

## Dr. Fangyi Zhang

Research Fellow in Manipulation and Vision

QUT Centre for Robotics

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## Summary

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Dr Zhang has been focusing on robotics and machine learning since 2014. He has over 16 peer-reviewed publications including those in top conferences and journals in robotics (The International Journal of Robotics Research, IEEE International Conference on Robotics and Automation, IEEE/RSJ International Conference on Intelligent Robots and Systems and IEEE Robotics & Automation Magazine) and machine learning (Conference on Neural Information Processing Systems, and The International Conference on Learning Representations). In the time that he has been an academic Dr Zhang has achieved several awards for research, including a Best Paper Award Finalist in ACRA 2017 and a Best Industry Paper in IJCAIW 2021. Dr Zhang has an h-index of 10 with over 780 citations, and with one paper cited more than 350 times. He is known globally and has been invited to many international activities and events: reviewing a grant proposal submitted to the 2020 FONDECYT Regular Competition of the Chilean National Commission for Scientific and Technological Research (CONICYT), chairing the Tactile Sensing I session at IROS 2023, co-organizing workshops on representing and manipulating deformable objects for ICRA 2023 and ICRA 2024, giving invited talks in Oxford Robotics Institute and Bristol Robotics Laboratory, and reviewing papers for top journals and conferences including Nature Machine Intelligence. He is an Associate Editor for the IEEE Robotics and Automation Letters (RA-L), one of the top journals in robotics. All these reflect his global impact in the areas of robotics and machine learning.

In addition, Dr Zhang has more than 6 years of work experience in the industry and has accumulated both hardware and software experience in the fields of robotics, machine learning, mechatronics, semiconductor manufacturing and testing, and high-end equipment manufacturing. He has been collaborating with SINTEF (Norway), Inria (France), and MIT (the US) in the GentleMAN project (financed by the Research Council of Norway; RCN299757) for two years, and has recently demonstrated for the first time a robot cutting salmon fillets using a sashimi knife. With this unique expertise, experience and international collaborations, Dr Zhang is perfectly placed to deliver research in AI and Robotics; and lead the translation of the outcomes into practice.

## Research Interests

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Robot Learning, Robotic Manipulation, Tactile Sensing, Robotic Vision, Reinforcement Learning, and Autonomous Systems

## Education

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PhD	Queensland University of Technology (QUT), Brisbane, Australia	2015-2018
	PhD Thesis: <b>Learning Real-world Visuo-motor Policies from Simulation</b>	
	Supervisors: Prof. Peter Corke, Dr. Jürgen Leitner, and Prof. Michael Milford	
B.Eng.	East China Jiaotong University (ECJTU), Nanchang, Jiangxi, P. R. China	2006-2010
	Thesis Title: Design of MiroSot Soccer Robot Control System	
	<b>Outstanding Thesis Award</b>	

## Work/Visit Experience

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■ Research Fellow	QUT Centre for Robotics, Brisbane, Australia	Dec 2021-present
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Research on robotic physical interaction with a particular focus on tactile sensing and tactile-based robotic manipulation.

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| ■ <b>Algorithm Expert</b>   | Alibaba DAMO Academy, China                            | Oct 2018-Nov 2021 |
| R&D in machine learning, data mining, robotic vision, and mobile robots.                    |  |                   |
| ■ <b>Visiting PhD Student</b>   | University of Maryland, College Park, USA              | Sep-Dec 2016      |
| Collaboration in building a mobile manipulation robot for housework in a kitchen scenario.  |  |                   |
| ■ <b>Research Assistant</b>   | Hong Kong University of Science and Technology (HKUST) | Mar-Dec 2014      |
| Research on VLC-based indoor localization and 3D-sensing using a 2D-laser-scanner.          |  |                   |
| ■ <b>Software Engineer</b>  | CRRC Zhuzhou Institute, China                          | Aug 2012-Mar 2013 |
| Developing control algorithms and software for the adhesion control of locomotives.         |  |                   |
| ■ <b>Applications Engineer</b>  | CRRC Zhuzhou Institute, China                          | Jul 2010-Jul 2012 |
| Developing testing and application technologies and equipment for power electronic devices. |  |                   |

**Selected Publications** (Please refer to my [Google Scholar profile](#) for a complete list)

- [1] Maceon Knopke, Liguao Zhu, Peter Corke, **Fangyi Zhang\*\***, "Towards Assessing Compliant Robotic Grasping from First-Object Perspective via Instrumented Objects," *IEEE Robotics and Automation Letters (RA-L)*, 2024. (Under Review) ([Web](#))
- [2] Robert Lee, Jad Abou-Chakra, **Fangyi Zhang**, Peter Corke, "Learning Fabric Manipulation in the Real World with Human Videos", in *Proceedings of the IEEE International Conference on Robotics and Automation (ICRA)*, 2024. ([Web](#))
- [3] **Fangyi Zhang**, Peter Corke, "Re-evaluating Parallel Finger-tip Tactile Sensing for Inferring Object Adjectives: An Empirical Study," in *Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pp. 8951-8957, 2023. doi: 10.1109/IROS55552.2023.10342262 ([PDF](#))
- [4] Yaohua Wang\*, **Fangyi Zhang\***, et al., "Robust Graph Structure Learning over Images via Multiple Statistical Tests," *Advances in Neural Information Processing Systems 35: 36th Conference on Neural Information Processing Systems (NeurIPS)*, pp. 32083-32096, 2022. ([PDF](#))
- [5] **Fangyi Zhang**, Jürgen Leitner, Zongyuan Ge, Michael Milford, Peter Corke, "Adversarial Discriminative Sim-to-real Transfer of Visuo-motor Policies," *International Journal of Robotics Research (IJRR)*, vol. 38, no. 10-11, pp. 1229-1245, 2019. doi: 10.1177/0278364919870227 ([PDF](#))
- [6] **Fangyi Zhang**, Jürgen Leitner, Michael Milford, Peter Corke, "Modular Deep Q Networks for Sim-to-real Transfer of Visuo-motor Policies," in *Proceedings of the Australasian Conference on Robotics and Automation (ACRA)*, 2017. ([PDF](#)) (**Best Paper Award Finalist**)
- [7] **Fangyi Zhang**, Jürgen Leitner, Michael Milford, Peter Corke, "Tuning Modular Networks with Weighted Losses for Hand-Eye Coordination," in *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition Workshops (CVPRW)*, 2017. doi: 10.1109/CVPRW.2017.74 ([PDF](#))
- [8] **Fangyi Zhang**, Jürgen Leitner, Michael Milford, Ben Upcroft, Peter Corke, "Towards Vision-Based Deep Reinforcement Learning for Robotic Motion Control," in *Proceedings of the Australasian Conference on Robotics and Automation (ACRA)*, 2015, ANU, Canberra, Australia. ([PDF](#)) ([Cited by 351](#))
- [9] **Fangyi Zhang**, Kejie Qiu, Ming Liu, "Asynchronous Blind Signal Decomposition Using Tiny-Length Code for Visible Light Communication-Based Indoor Localization," in *Proceedings of the IEEE International Conference on Robotics and Automation (ICRA)*, pp. 2800-2805, 2015. doi: 10.1109/ICRA.2015.7139580 ([PDF](#))
- [10] Yaohua Wang, Yaobin Zhang, **Fangyi Zhang**, et al., "Ada-NETS: Face Clustering via Adaptive Neighbour Discovery in The Structure Space," in *Proceedings of the International Conference on Learning Representations (ICLR)*, 2022. ([PDF](#))
- [11] Huafeng Yang, Xingjian Chen, **Fangyi Zhang\*\***, et al., "GCN-Based Linkage Prediction for Face

Clustering on Imbalanced Datasets: An Empirical Study," in *Workshops of the International Joint Conference on Artificial Intelligence (IJCAI)*, 2021. ([PDF](#)) (**Best Industry Paper**)

[12] Cangning Fan, **Fangyi Zhang**, et al., "Importance Weighted Adversarial Discriminative Transfer for Anomaly Detection," *arXiv preprint arXiv:2105.06649*, 2021. ([PDF](#))

[13] Kejie Qiu, **Fangyi Zhang**, Ming Liu, "Let the Light Guide Us: VLC-based Localization," *IEEE Robotics and Automation Magazine (RAM)*, vol. 23, no. 4, pp. 174-183, 2016. doi: 10.1109/MRA.2016.2591833 ([PDF](#))

[14] Kejie Qiu, **Fangyi Zhang**, Ming Liu, "Visible Light Communication-based Indoor Localization using Gaussian Process," in *Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pp. 3125-3130, 2015. doi: 10.1109/IROS.2015.7353809 ([PDF](#))

[15] Kejie Qiu, **Fangyi Zhang**, Ming Liu, "Visible Light Communication-based Indoor Environment Modeling and Metric-free Path Planning", in *Proceedings of the IEEE International Conference on Automation Science and Engineering (CASE)*, pp. 200-205, 2015. doi: 10.1109/CoASE.2015.7294062 ([PDF](#))

\*: Equal contribution, listed in alphabetical order by last name.

\*\* : Corresponding author.

## Selected Grants

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QCR ECR Funding Scheme	Assessing Compliant Robotic Grasping Performance through Novel Instrumented Objects (\$20,000)	Oct 2022- Jun 2023
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## Selected Awards & Honors

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■ Recognized as <b>Global Talents</b> , Australia	2021
■ Recognized as <b>High-end Talents</b> , Hangzhou, China	2020
■ <b>ACRA 2017 Best Paper Award Finalist</b>	2017
■ <b>ACRV Best Team Project</b> (for the contribution in the Amazon Picking Challenge)	2016

## Skills & Certificates

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■ <u>Skills: ROS, C++, C, Python, Matlab, Lua, PyTorch, TensorFlow, Linux, V-REP, Embedded Systems</u>	
■ National Computer Rank Examination Certificate, Grade: 2, Language: C++, Result: Pass	2008
■ National CAD Rank Examination Certificate, Grade: 2, Software: AutoCAD, Result: Excellent	2008
■ China Intellectual Property Training, Course: The Basis of Intellectual Property Law, Result: Pass	2008

## Academic Services

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- Journal Reviewer: Nature Machine Intelligence, RA-L, T-ASE, TNNLS, ISJ, AURO
  - Conference Reviewer: ICRA, IROS, Humanoids
  - Grant Review: FONDECYT (Chilean National Fund for Science and Technology)

## Selected Project Briefs

Research page: [Projects 3-5](#).

Note: In the projects 1, 2, 3, 4, 7 and 10 to 13, I am the principal investigator.

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| 1. <b>Tactile Sensing and Dexterous Manipulation</b> | Dec 2021-present |
|--|------------------|
- Baselines and research for tactile sensing and learning tactile-based manipulation.
  - Design and development of novel instrumented objects for assessing compliant robotic grasping.
  - Dexterous manipulation with multiple-finger hands and tactile sensors.

2. **Deep Learning and Data Mining** Apr 2020-Nov 2021
  - Research on deep learning based clustering techniques for computer vision applications.
  - Investigation of computer vision approaches for remote sensing image understanding.
  - Supervision on research interns and collaboration with fellow researchers for publications.
3. **Indoor Visual Localization and Navigation on UAVs** Oct 2018-Mar 2020
  - Led the building of a robotic vision lab under the Machine Intelligence Technology Lab of Alibaba DAMO Academy.
  - Investigation of different VSLAM approaches for indoor localization on UAVs.
  - Investigation of various 3D sensing approaches using either stereo or monocular cameras.
  - Investigation of approaches for real-time path planning and obstacle avoidance.
  - System integration for autonomous navigation, obstacle avoidance and target following.
4. **Learning Real-world Visuo-motor Policies from Simulation** Feb 2015-Sep 2018
  - Feasibility analysis on learning vision-based robotic planar reaching using DQNs in simulation.
  - Proposed a modular deep Q network architecture for fast and low-cost transfer of visuo-motor policies from simulation to the real world.
  - Proposed an end-to-end fine-tuning method using weighted losses to improve hand-eye coordination.
  - Proposed a kinematics-based guided policy search method (K-GPS) to speed up Q learning for robotic applications where kinematic models are known.
  - Demonstrated in robotic reaching tasks on a real Baxter robot in velocity and position control modes, e.g., table-top object reaching in clutter and planar reaching.
  - More investigations are undergoing for semi-supervised and unsupervised transfer from simulation to the real world using adversarial discriminative approaches.
5. **Robotic Manipulation for Warehouse and Household Applications** 2016
  - Baxter robot hand-eye calibration for the Amazon Picking Challenge (collaboration with Dr. Leo Wu).
  - A mobile manipulation robot for housework in a kitchen scenario, mainly taking in charge of the sub-task of table cleaning (project during my visit to the University of Maryland, College Park, Sep-Dec 2016).
6. **Visible Light Communication (VLC) based Indoor Localization** 2014
  - Developed a beacon code selection algorithm and a decomposition algorithm for blindly mixed beacon signals, based on CDMA code selection principles and Gold-sequence correlation properties.
  - Participated in the development of a light intensity distribution map generation algorithm using **Gaussian Process Regression**.
  - Participated in the development of localization and path planning algorithms using Kalman Filter (**KF**) and **A star**.
7. **3D-sensing based on a 2D-laser-scanner** 2014
  - Developed a software framework based on Robot Operating System (**ROS**).
  - Developed a motor position estimation algorithm using Extended Kalman Filter (**EKF**).
  - Developed an algorithm to project point clouds from 2D-space to 3D-space.
8. **R&D of the Adhesion Control for Locomotives** 2012-2013
  - Optimized a **Matlab (Simulink)** model of adhesion control for more realistic simulation.
  - Optimized the adhesion control algorithm by taking use of the derivative of wheel acceleration.
  - Applied the algorithm on various electric locomotives, diesel locomotives and metro vehicles.
9. **R&D of Testing and Application Technologies for Power Electronic Devices** 2010-2012
  - Developed controllers for various experimental circuits, using **Freescale MCU** based embedded systems.

- Participated in the simulation (using **PSIM**), design and building of a 150 kA Pulse Discharge Testboard, including its main and control circuits. Developed an offline test data analysis software for the testboard using Visual Basic for Applications (**VBA**).
- Participated in enabling the auto scan of an X-TEK X-ray instrument for IGBT, using **Visual Basic**.
- Investigated the characteristics of newly designed semiconductor devices (pulsed thyristor and IGCT), such as gate, frequency and high-temperature characteristics.

#### 10. **FIRA-MiroSot Soccer Robot Control System (Excellent Graduation Project)** 2009-2010

- Developed a host computer software system for soccer robots, which consists of three subsystems: image processing, behavior control and multi-agent coordination. The implementation is based on **Visual C++**, using **multithreading**, dynamic link library (**DLL**) and **database** techniques.
- Developed algorithms for some basic motions using **PID**. Regression approaches were used to fit experimental data for robot motion characteristics to prevent robots from being out of control.
- Optimized a **mid-perpendicular based method** for more reliable shooting motions. A higher shooting success rate was achieved by specifying wheel velocities using an experimentally fitted function.
- Realized real-time path planning including obstacle avoidance, using an optimized artificial potential field (**APF**) approach. Solved the “local minimum trap” problem of APF and improved the smoothness of planned paths by optimizing artificial potential functions.

#### 11. **Smart Cars** (based on small size model cars and Freescale MCU) 2009

- Developed a smart model car for the 4<sup>th</sup> Freescale Smart Car Competition (**FSCC**). Achieved an average velocity of 1.8 m/s, using **PID**, customized **fuzzy control**, and **statistic pattern recognition approaches**. **Won the Excellent Award in South China Region.**
- Developed a smart model car to counterbalance a teeterboard, with the capability to adapt to balance point changes, using customized **fuzzy control**.
- Developed a multi-functional smart model car for a series of tasks where the car was required to detect the positions of copper pieces on a road, then avoid obstacles and enter a garage at the end.

#### 12. **Localization and Control Systems** 2009

- Developed a sound localization system for the 9th National Undergraduate Electronic Design Contest (**NUEDC**). Its function was to first localize a model car through a ground system according to a sound signal emitted by the car, and then wirelessly control the car to some specific locations. Localization and control algorithms were designed based on the sound characteristics and the system’s geometric model. Implemented on a Freescale MCU based embedded system. **Won the Second Prize in Jiangxi Province.**
- Developed a pensile motion control system which can draw various patterns on a perpendicular drawing board. The control algorithms were designed based on its geometric and motion models. Implemented on a Freescale MCU based embedded system.

#### 13. **Innovation of a Smart Socket and its Remote Controller** (Challenge Cup project) 2008-2009

- Developed a smart socket which can monitor and control the power of connected appliances, preventing them from overloading, and helping save energy.
- Developed a remote controller which can wirelessly communicate with the socket, providing its working states such as power consumption, and controlling the socket.