XUN FU

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Education

University of Michigan, Ann Arbor, MI USA
Ph.D. in Robotics, *Advisors: Dr. Ram Vasudevan, Dr. Talia Moore* — Aug. 2020 – Present

University of Michigan, Ann Arbor, MI USA
M.S. in Mechanical Engineering — Aug. 2018 – Dec. 2019

Northwestern Polytechnical University (NPU), Xi'an, Shaanxi China
B.E. in Mechatronics Engineering — Aug. 2014 – June. 2018

Professional Appointment

University of Michigan, Ann Arbor, MI USA
Research Engineer, ROAHM Lab — Jan. 2020 – Aug. 2020

Awards and Scholarships

- Graduation with honors at NPU — June. 2018
- National Scholarship — Nov. 2017
- NPU Outstanding Student Award & First Prize Scholarship — Nov. 2017
- Samsung Scholarship — Dec. 2016
- NPU Outstanding Student Award & First Prize Scholarship — Dec. 2016
- NPU Outstanding Student Award & First Prize Scholarship — Nov. 2015

Publications

- Daniel Bruder, Xun Fu, and Ram Vasudevan. Advantages of bilinear koopman realizations for the modeling and control of systems with unknown dynamics. *IEEE Robotics and Automation Letters (RA-L)*, 2021. doi: 10.1109/LRA.2021.3068117
- Daniel Bruder, Xun Fu, Brent Gillespie, C. David Remy, and Ram Vasudevan. Koopman-based control of a soft continuum manipulator under variable loading conditions. *IEEE Robotics and Automation Letters (RA-L)*, 2021. doi: 10.1109/LRA.2021.3095268
- Daniel Bruder, Xun Fu, Brent Gillespie, C. David Remy, and Ram Vasudevan. Data-driven control of soft robots using koopman operator theory. *IEEE Transactions on Robotics (T-RO)*, 2020. doi: 10.1109/TRO.2020.3038693
- Xun Fu, and Xiaojuan Mo. The application of wearable sensors on the diagnosis and monitoring of Parkinson's disease. *DEStech Trans. Eng. Technol. Res, AMEE*, 2018. doi: 10.12783/dtetr/amee2018/25339

Teaching

- ROB599 002: BioInspiration, University of Michigan, *Graduate Student Instructor* — Winter 2021
- ROB599 003: BioInspiration, University of Michigan, *Teaching Assistant* — Winter 2020

Research Summary

In my research, I leverage optimization techniques to develop explicit dynamical models of complex systems including soft robots and mammalian tails. These models inform evolutionary studies of functional biomechanics and robotic controllers.

Research Experience

EMBiR Lab, University of Michigan, *Advisor: Dr. Talia Moore* Jan. 2020 - Present

- **Musculoskeletal modeling of rodent tails**
  Leveraging optimal control methods to generate predictive, three-dimensional muscle-driven simulations of rodent tails to explore their contributions to locomotion.

ROAHM Lab, University of Michigan, *Advisor: Dr. Ram Vasudevan* July. 2019 - Present

- **Data-driven modeling and control of soft robots**
  Utilized koopman operator to construct linear, bilinear, and nonlinear models of soft robots.
  Applied model predictive control methods to control soft robots and achieved over three times more accuracy than a benchmark method in terms of average tracking error.
  Proved necessary and sufficient conditions for a dynamical system to have a valid linear or bilinear koopman realization.
  Accomplished the first demonstration of autonomous pick and place of objects of unknown mass on a soft continuum manipulator.
- **System identification for autonomous rovers**
  Built rovers integrated with various types of sensors including LiDAR, camera, and IMU operating in the Robot Operating System (ROS).
  Applied data-driven methods to identify the dynamical model of the rovers.

HaptiX Lab, University of Michigan, *Advisor: Dr. Brent Gillespie* Nov. 2018 – April. 2019

- **Shared control in vehicle steering across routine and off-nominal conditions**
  Designed and implemented automobile lane keeping and obstacle avoidance controller.
  Designed and realized various control sharing schemes to study the interaction between human and autonomous vehicles when transitions between levels of automation occur.
  Designed and conducted experiments to understand authority transitions, increase driving safety, and improve driving performance.
- **Adaptive haptic shared control**
  Used grip forces to estimate drivers' mechanical impedance and developed an adaptive haptics shared control scheme.
  Designed and conducted experiments to compare the haptic shared control scheme with conventional schemes.

Internship

Beijing Jingdiao Group Co., Ltd., Beijing, China July. 2017 – Aug. 2017

Optimized planned machining path and improved machining precision and accuracy.
Coordinated group to complete building a UAV and a single-cylinder engine metal model.

Reviewer

IEEE Transactions on Robotics (T-RO)

IEEE International Conference on Robotics and Automation (ICRA)