Mingsong Jiang

Ph.D. in Mechanical Engineering

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Education

University of California San Diego, La Jolla, CA, USA

Ph.D., Mechanical Engineering 4/2018–12/2021
Fields: Soft Robotics (Design & Fabrication), Reconfigurable Robotics, 3D Printing
Thesis: *Towards Reconfigurable and Adaptive Soft Robots via Hybrid Materials, Designs and Mechanisms*
Advisor: Prof. Nick Gravish (his 1^{st} PhD to graduate)
Committee: Prof. Nick Gravish, Mike Tolley, Marc Meyers, Shengqiang Cai, and Ken Loh

M.S., Mechanical Engineering (GPA 3.7/4.0) 9/2016–3/2018
Fields: Soft Robotics (Design & Fabrication)
Thesis: *Sliding-layer laminates: a new robotic material enabling robust and adaptable undulatory locomotion*
Advisor: Prof. Nick Gravish
Committee: Prof. Nick Gravish, Mike Tolley, and Mike Yip

Xi'an Jiaotong University, Xi'an, Shaanxi, China

B.S., Mechanical Engineering (Major GPA 90/100) 9/2012–6/2016
Thesis: *Design and fabrication of a 3D printed rehabilitative hand exoskeleton device*
(Best student thesis nominee)

Publications

1. **Jiang, M.**; Wang, J. and Gravish, N. Internal actuation of inflatable beams to achieve "soft" linkage robots with reconfigurable "rigid" kinematics. 2022 (In preparation).
2. **Jiang, M.**; and Gravish, N. Reconfigurable laminates enable multifunctional robotic building blocks. *Smart Materials and Structures*. 2021. 30 (3), 035005.
3. **Jiang, M.**; Yu, Q.; and Gravish, N. Vacuum induced tube pinching enables reconfigurable flexure joints with controllable bend axis and stiffness. *IEEE 4th International Conference on Soft Robotics (Robosoft)*. 2021. pp. 315–320.
4. Yu, Q.; **Jiang, M.**; and Gravish, N. Flexoskeleton Fingers: 3D Printed Reconfigurable Ridges Enabling Multi-functional and Low-cost Underactuated Grasping. *IEEE Robotics and Automation Letters*. 2021. pp. 3971-3978.
5. **Jiang, M.**; Zhou, Z.; and Gravish, N. Flexoskeleton printing enables versatile fabrication of hybrid soft and rigid robots. *Soft Robotics*. 2020. 7 (6), 770-778.
6. **Jiang, M.**; Song, R.; and Gravish, N. Knuckles that buckle: compliant underactuated limbs with joint hysteresis enable minimalist terrestrial robots. *IEEE/RSJ Int'l Conference on Intelligent Robots and Systems (IROS)*. 2020. pp. 3732-3738
7. **Jiang, M.**; and Gravish, N. Rapid prototyping of insect-exoskeleton inspired robots. *9th International Symposium on Adaptive Motion of Animals and Machines*. 2019.
8. **Jiang, M.**; and Gravish, N. Sliding-layer laminates: a robotic material enabling robust and adaptable undulatory locomotion *IEEE/RSJ Int'l Conference on Intelligent Robots and Systems (IROS)*. 2018. pp. 5944-5951.

Research Experience

Gravish Lab, UC San Diego, La Jolla, CA, USA 9/2016–12/2021
Graduate Research Assistant

Soft Curved Reconfigurable Anisotropic Mechanisms (SCRAMs) 9/2019–12/2021
• New reconfigurable soft robot paradigms with on-demand mechanical "virtual" joints based on curvature control and planar fabrications (sewing, lamination, and 3D printing).
• Funded by NSF Award: **EFRI C3 SoRo, No. 1935324, 2M$**
• Multi-disciplinary team collaboration among four universities
PIs: Prof. Nick Gravish, Dan Aukes, Cindy Harnett and Ross Hatton.
• Established a truly reconfigurable soft robotic manipulator with on-demand joint formation and actuation (plus two "virtual" joint mechanisms)
• Bi-weekly group discussions on: 3D soft robot printing, embroidered sensors and actuators, bio-inspired mechanisms and geometric methods for robot controls
• Mentored two students and published two papers.
• One top-tier journal paper in preparation.

Flexoskeleton Printing Enables Hybrid Functional Robots 12/2018–4/2020
• Low-cost rapid prototyping of multi-material robots based on commercial 3D printers.
• Embedded compliance, rigid chassis, actuators and sensors via simple fabrication steps
• Demonstrated a series of underactuated robots as multi-legged walking robots, multi-fingered grippers, and tailed and limbed swimmers.
• Mentored two students and published three papers.
• Press highlights on multiple major tech-sites.

Reconfigurable Laminates as Multifunctional Robotic Materials 5/2017–1/2020
• Geometric reconfiguration of hybrid material compositions to achieve tunable properties
• Laser cutting and manual lamination of various robotic fabrics and prototypes.
• Research outreach to high school students in laminate robot fabrication.
• Mentored several undergrads and published two papers.

Other Lab Duties
• Early stage lab establishment: building experimental stages and lab arrangements, self-built DPSS laser micro-fabrication stage with Prof. Gravish.
• As a safety coordinator, in charge of lab daily operation and training new students.

Work Experience

XPeng Robotics, affiliate of XPeng Inc., Shenzhen, China 3/2022–6/2022
System Design Expert

• Worked in a startup team (300 people) to build next-generation quadruped robots for urban transportation and in-house entertainment.
• Directly reported to CEO and board committee on product definition, concerning key technical parameters of robot actuation, transmission and power systems.
• System-level optimization of design parameters, e.g., robot form factors (weights, sizes), length distribution associated by robot vision, passability, safety and user experience.
• Drawing technical solutions for robot riding safety (target users: young kids).

Teaching Experience

UC San Diego, La Jolla, CA, USA 9/2017–12/2019
Graduate Teaching Assistant

MAE156A, Fundamental Principles of Mechanical Design I, Fall 2017– Fall 2019
• Undergrad class on engineering science to the design and analysis of mechanical components.
• Held lab courses on design and control of motorized robotic systems via self-built electronics and microcontrollers. Also taught robot fabrication based on 3D printing and laser cutting.
• Held office hours and contributed to the design and grading of homework and midterms.
Course by: Prof. Nate Delson and Nick Gravish.

MAE207, Bioinspired Mobile Robotics, Spring 2018 & Spring 2019
• Graduate-level bioinspired robotics class focusing on the theories and experimentation of dynamic robot locomotion and interesting biological mechanisms
• Held lab-based courses on control of legged robot locomotion via direct drive motors, on board sensors and controllers (ODrive motor controllers), coded by Python.
• As the lead TA, held office hours and contributed to designing and grading of homework.
Course by: Prof. Nick Gravish.

Robot Inventors (Cluster 10), COSMOS summer high school, Summer 2019
• UCSD STEM program for high school students interested in engineering and robotics
• Lectures on introduction of robotics, operation of motors, computer vision and basic programming using Python.
Course by: Prof. Nick Gravish and Curt Schurgers.

Mentorship (selected)

Gravish Lab, UC San Diego (3 Undergrads & 5 MS students)

Qifan Yu, Undergrad student, Mechanical Engineering, UCSD 10/2020-10/2021
• First author IEEE RAL paper: *Flexoskeleton Fingers: 3D Printed Reconfigurable Ridges Enabling Multi-Functional and Low-Cost Underactuated Grasping*
• Received best paper nominee in Robosoft 2021.
• Day-to-day research mentorship and instructions on scientific writing.
• Successfully admitted to MIT Ph.D. program (Mechanical Engineering).

Jiangsong Wang, Undergrad student, Aerospace Engineering, UCSD 9/2020–12/2021
• Contributing author to SCRAMs team research: *Internal actuation of inflatable beams to achieve soft linkage robots with reconfigurable rigid kinematics*
• Successfully admitted to CMU M.S. program (Robotics).

Shuhang Zhang, MS student, Mechanical Engineering, UCSD 6/2020–6/2021
• Lead author in original research of flexoskeleton printing combined with pouch actuation
• Successfully admitted to EPFL Ph.D. program (Robotics).

Presentations (selected)

IEEE Robosoft 2021 Poster Session, virtual	4/2021
IROS 2020 Poster Session, virtual	10/2020
Jacobs School of Engineering Research Expo, UCSD	4/2019 & 4/2018
Invited talk on robotic laminates, Contextual Robotics Institute, UCSD	11/2017

Press (selected)

Flexoskeleton Printing

TechXplore – Flexoskeleton printing: Fabricating flexible exoskeletons for insect-inspired robots

EEPOWER – 3D Printed Insect-Inspired 'Flexoskeleton' Robots are Fast and Inexpensive

Hackster.io – 3D-Printed Flexoskeleton Soft Robots Developed Using Insect Inspiration

Engadget – Scientists can 3D print insect-like robots in minutes

Workshop

Robosoft2021 Workshop Organization: *Breaking the Mold: Challenging Current Paradigms in Soft Robotics* 4/2021

Awards

Co-author of Best Paper Award Nominee, *IEEE Robosoft 2021*	4/2021
Chinese National Student Fellowship *(8000 RMB)*	12/2015
Dancing Robot Competition, 3rd place, *Robocon China 2014*	5/2014

Github

Original Project Website: https://github.com/gravish-lab/Flexoskeleton-printing

References

Nicholas G. Gravish
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Michael T. Tolley
Dept. of Mechanical & Aerospace Engineering
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Cindy K. Harnett
J.B. Speed School of Engineering
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Daniel M. Aukes
Ira A. Fulton Schools of Engineering
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Zhigen Xu
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Personal

Enjoy running, hiking, swimming, tennis, basketball, frisbee, and many other team sports.