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Xiaobin Xiong

Research Goals: My research centers around developing motion intelligence on dynamic robots. I aim to develop intuitive, efficient, effective, and elegant (IEEE) algorithms that leverage known principles and available data to address challenging problems in physical robotics using mathematical techniques from system modeling, control theory, numerical optimization, and machine learning. My ultimate goal is to develop principled and rigorous methodologies to achieve superhuman-level physical intelligence in robotic systems that can integrate seamlessly into daily life.

Interested Areas: Legged & Humanoid Robots, Control & Estimation, Motion Planning, Robot (Co-)Design, Robot Autonomy

Education

PhD **California Institute of Technology**
Mechanical Engineering (Robotics)
Advisor: Aaron Ames, 2017-2021
Thesis: Reduced Order Model Inspired Robotic Bipedal Walking: A Step-to-Step Dynamics Approximation based Approach

MS **Northwestern University**
Mechanical Engineering
Advisors: Kevin M. Lynch, Paul Umbanhowar, 2013-2015
Thesis: Simultaneous Manipulation of Multiple Point Objects in Linear and Nonlinear Planar Velocity Fields.

BE **Tongji University**
Mechanical Engineering, 2009-2013
Thesis: Design and Analysis on the Assembly-disassembly Construction Scheme of the 2500t Ring Crane.

Appointment History

Assistant Professor Tenure-track, Department of Mechanical Engineering
University of Wisconsin-Madison, 2023-Present

Post-doc Scholar Department of Mechanical and Civil Engineering
California Institute of Technology, 2021-2022

Graduate Research Assistant AMBER lab, Department of Mechanical and Civil Engineering
California Institute of Technology, 2017-2021
Advisor: Prof. Aaron Ames

Research Intern Intuitive Surgical, 2016
Mentor: Dr. Anthony Jarc

Graduate Research Assistant CRAB lab, School of Physics
Georgia Institute of Technology, 2015-2017
Advisor: Prof. Daniel Goldman

Research Assistant Department of Mechanical Engineering
Northwestern University, 2014
Advisors: Prof. Kevin Lynch, Dr. Paul Umbanhowar

Selected Awards and Honors

- I-Fong's Donation in Memory of Ali Seireg, 50,000 USD, Fongsong Life Foundation, 2025
- 3rd Place Research Group Award, Engineering EXPO, UW-Madison, 2024
- Presidential Young Professorship, National University of Singapore (NUS), 2022
- Best Paper Award - RoboCup, IEEE/RSJ International Conference on Intelligent Robots and Systems, 2019
- Amazon Fellowship in AI, Caltech-Amazon, 2019
- Simondis Discovery Fund, Caltech-IST, 2018
- IROS Student and Developing Countries (SDC) Award, RAS-IEEE, 2019
- Caltech Student Travel Grant, 2019
- IROS Student and Developing Countries (SDC) Award, RAS-IEEE, 2018
- NSF-IROS Doctoral Consortium, RAS-IEEE, 2017
- National Intelligent Car Competition 2nd Prize, Freescale & Ministry of Education of China, 2012
- Enn New Energy Scholarship (2011), Mubea Scholarship (2012), Tongji University
- Outstanding Student Award, Tongji University, 2012
- 1st Class scholarship (2011 & 2012), and 2nd Class scholarship (2010), Tongji University

Peer-reviewed Publications

Underlines denote students of WELL Lab; * indicates first co-authors; # represents the corresponding author.

Journals:

- Jiarong Kang*, Yi Wang*, **Xiaobin Xiong**#
  Fast Decentralized State Estimation for Legged Robot Locomotion via EKF and MHE
  In: *IEEE Robotics and Automation Letters (RA-L),* 2024
- **Xiaobin Xiong**#, Aaron D. Ames
  3D Underactuated Bipedal Walking via H-LIP based Gait Synthesis and Stepping Stabilization
  In: *IEEE Transactions on Robotics (T-RO),* 2022
- Mohamadreza Ahmadi, **Xiaobin Xiong**, Aaron D. Ames
  Risk-Sensitive Path Planning via CVaR Barrier Functions: Application to Bipedal Locomotion
  In: *IEEE Control Systems Letters (L-CSS) with CDC,* 2021
- **Xiaobin Xiong**#, Aaron D. Ames
  SLIP Walking over Rough Terrain via H-LIP Stepping and Backstepping-Barrier Function Inspired Quadratic Program
  In: *IEEE Robotics and Automation Letters (RA-L) with ICRA,* 2021
- **Xiaobin Xiong**#, Aaron D. Ames
  Dynamic and Versatile Humanoid Walking via Embedding 3D Actuated SLIP Model with Hybrid LIP Based Stepping
  In: *IEEE Robotics and Automation Letters (RA-L) with IROS,* 2020
- Aneeq Zia, Chi Zhang, **Xiaobin Xiong**, Anthony Jarc
  Temporal Clustering of Surgical Activities in Robot-assisted Surgery
  In: *International Journal of Computer Assisted Radiology and Surgery (IJCARS),* 2017

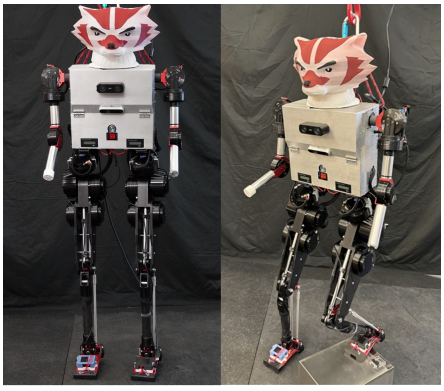
Conferences:

- Yicheng Zeng*, Yuhao Huang*, **Xiaobin Xiong**#
  Reference-Steering via Data-Driven Predictive Control for Hyper-Accurate Robotic Flying-Hopping Locomotion
  Submitted to: *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS),* 2025
- Xiao Lin, Yuhao Huang, Taimeng Fu, **Xiaobin Xiong**, Chen Wang
  iWalker: Imperative Visual Planning for Walking Humanoid Robot
  Submitted to: *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS),* 2025
- Jiarong Kang, **Xiaobin Xiong**#
  Simultaneous Ground Reaction Force and State Estimation via Constrained Moving Horizon Estimation
  To Appear In: *IEEE International Conference on Robotics and Automation (ICRA),* 2025
- Yuhao Huang*, Yicheng Zeng*, **Xiaobin Xiong**#
  STRIDE: An Open-Source, Low-Cost, and Versatile Bipedal Robot Platform for Research and Education
  In: *IEEE RAS International Conference on Humanoid Robots (Humanoids),* 2024
- Yifei Chen*, Arturo Gamboa-Gonzalez*, Michael Wehner, **Xiaobin Xiong**#
  Explosive Legged Robotic Hopping: Energy Accumulation and Power Amplification via Pneumatic Augmentation
  In: *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS),* 2024
- Kejun Li, Jeeseop Kim, **Xiaobin Xiong**, Kaveh Akbari Hamed, Yisong Yue, and Aaron D Ames
  Data-Driven Predictive Control for Robust Exoskeleton Locomotion
  In: *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS),* 2024
- Yi Wang*, Jiarong Kang*, Zhiheng Chen*, **Xiaobin Xiong**#
  Terrestrial Locomotion of PogoX: From Hardware Design to Energy Shaping and Step-to-step Dynamics Based Control
  In: *IEEE International Conference on Robotics and Automation (ICRA),* 2024
- Min Dai, **Xiaobin Xiong**, Jaemin Lee, Aaron D. Ames
  Data-Driven Adaptation for Robust Bipedal Locomotion with Step-To-Step Dynamics
  In: *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS),* 2023
- Joris Verhagen, **Xiaobin Xiong**, Aaron Ames, Ajay Seth
  From Human Walking to Bipedal Robot Locomotion: Reflex Inspired Compensation on Planned and Unplanned Downsteps
  In: *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS),* 2022
- Min Dai, **Xiaobin Xiong**, Aaron D. Ames
  Bipedal Walking on Constrained Footholds: Momentum Regulation via Vertical COM Control
  In: *IEEE International Conference on Robotics and Automation (ICRA),* 2022
- **Xiaobin Xiong**#, Yuxiao Chen, Aaron D. Ames
  Robust Disturbance Rejection for Robotic Bipedal Walking: System-Level-Synthesis with Step-to-step Dynamics Approximation
  In: *IEEE Conference on Decision and Control (CDC),* 2021
- Tyler Westenbroek, **Xiaobin Xiong**, S. Shankar Sastry, Aaron Ames
  Smooth Approximations for Hybrid Optimal Control Problems with Application to Robotic Walking
  In: *IFAC Conference on Analysis and Design of Hybrid Systems (ADHS),* 2021
- **Xiaobin Xiong**#, Jenna Reher, Aaron Ames
  Global Position Control on Underactuated Bipedal Robots: A Step-to-step Dynamics Approximation for Step Planning
  In: *IEEE International Conference on Robotics and Automation (ICRA),* 2021

- **Xiaobin Xiong**#, Aaron D. Ames
  Sequential Motion Planning for Bipedal Somersault via Flywheel SLIP and Momentum Transmission with Task Space Control
  In: *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2020
- H.J. Terry Suh, **Xiaobin Xiong**, Andrew Singletary, Aaron D. Ames, Joel W. Burdick
  Optimal Motion Planning for Multi-Modal Hybrid Locomotion
  In: *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2020
- **Xiaobin Xiong**#, Aaron D. Ames
  Orbit Characterization, Stabilization and Composition on 3D Underactuated Bipedal Walking via Hybrid Passive Linear Inverted Pendulum Model
  In: *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2019
- **Xiaobin Xiong**#, Aaron D. Ames
  Motion Decoupling and Composition via Reduced Order Model Optimization for Dynamic Humanoid Walking with CLF-QP based Active Force Control
  In: *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2019
- Tyler Westenbroek, **Xiaobin Xiong**, Aaron D. Ames, S. Shankar Sastry
  Optimal Control of Piecewise Smooth Control System via Singular Perturbations
  In: *IEEE Conference on Decision and Control (CDC)*, 2019
- **Xiaobin Xiong**#, Aaron D. Ames
  Bipedal Hopping: Reduced-order Model Embedding via Optimization-based Control
  In: *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2018
- **Xiaobin Xiong**#, Aaron D. Ames
  Coupling Reduced Order Models via Feedback Control for 3D Underactuated Bipedal Robotic Walking
  In: *IEEE RAS International Conference on Humanoid Robots (Humanoids)*, 2018
- Jonathan Gosyne, Christian Hubicki, **Xiaobin Xiong**, Aaron D. Ames, Daniel I. Goldman
  Bipedal Locomotion Up Sandy Slopes: Systematic Planar Experiments Using Zero Moment Point Methods
  In: *IEEE RAS International Conference on Humanoid Robots (Humanoids)*, 2018
- **Xiaobin Xiong**#, Aaron D. Ames, Daniel I. Goldman
  A Stability Region Criterion for Flat-footed Bipedal Walking on Deformable Granular Terrain
  In: *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2017

Robots

The following robots are ones I have built by myself or with students, or purchased off-the-shelf. They are used to evaluate scientific algorithms developed in the publications.

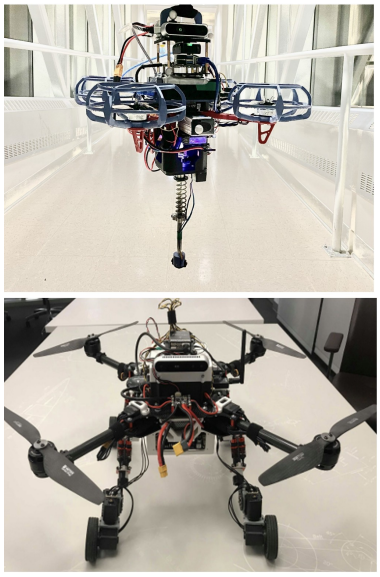


Humanoid BUCKY-V1 (custom-built)

BUCKY-V1 is a 26 DOF humanoid robot **I built all by myself** during the period of 2023-early 2024. It's 4 feet tall and weighs 60 lbs. It has an unique design that all actuators are located above the mid-thigh, which provides the potential for fast dynamic locomotion capabilities by reducing swinging inertias. The robot is very new in the lab: stay tuned!

V2. *BUCKY GRF Estimation in Simulation*, August 2024, in Paper [Kang and Xiong 2025 ICRA]: `https://youtu.be/Bih7cslSkTo`

V1. *BUCKY Walking in-place in WELL Lab*, April 2024. Unpublished Videoes: Click this Link (limited circulation)



Multi-Domain Robots (custom-built)

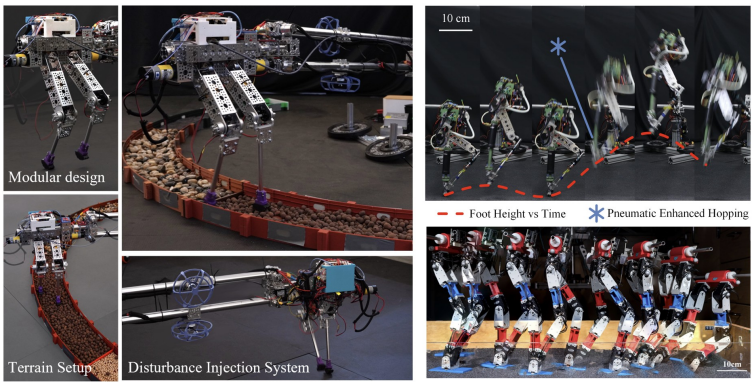
PogoX (top) and Drivocopter (bottom) are a class of multi-domain robots that I built with my students and collaborator. PogoX particularly excels in efficient hopping and agile flying. Drivocopter combines ground wheeled mobility and flying. A set of new class of multi-domain robots are currently being developed in my lab. They will be able to perform efficient flying, swimming, ground skating and hopping. Stay tuned.

V4. *PogoX-v2 Hopping and Flying via Data-Driven Control*, August 2024, in Submission [Zeng, Huang, and Xiong, 2025 IROS]: `https://youtu.be/YM8VbjKEK9A`

V3. *PogoX-v2 Optimal Estimation*, August 2024, in Paper [Kang and Xiong, 2024 RA-L]: `https://youtu.be/-5kkeep_Lhw`

V2. *PogoX-v1 Hopping*, August 2023, in Paper [Wang, Kang, Chen and Xiong, 2024 ICRA]: `https://youtu.be/uWcNDZ4D2Aw`

V1. *Drivocopter*, 2020, in Paper [Suh and Xiong and et al, 2020 IROS]: `https://youtu.be/QZyuvXfifvQ?si=bEf1CZ6MV80n2HkA`



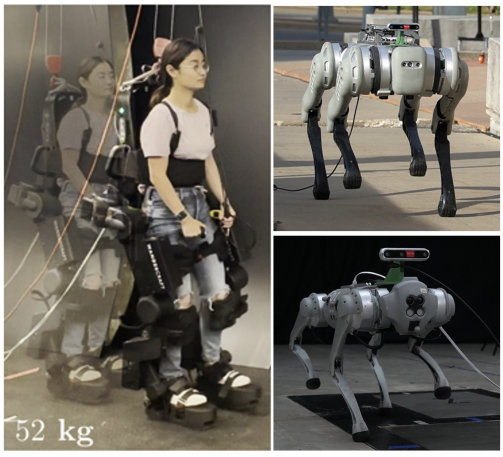
Legged Robots on Boom (custom-built)

These legged robots are custom-built by me and my students. They are planar robots as they are pinned on a circular boom. Their simplicity does not simplify the scientific questions being studied. They are used for rapidly evaluating novel ideas and tasks on non-trivial and general legged platforms.

V3. *STRIDE for research and education*, June 2024, in Paper [Huang, Zeng and Xiong, 2024 Humanoids]: `https://youtu.be/wJkxvUG6msU`

V2. *Explosive Hopping*, 2023, in Paper [Chen and et al and Xiong, 2024 IROS]: `https://youtu.be/JObkOIaiOqE`

V1. *Walking on Granular Terrain*, 2017, in Paper [Xiong et al, 2017 IROS]: `https://youtu.be/7sjJs95awK8`

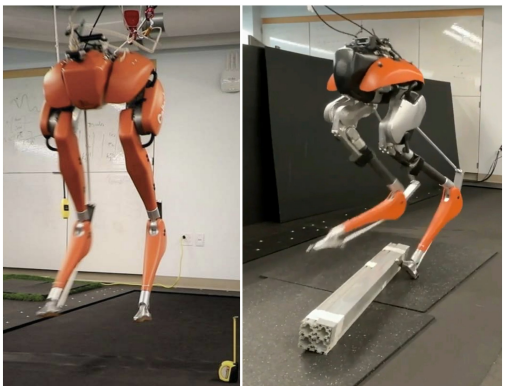


Exoskeleton & Quadrupedal Robots

The exoskeleton and quadrupedal robots are off-the-shelf ones that I mainly worked with the students on using them for algorithm evaluation. The exoskeleton Atalante is built by Wandercraft and was used at Caltech during my PhD. The two quadrupedal robots B1 and Go1-Edu are recently purchased from Unitree robotics in 2024. Stay Tuned.

V2. *Quadrupedal Robot State and GRF Estimation*, August 2024, in Paper [Kang, and Xiong, ICRA 2024]: `https://youtu.be/Bih7cslSkTo`

V1. *Exoskeleton Walking via Data-Driven Control*, 2024, in Paper [Li et al, 2024 IROS]: `https://www.youtube.com/watch?v=rgs36YXRb4I&ab_channel=KejunLi`



Bipedal Robot Cassie

Cassie is a bipedal robot built by Agility Robotics. It is the main robot platform I developed motion algorithms on during 2017-2021 at Caltech. Its underactuated leg design, despite promotes efficiency, presents interesting challenges on model-based control, which motivates robust walking controller designs in my PhD thesis.

V3. *Cassie Rubust Walking on Unstable Terrain*, 2021, in Paper [Xiong and Ames, 2021 T-RO]: `https://youtu.be/DOS-xBs4Kdw`

V2. *Cassie Versatile Walking*, 2020, in Paper [Xiong and Ames, 2021 T-RO]: `https://youtu.be/qEp1RUf6X-U`

V1. *Cassie Hopping*, 2017, in Paper [Xiong and Ames, 2018 IROS]: `https://youtu.be/5s19IWqN4-c`

Teaching and Mentoring

Instructor at UW-Madison

Dept. of Mechanical Engineering,

Undergraduate level:

ME340 Dynamic Systems-Discussion	2023 Spring
Guest Lecture for ME601 Feedback Control of Autonomous Systems	2023 Spring
ME340 Dynamic Systems	2023 Fall
ME351 Interdisciplinary Design I	2024 Spring
ME352 Interdisciplinary Design II	2024 Fall
ME340 Dynamic Systems	2025 Spring

Graduate level:

ME601 Adv. Robotics: Modern Motion Planning, Estimation, and Control. 2024 Fall
ME601 is a graduate-level course I developed to provide a comprehensive understanding of how to mathematically model, plan, control and estimate robot motion.

Teaching Assistant at Caltech

Dept. of Computing + Mathematical Sciences,

Graduate level:

CDS 232 Nonlinear Dynamics	2018 Winter
CDS 233 Nonlinear Control	2018 Spring

Research Advising at UW-Madison

WELL lab, as PI

- *PhD Students*: Kunzhao Ren (2025-), Hanwen Wang (2024-), Jiarong Kang (2023-), Arturo Gamboa-Gonzalez (co-advised with Michael Wehner, 2023-2024)
- *MS Students*: Yicheng Zeng (2023 - 2025), Yuhao Huang (2023 - 2025)
- *BS Students*: Jon Brooks, Zhiheng Chen, Anthony Klein, Zachary Peachin, Ryan Gomes-Paiva, Alec Brey, Jacky Chen, Conrad Ho
- *Visiting Students*: Yifei Chen (SUSTECH, 2023), Yi Wang (Columbia University, 2024), Tianwei Bao (Northwestern University, 2024)

Research Advising at Caltech

AMBER lab, as senior member

- *PhD Students*: Amy Li (multi-contact walking on an lower-body powered exoskeleton, 2022), Min Dai (bipedal robotic walking with constrained footholds 2021-2022)
- *MS Students*: Joris Verhagen (Human Inspired Down-step Controller on Cassie-Thesis Committee Member, 2022)
- *BS Students*: Brad Greer (SURF-Summer Research: robotic tail design on bipedal robot, 2022), HJ Terry Suh (BS-Thesis: Design and Planning of Flying-Driving Hybrid Robot, 2018-2019)

Committee on PhD Thesis

- Brian Acosta, University of Pennsylvania, 2025
- Kieran Nichols, University of Wisconsin-Madison, 2024

Professional Services

- Associate Editor: IEEE Robotics & Automation Letters (R-AL), 2024 -
- Reviewer:
  - -IEEE Transactions on Robotics (T-RO)
  - -IEEE Transactions on Automatic Control (TAC)
  - -IEEE Transactions on Mechantronics (TMech)
  - -IEEE Transactions on Control Systems Technology (TCST)
  - -IEEE Robotics & Automation Letters (RA-L)
  - -IEEE Control Systems Letters (L-CSS)
  - -Robotics: Science & Systems (RSS)
  - -IEEE International Conference on Robotics and Automation (ICRA)
  - -IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)
  - -IEEE-RAS International Conference on Humanoid Robots (Humanoids)
  - -American Control Conference (ACC)
- Member of IEEE, IEEE Robotics and Automation Society (RAS)
- Member of IEEE RAS Technical Committee on Model-Based Optimization for Robotics
- Student Organizer of IROS, 2014

Other Publications

- Xiaobin Xiong, Min Dai, Yuxiao Chen, Aaron Ames
  Data-driven Step-to-step Dynamics based Robust and Adaptive Bipedal Robotic Walking
  In: *Dynamic Walking* (Abstract & Presentation), 2022
- Xiaobin Xiong, Aaron Ames
  A Step-to-Step Dynamics based Control Approach for Bipedal Robotic Walking Realization
  In: *Dynamic Walking* (Abstract & Poster (Virtual)), 2021
- Min Dai, Xiaobin Xiong, Aaron Ames
  Bipedal Walking on Constrained Footholds: Momentum Regulation via Vertical COM Control
  In: *Dynamic Walking* (Abstract & Poster (Virtual)), 2021
- Xiaobin Xiong, Aaron Ames
  Continuous gait generation for 3D underactuated bipedal walking via Hybrid Linear Inverted Pendulum Model
  In: *Dynamic Walking* (Abstract & Presentation), 2019
- Xiaobin Xiong, Aaron Ames
  Continuous gait generation for 3D underactuated bipedal walking via Hybrid Linear Inverted Pendulum Model
  In: *36th Southern California Control Workshop* (Presentation), 2019
- Xiaobin Xiong, Aaron Ames

Bipedal walking on homogeneous granular terrain with model-based approaches
In: *Workshop of planning legged and aerial locomotion with dynamic motion primitives, IROS* (Poster), 2017

- Xiaobin Xiong, Jeffrey Aguilar, Jennifer Rieser, Allison Kim, Aaron Ames, Daniel Goldman
  Overshoot intrusion forces promote robophysical bipedal walking on homogeneous granular media
  In: *APS March Meeting* (Abstract & Presentation), 2017
- Xiaobin Xiong, Chaohui Gong, Daniel Goldman
  Geometric mechanics in locomotion
  In: *Physics of Living Systems (iPoLS)* (Abstract & Presentation), 2015

Invited Talks

- Key Components of Expeditious Legged Robots: Balancing Control, Energy Efficiency, and Power Amplification, In IEEE Humanoids 2023 workshop: Generalizable and Robust Decision Making, Planning, and Control for Humanoid Loco-Manipulation
- Towards Discovering Essential Locomotion Science and Methodology for Bipedal Robotic Systems, 2022
  - University of Wisconsin-Madison
  - National University of Singapore
  - Duke University
- Towards Highly-Dynamic, Versatile and Robust Robotic Bipedal Locomotion on Natural Environments, 2021
  - Agility Robotics
  - Baidu USA Research
  - Ubtech Robotics
  - University of Chicago, RAM Lab.
- Reduced Order Model Induced Planning and Control for Underactuated Bipedal Robotic Locomotion, 2019
  - Zhejiang University
  - Harbin Institute of Technology
  - Southern University of Science and Technology
  - Ubtech Robotics

References

References are available upon request.