Ke Wang

Short Introduction

I am a senior robot research engineer at Dyson. I hold a PhD degree from Imperial College London with deep knowledge in robotics and machine learning. During my Ph.D., I focus on "How to build a bipedal robot and How to control it to walk?". I designed, built and developed novel control algorithms for the world's *first* kneeless bipedal walking robot SLIDER (website) with the design published, which has won *Best Poster Award* and *Best Paper Award* at international robotic conferences. Recently, we trained a reinforcement learning-based controller to make the robot walk(Link). Now at Dyson, I use deep imitation learning and reinforcement learning to solve challenging robot control and planning problems.

Work Experience

Apr 2022 - present | **Dyson Ltd**

Senior Robot Research Control/Machine Learning Engineer

- Working on research projects that will potentially be the next-generation robot products of Dyson. Focus on deep reinforcement learning and imitation learning for robot control and planning.

Jan 2020 - Mar 2022 | **Extend Robotics Ltd, London**

Leading robotic control software development

- Developed and wrote optimization-based real-time inverse kinematics solver for a robot arm, demo seen at (video1) and (video2)
- Developing deep imitation learning algorithm for robot manipulation

Jan-Oct 2016 | **Max Plank Institute for Intelligent Systems, Autonomous Motion Department**

Learning haptic feedback controllers for a dexterous hand from human demonstrations

- wrote and improved the ROS and low-level control interface of a 21 Degrees of Freedom dexterous hand in Gazebo simulation
- developed the torque controller for the hand with haptic feedback using hand kinematics and dynamics
- applied machine learning methods (PCA and autoencoder) to reduce the dimensionality of controller state the controller

Mar-Aug 2015 | **German Aerospace Center (DLR), Institute for Robotics and Mechatronics**

Motion Planning for KUKA Mobile Manipulator OmniRob.

- built the kinematics model for the mobile manipulator (7 degrees of freedom arm with 3 degrees of freedom mobile base) in Moveit!
- thoroughly experimented with different sampling based and optimization based motion planning algorithms and plan a viable path for mobile manipulator

Oct 2012 - Apr 2013 | **Robert Bosch Engineering**

developed an android APP for remote controlling a karting car using WiFi.

Education

Oct 2017 - Mar 2022	PhD Candidate in Robotics Control and Machine Learning **Imperial College London**, London Supervisor: Petar Kormushev Thesis Topic: "Optimal Control and Machine Learning for the straight-legged bipedal robot SLIDER."
Jan 2021 - Jun 2021	Visiting Student at **University of Edinburgh**, Edinburgh Supervisor: Sethu Vijayakumar, Carlos Mastalli and Songyan Xin Topic: "Multi-Contact Humanoid Motion Planning on Uneven Terrains with TALOS."
Sep 2013 - Dec 2016	Master in Robotics, Cognition, Intelligence **Technical University of Munich**, Munich Supervisor: Jeannette Bohg and Ludovic Righetti Thesis: "Learning Haptic Feedback Controllers from Human Demonstrations"
Sep 2008 - Jul 2013	Bachelor in Automotive Engineering **Tongji University**, Shanghai

Scholarships and Awards

Aug 2011	First prize of "Freescale Cup" Chinese National Smart Car Competition
Aug 2012	First prize of "Freescale Cup" Chinese National Smart Car Competition
Sep 2012	First Class Study scholarship of Tongji University
Since Sep 2017	Imperial College London Scholarship
July 2018	Best Poster Award, 19th Towards Autonomous Robotic Systems (TAROS)
Sep 2021	Best Paper Award, 21st International Conference on Climbing and Walking Robots and Support Technologies for Mobile Machines (CLAWAR)

Teaching

2017-22 Robotics GTA at Imperial College London in autumn and spring term.

Journal Under Review

- **Ke Wang**, Zhaoyang Jacopo Hu, Peter Tisnikar, Oskar Helander, Digby Chappell, Petar Kormushev, "When and Where to Step: Terrain-Aware Real-Time Footstep Location and Timing Optimization for Bipedal Robots", in review at *Robotics and Autonomous System* (video)
- Jiayi Wang, Sanghyun Kim, Teguh Santoso Lembono, Wenqian Du, Jaehyun Shim, Saeid Samadi, **Ke Wang**, Vladimir Ivan, Sylvain Calinon, Sethu Vijayakumar, Steve Tonneau, "Online Multi-Contact Receding Horizon Planning via Value Function Approximation", submitted to *IEEE Transactions on Robotics* (video)

Publications

- **Ke Wang**, Guiyang Xin, Songyan Xin, Michael Mistry, Sethu Vijayakumar and Petar Kormushev "A Unified Model with Inertia Shaping for Highly Dynamic Jumps of Legged Robots", *Mechatronics* (video)
- **Ke Wang**, Hengyi Fei Guiyang Xin and Petar Kormushev "Fast Online Optimization for Terrain-Blind Legged Robot Walking with a Decoupled Actuated SLIP Model", *Frontiers in Robotics and AI* (video)
- **Ke Wang**, Roni Permana Saputra, James Paul Foster, Petar Kormushev, "Improved Energy Efficiency via Parallel Elastic Elements for the Straight-legged Vertically-compliant Robot SLIDER", **Best Paper Award** *In Proc. 21st International Conference on Climbing and Walking Robots and Support Technologies for Mobile Machines (CLAWAR 2021), Japan, 2021.* (video)
- Roni Permana Saputra, Nemanja Rakicevic, Digby Chappell, **Ke Wang**, Petar Kormushev, "Hierarchical Decomposed-Objective Model Predictive Control for Autonomous

Casualty Extraction", *IEEE Access, 2021*

- Chaochao Lu, Biwei Huang, **Ke Wang**, Kun Zhang, Jose Miguel Hernandez-Lobato, Bernhard Schölkopf, "Sample-Efficient Reinforcement Learning via Counterfactual-Based Data Augmentation", *Proceedings of Neural Information Processing Systems Workshop on Offline Reinforcement Learning, 2020*
- **Ke Wang**, David Marsh, Akshay Raut, Stergio Chikaros, Zhonghe Jiang, Roni Permana Saputra, Digby Chappel, and Petar Kormushev, "Design and Control of SLIDER: An Ultra-lightweight, Knee-less, Low-cost Bipedal Walking Robot", *International Conference on Intelligent Robots and Systems (IROS), 2020* (video)
- Fabian Falck, Sagar Doshi, Marion Tormento, Gor Nersisyan, Nico Smuts, John Lingi, Kim Rants, Roni Permana Saputra, **Ke Wang**, and Petar Kormushev, "Robot DE NIRO: A Human-Centered, Autonomous, Mobile Research Platform for Cognitively-Enhanced Manipulation", *Frontiers in Robotics and AI, July 2020*
- **Ke Wang**, Aksat Shah, Petar Kormushev, "SLIDER: A Bipedal Robot with Knee-less Legs and Vertical Hip Sliding Motion", *In Proc. 21st International Conference on Climbing and Walking Robots and Support Technologies for Mobile Machines (CLAWAR 2018), Panama, 2018*.

Conference Abstracts and Presentations

- **Ke Wang**, Aksat Shah, Petar Kormushev, "SLIDER: A Novel Bipedal Walking Robot without Knees", In Proc. 19th International Conference Towards Autonomous Robotic Systems (TAROS 2018), Bristol, UK, 2018. (**Best Poster Award**)
- **Ke Wang**, Roni Permana Saputra, James P. Foster, and Petar Kormushev, "Improved Energy Efficiency via Parallel Elastic Elements for the Straight-legged Vertically-compliant Robot SLIDER", In Proc. 2019 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2019), Macau, China, 2019.
- **Ke Wang** and Petar Kormushev, "RotoGait", In Dynamic Walking 2023, Munich, Germany, 2023.

Invited Talk

- "Fast Online Optimization for Terrain Blind Bipedal Robot Walking with a Decoupled Actuated SLIP Model", workshop on Advances in Trajectory Optimization and Model Predictive Control for Legged Systems, Humanoids 2022, Okinawa, Japan (Link)

Reviews

RAL, ICRA, IROS, Humanoids, Frontiers in Robotics and AI, Neurips

Recommendations

Prof. Petar Kormushev (p.kormushev@imperial.ac.uk)
Dr. Chang Liu (chang.liu52@icloud.com)
Prof. Sethu Vijayakumar (sethu.vijayakumar@ed.ac.uk)