Shiwei Xu

Ph. D. candidate (scheduled to defend in May, 2025)
Date of Birth: Feb. 27, 1998
Department of Engineering Mechanics,
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Education

Tsinghua University (Beijing, China) Sept, 2020 - Present
Ph. D. in Mechanics Advisor: Prof. Yihui Zhang
Doctoral dissertation: Thin-film-shaped actuators and shape-morphing machines
Huazhong University of Science and Technology (Wuhan, China) Sept, 2016 - Jun, 2020
B.Eng. in Engineering Mechanics GPA: 93.2/100 (Ranked 1st in the department)

Research Experience

1. Mechanical behaviors of 3D mesostructures

- Mechanics for shape fixation of 3D mesostructures
  - A mechanics model capturing the shape fixation effect of freestanding 3D mesostructures based on buckling-guided assembly was established;
  - A dozen of complex freestanding 3D mesostructures were demonstrated.
- Reconfigurable 3D mesostructures driven by electrostatic force
  - An electroadhesion - mediated strategy to achieve controlled deformation of the 3D mesostructures during the buckling-guided assembly was presented;
  - An electromechanical model was developed to capture the deformation.

2. 3D architected electronics

- Continuously morphable 3D displays
  - A design strategy of integrating LED arrays with continuously-morphable actuators was introduced;
  - 3D displays capable of complex shape morphing were demonstrated.
- Reconfigurable tactile display
  - The developed tactile display could offer various haptic feedback, including dynamic tactile patterns and vibrations for localizable surface textures on the morphed shape.

3. Thin-film-shaped actuators and multimodal microrobots

- Microrobot capable of climbing and transitioning complex surfaces
  - Design strategies of voltage-driven 3D soft actuators that can reversibly morph between different configurations at small scales were developed;
  - A microrobot capable of climbing on surfaces with diverse shapes and transitioning between two distinct surfaces was demonstrated.
- Transforming machines capable of continuous 3D shape morphing and locking
  - A synergistic design concept of small-scale actuators with continuous shape morphing/locking capabilities was introduced;
  - A multimodal wheeled microrobot and a terrestrial-aerial microrobot were fabricated.
- Machines capable of complex transforming and tunable dynamic actuation
  - Variable-stiffness actuators with capabilities of complex shape transformation and tunable dynamic actuation were developed;
  - An untethered soft multimodal microrobot based on shape-morphing principle was fabricated.

Skills

- **Finite element analysis**

ABAQUS: deformation and failure analyses, buckling analyses, and strong nonlinear contact simulations;
HFSS: RF analysis of antennas and inductors

- **Mechanical tests**

Tensile & compression test, impact test, vibration test, fatigue test, nanoindentation test

- **Micro fabrications**

3D printing, sputtering, e-beam, ICP/RIE, photography/etching technologies

- **Smart material synthesis**

Liquid crystal elastomers (LCEs), shape memory polymers (SMPs), dielectric elastomers (DEs)

- **Software**

MATLAB, Mathematica, AutoCAD, PS, AI, Origin, KeyShot, Rhino

Publications (google scholar: link)

(† authors contributed equally, * Corresponding authors)

- **First author and co-first author:**

1. **Xu S**, Hu X, Yang R, et al. Transforming machines capable of continuous 3D shape morphing and locking. ***Nature Machine Intelligence***, 2025, https://doi.org/10.1038/s42256-025-01028-4.

2. **Xu S**, Tang Z, Yang R, et al. A mechanics model of coating-assisted strategy for shape fixation of 3D mesostructures based on buckling-guided assembly. ***European Journal of Mechanics - A/Solids***, 2025, 111: 105549.

3. **Xu S**, Yang R, Yang Y, Zhang Y*. Shape-morphing bioelectronic devices. ***Materials Horizons***, 2025, accepted.

4. **Xu S†**, Ji Z†, Zhang Y. Bioinspired passive microfliers. ***Chinese Science Bulletin*** (in Chinese), 2023, 68(19): 2504-2514.

5. Pang W†, **Xu S†**, Wu J, et al. A soft microrobot with highly deformable 3D actuators for climbing and transitioning complex surfaces. ***Proc Natl Acad Sci U S A***, 2022, 119(49): e2215028119.

6. Bo R†, **Xu S†**, Yang Y†, Zhang Y*. Mechanically-Guided 3D Assembly for Architected Flexible Electronics. ***Chemical Reviews***, 2023, 123(18): 11137-11189.

7. Pang W†, **Xu S†**, Liu L, Zhang Y*. Thin-Film-Shaped Flexible Actuators. ***Advanced Intelligent Systems***, 2023, 5(8): 2300060.

- **Other authors:**

1. Xue Z†, Jin T†, **Xu S**, et al. Assembly of complex 3D structures and electronics on curved surfaces. ***Science Advances***, 2022, 8(32): eabm6922.

2. Cheng X, **Xu S**, et al. Bifurcation and mode transition of buckled ribbons under oblique compressions. ***Mechanics Research Communications***, 2023, 131: 104145.

3. Jin T, Cheng X, **Xu S**, et al. Deep learning aided inverse design of the buckling-guided assembly for 3D frame structures. ***Journal of the Mechanics and Physics of Solids***, 2023, 179.

4. Pang W†, Liu L†, **Xu S**, et al. Electroadhesion-Mediated Interface Delamination for Assembly of Reconfigurable 3D Mesostructures. ***Journal of Applied Mechanics***, 2023, 90(6): 061006.

5. Lai Y†, Zang C†, Luo G, **Xu S**, et al. An agile multimodal microrobot with architected passively morphing wheels. ***Science Advances***, 2024, 10(51): eadp1176.

6. Liu Z†, Hu X†, Bo R†, Yang Y, Cheng X, Pang W, Liu Q, Wang Y, Wang S, **Xu S**, et al. A three-

dimensionally architected electronic skin mimicking human mechanosensation. ***Science***, 2024, 9(39): eadi8606.

7. Cao S†, Wei Y†, Bo R, Yun X, **Xu S**, et al. Inversely engineered biomimetic flexible network scaffolds for soft tissue regeneration. ***Science Advances***, 2023, 9(39): eadi8606.

8. Xiao Y, Hu X, Wu J, Shen Z, Wang S, **Xu S**, et al. Imperfection-insensitive flexible random network materials with horseshoe microstructures. ***Journal of the Mechanics and Physics of Solids***, 2025, 195: 105968.

9. Ji Z†, Zhao J†, Song H, **Xu S**, et al. Morphable three-dimensional electronic mesofliers capable of on-demand unfolding. ***Science China Materials***, 2022, 65(8): 2309-2318.

Selected Awards and Honors

1. **Comprehensive first-class Scholarship,** Tsinghua University, 2023
2. **The award for research exploration**, Tsinghua University, 2023
3. **The best presentation award** in "the Ph.D. students forum of Tsinghua University in the multidisciplinary area of flexible electronics", Tsinghua University, 2022
4. **Comprehensive second-class Scholarship**, Tsinghua University, 2022
5. **Outstanding graduates (top 10%)**, Huazhong University of Science and Technology, 2020
6. **National first prize (top 0.2%)** in "National Zhou Peiyuan competition on Mechanics", The Chinese Society of Theoretical and Applied Mechanics, 2019
7. **Second class prize in "**International Engineering Mechanics Contest (Final)"**,** Committee of International Engineering Mechanics Contest, 2019
8. **Grand prize in "**International Engineering Mechanics Contest (Asian Region)", Committee of International Engineering Mechanics Contest, 2019
9. **National Scholarship**, Ministry of Education (P. R. China), 2017

Reference

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Prof. Li Wen
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