YANRAN DING

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RESEARCH INTERESTS

Legged Robot, Optimization-Based Control, Design, Trajectory Optimization, Motion Planning

EDUCATION

University of Illinois at Urbana-Champaign (UIUC) Dec. 2017 - March 2021
Doctor of Philosophy, Mechanical Science and Engineering
Advisors: Dr. Hae-Won Park and Dr. João Ramos

University of Illinois at Urbana-Champaign Aug. 2015 - Dec. 2017
Master of Science, Mechanical Science and Engineering
Advisors: Dr. Hae-Won Park

Shanghai Jiao Tong University (SJTU) Sept. 2011 - Aug. 2015
Bachelor of Science, Mechanical Engineering (with honor)
Advisor: Dr. Peisen Huang

RESEARCH EXPERIENCE

Graduate Research Assistant 2015 - present
Dynamic Robotics Lab, UIUC

- Designed and built a torque-controllable quadrupedal robot *Panther* with dynamic capabilities
- Originated the Representation-Free Model Predictive Control (RF-MPC) for dynamic motions in quadrupeds, applications include extremely dynamic maneuver, wall/ceiling climbing robots
- Implemented the RF-MPC algorithm on *Panther* for Real-Time control; demonstrated the RF-MPC in experiments of various dynamic motions such as trotting, bounding, squat jumping and tumbling
- Developed a Mixed-Integer Convex Program based kino-dynamic motion planning framework, which enables dynamic single/multiple legged robots to traverse challenging terrains

Visitng Researcher June-Aug. 2019
HUBO Lab, Korean Advanced Institute of Science and Technology (KAIST)

- Implemented the RF-MPC on the quadrupedal robot *Panther* and conducted hardware experiments

Undergraduate Research Assistant 2013-2015
State Key Laboratory of Mechanical Systems and Vibration, SJTU

- Implemented a Real-Time PID control system for a piezo-actuated planar motor using LabVIEW; tuned gain values and limited motion deviation within ± 1 μm

PUBLICATIONS

JOURNAL

9. **[T-RO' 21]** Yanran Ding, Abhishek Pandala, Chuanzheng Li, Young-Ha Shin, and Hae-Won Park. " Representation-Free Model Predictive Control for Dynamic Motions in Quadrupeds." *Transactions on Robotics*, 2021. [pdf]

8. [**Mechatronics' 20**] Chuanzheng Li, Yanran Ding, and Hae-Won Park. "Centroidal-Momentum-Based Trajectory Generation for Legged Locomotion." *Mechatronics*, 2020. [pdf]
7. [**RA-L' 19**] Abhishek Pandala, Yanran Ding, and Hae-Won Park. "qpSWIFT: A Real-time Sparse Quadratic Program Solver for Robotic Applications." *Robotics and Automation Letters*, 2019. [pdf]

CONFERENCE

6. [**ICRA' 21**] Yanran Ding, Mengchao Zhang, Chuanzheng Li, Hae-Won Park, and Kris Hauser. "Hybrid Sampling/Optimization-based Planning for Agile Jumping Robots on Challenging Terrains." *IEEE International Conference on Robotics and Automation*, 2021.
5. [**IROS' 20**] Yanran Ding, Chuanzheng Li, and Hae-Won Park. "Wrench-based Kinodynamic Motion Planning for Multi-Legged Robots via Mixed-Integer Convex Program." *IEEE/RSJ International Conference on Intelligent Robots and Systems*, 2020.[pdf]
4. [**ICRA' 19**] Yanran Ding, Abhishek Pandala, and Hae-Won Park. "Real-time Model Predictive Control for Versatile Dynamic Motions in Quadrupedal Robots." *IEEE International Conference on Robotics and Automation*, 2019.[pdf]
3. [**IROS' 18**] Yanran Ding, Chuanzheng Li, and Hae-Won Park. "Single Leg Dynamic Motion Planning with Mixed-Integer Convex Optimization." *IEEE/RSJ International Conference on Intelligent Robots and Systems*, 2018.[pdf]
2. [**IROS' 17**] Yanran Ding and Hae-Won Park. "Design and Experimental Implementation of a Quasi-Direct-Drive Leg for Optimized Jumping." *IEEE/RSJ International Conference on Intelligent Robots and Systems*, 2017.[pdf]
(**Best Student Paper Award Finalist**)

MANUSCRIPTS SUBMITTED

1. [**IROS' 21**] João Ramos, Yanran Ding, Youngwoo Sim, Kevin Murphy, and Daniel Block. "HOPPY: An Open-source Kit for Education with Dynamic Legged Robots." *Manuscript submitted to IROS*, 2021.

PATENT

[CN104648665A]. "A Linkage Mechanism for Quadrotor Power Cable Cruise ." *China*, granted Dec. 2016.

TEACHING AND MENTORING

University of Illinois at Urbana-Champaign

Teaching Assistant, ME446 Robot Dynamics and Control *2020 Spring*

- Developed simulation leading to students implementing hopping controllers on a legged robot
- Delivered one lecture on inverse dynamics control and an introduction on legged robots

Teaching Assistant, ME360 Fundamentals of Signal Processing *2019 Fall*

- Instructor for the lab sessions and office hours
- Received rating as excellent TA by students [19Fall]

TA, ME340 Modeling and Analysis of Dynamical Systems *2020 Fall, 2017 Fall, 2016 Spring*

- Instructor for the lab sessions and assistant for the lectures
- Received rating as excellent TA by students [17Fall] [16Spring]

Graduate Mentor *2016-2018*

- Mentored 7 undergraduates from the Department of Mechanical Science and Engineering, UIUC to assist in research projects. Tasks include designing and manufacturing test-bed for the dynamic robot leg, conducting simulations for dynamic motions, and analyzing experimental data.
- Two of the undergraduates went on for Ph.D. study on Robotics in Georgia Tech and Princeton, respectively

Shanghai Jiao Tong University

Teaching Assistant, ME395 Engineering Laboratory *2015 Spring*

- Designed and implemented laboratory experiments with the instructors on various topics including motor control, vibration, and heat transfer

HONORS AND AWARDS

Best Robotics Demo Award, Coordinated Science Lab Student Conference, UIUC	2017,2019
Coordinated Science Laboratory Video of the month, UIUC	March 2019
Finalist of Best student paper, IROS, Vancouver	2017
Senior Design project Gold Prize, Shanghai Jiao Tong University	2015
Yu Liming Scholarship, UM-SJTU Joint Institute	2015
National Scholarship of China, Ministry of Education	2014

ACADEMIC SERVICES

- **Reviewer for**: IEEE Robotics and Automation Letters, IEEE ICRA, IEEE IROS, IEEE CASE

INVITED TALKS

4. "Planning and Control of Legged Robots in Challenging Terrains", *Virtual Seminar in Robotics, Optimization, and Assistive Mobility (ROAM) Lab*, University of Notre Dame, Notre Dame, IN, 2020.
3. "Design and Control of a Quadruped Robot Panther for Highly Dynamic Motions", *RoboGrads Fall 2020 Student Virtual Seminar*, Georgia Tech., Atlanta, GA, 2020.
2. "Design and Control of a Quadruped Robot for Dynamic Motions", *Robotics Seminar Series*, Illinois Robotics Group, UIUC, Urbana, IL, 2019.
1. "Design, Planning and Control of a Highly Dynamic Quadrupedal Robot", *Coordinated Science Laboratory Student Conference*, University of Illinois at Urbana-Champaign, Urbana, IL, 2019.

POSTER PRESENTATION

1. "Design and Experimental Implementation of a Proprioceptive Leg for Optimized Jumping", *Midwest Robotics Workshop*, Toyota Technological Institute at Chicago, IL, 2018.

SKILLS

- **Programming**: MATLAB, Simulink, LabVIEW, Python
- **Softwares**: SolidWorks, Latex, Adobe Premiere, YALMIP, CasADi, MPT3, MS Office
- **Languages**: English (fluent), Chinese (native)