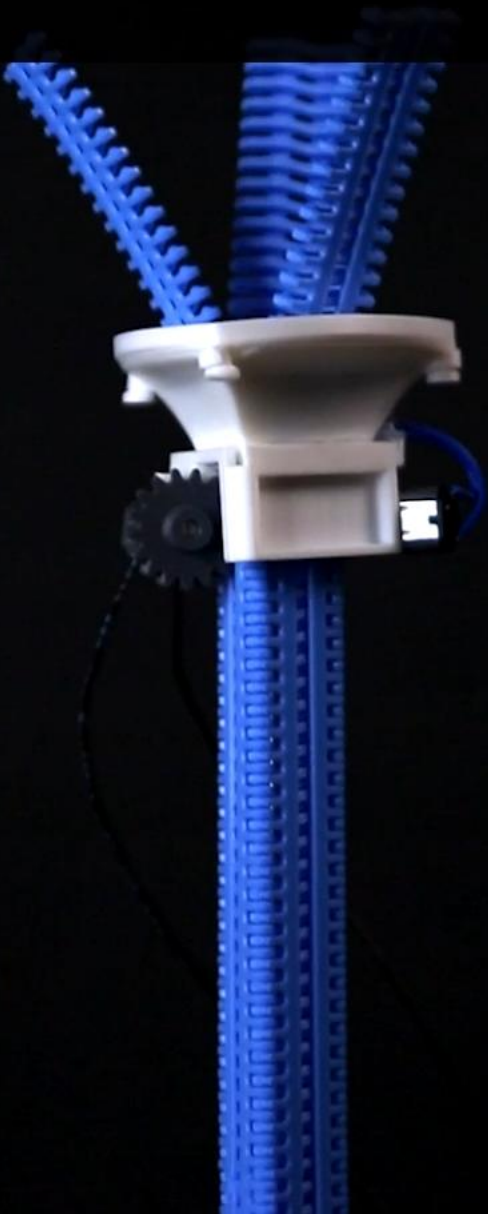


Coil



Screw

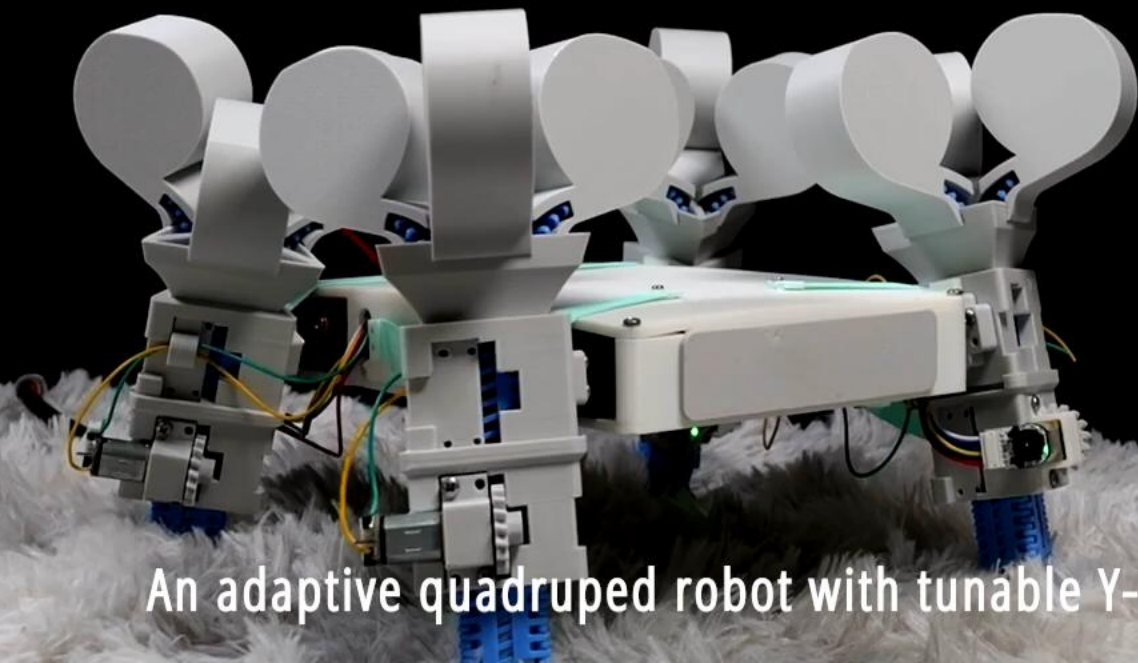




WORKFLOW



Actuating rigid bud to flexible flower



An adaptive quadruped robot with tunable Y-Zipper legs



Tent on the ground without structural support