

# Fengkang Ying

Phone: +86 18850077449 | Email: fengkang@u.nus.edu | Website: [bruce-yfk.netlify.app](https://bruce-yfk.netlify.app)  
Research Interest: robotics, deep reinforcement learning, motion planning, intelligent control

## Education

Donghua University, M.E, Shanghai, China

Sep 2019 – Mar 2022

Major: Electrical Engineering | GPA: 89.5/100 (Rank: 1/160)

Thesis: Robotic Trajectory Generation Based on Deep Reinforcement Learning with Deterministic Policy Gradient

(National Excellent Master's Thesis Award, conferred by Chinese Association of Automation, 29 recipients in total)

Courses: Robotics and Control (98/100), Linear System Theory (92/100), Intelligent Systems and Control (91/100), Modern Power Source Technology (93/100)

Huaqiao University, B.E, Fujian, China

Sep 2015 – Jun 2019

Major: Electrical Engineering & Automation | GPA: 84/100 (Rank: 3/54)

Thesis: Automatic Obstacle Avoidance and Parking System for Mobile Robots

Courses: Probability and Mathematical Statistics (99/100), Power System Analysis (94/100), Principles and Applying of Programming Logic Controller (91/100), Power Drive Technique (94/100)

## Publications

- ♦ H.S. Liu\*, **F.K. Ying\*** (\* equal contribution), R.X. Jiang, Y.H. Shan, and B. Shen, "Obstacle-avoidable Robotic Motion Planning Framework Based on Deep Reinforcement Learning", *IEEE/ASME Transactions on Mechatronics* (Minor revision, top journal, IF: 6.4)
- ♦ **F.K. Ying**, H.S. Liu, M.H. Dong, and R.X. Jiang, "[Extensively Explored and Evaluated Actor-Critic with Expert-Guided Policy Learning and Fuzzy Feedback Reward for Robotic Trajectory Generation](#)", *IEEE Transactions on Industrial Informatics*, vol. 18, no. 11, pp. 7749-7760, 2022 (Published, top journal, IF: 12.3)
- ♦ **F.K. Ying**, H.S. Liu, R.X. Jiang, and X. Yin, "[Trajectory Generation for Multiprocess Robotic Tasks Based on Nested Dual-Memory Deep Deterministic Policy Gradient](#)", *IEEE/ASME Transactions on Mechatronics*, vol. 27, no. 6, pp. 4643-4653, 2022 (Published, top journal, IF: 6.4)
- ♦ **F.K. Ying**, H.S. Liu, and B. Shen, "From Dedicated to Universal: A Survey on Robotic Motion Planning with Deep Reinforcement Learning", *Robotic Intelligence and Automation* (Invited paper, submitted)
- ♦ R.X. Jiang, **F.K. Ying** (corresponding author), G.J. Zhang, Y.F. Xing, and H.S. Liu, "[Globally Perceived Obstacle Avoidance for Robots based on Digital Twin and Deep Reinforcement Learning](#)", *2023 7th International Conference on Robotics, Control and Automation (ICRCA)*, 2023 (Published)
- ♦ M.H. Dong, **F.K. Ying**, X.J. Li, and H.S. Liu, "[Efficient Policy Learning for General Robotic Tasks with Adaptive Dual-memory Hindsight Experience Replay Based on Deep Reinforcement Learning](#)", *2023 7th International Conference on Robotics, Control and Automation (ICRCA)*, 2023 (Published)
- ♦ Y.Y. Chen, **F.K. Ying**, X.J. Li, and H.S. Liu, "[Deep Reinforcement Learning in Maximum Entropy Framework with Automatic Adjustment of Mixed Temperature Parameters for Path Planning](#)", *2023 7th International Conference on Robotics, Control and Automation (ICRCA)*, 2023 (Published)
- ♦ H.Y. Han, **F.K. Ying**, Z.W. Pang, H.S. Liu, "Dual-strategy Pose Estimation Network Based on Mask-RCNN", *42nd Chinese Control Conference (CCC)*, 2023 (Accepted)

## Research Experience

### IK-free Trajectory Generation with Automatic Obstacle Avoidance for Manipulators

Donghua University – KUKA robotic laboratory, Group of Roboteam

Aug 2022 – Present

- ♦ Proposed a prophet-guided actor-critic (PAC) algorithm for prompt and stable task replanning
- ♦ Designed a reward system to make the body and the end-effector of a manipulator avoid collisions simultaneously
- ♦ Proposed an expandable memory to augment high-quality samples from only a few expert demonstrations

### Extensively Explored and Evaluated Actor-Critic (E3AC) with Expert-Guided Policy Learning and Fuzzy Feedback Reward for Robotic Trajectory Generation

Donghua University – KUKA robotic laboratory, Group of Roboteam

Mar 2021 – Jan 2022

- ♦ Proposed a novel deep reinforcement learning algorithm (E3AC) with extensive exploration and evaluation based on single-actor-multiple-critic framework and deterministic policy gradient
- ♦ Proposed a dual-memory structure based on an increasingly unbiased expert-guided strategy for efficient policy learning
- ♦ Designed a fuzzy feedback reward based on multilayer perceptron and fuzzy system for efficient reward obtaining without manually establishing explicit reward functions
- ♦ Adopted DDPG, SAC, PER, GMM, and other benchmarks to verify the proposed IK-free trajectory generation scheme

## **Trajectory Generation for Multiprocess Robotic Tasks Based on Nested Dual-Memory Deep Deterministic Policy Gradient**

*Donghua University – KUKA robotic laboratory, Group of Roboteam*

**Jun 2019 – Jan 2022**

- ◆ Proposed a general IK-free trajectory generation scheme suitable for manipulators of any DoFs by deep reinforcement learning
- ◆ Designed a multi-policy agent based on a novel nested architecture aiming at multiprocess assembly
- ◆ Proposed a dual-memory structure with a local-to-global strategy for efficient policy learning
- ◆ Designed a compound reward system to control the position and orientation of the end effector simultaneously and flexibly

## **Digitalized Pick-and-Place Assembly System Based on V-REP**

*Donghua University – KUKA robotic laboratory, Group of Roboteam*

**Jan 2019 – Mar 2020**

- ◆ Adjusted and tested the KUKA assembly line
- ◆ Responsible for 3D modeling of robots and other devices on SolidWorks, and real-time interaction between KUKA LBR iiwa 7 R800 and V-REP
- ◆ Constructed a virtual twin system (VTS) that was a 1:1 reproduction of the real-world assembly platform to directly apply the algorithm trained in simulation to real-world robot control

## **Automatic Obstacle Avoidance and Parking Technologies for Mobile Robots**

*Huaqiao University – College of Information Science and Engineering*

**Apr 2018 – Mar 2019**

- ◆ Handled basic skills about Arduino and MATLAB
- ◆ Implemented the design, analysis, programming and testing of the automatic obstacle avoidance and parking systems
- ◆ Developed the achievements into graduation design

## **Intelligent Wireless Power Transmission for Electric Vehicles**

*Zhejiang University – College of Control Science and Engineering*

**Jul 2018**

- ◆ Handled basic skills and operations about Simulink and PLECS
- ◆ Analyzed the fundamentals of wireless power transmission system
- ◆ Designed a controller based on T-parameter and compared it with the PI controller

## **Patents**

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- ◆ **F.K. Ying et al.**, “An implementation of human-robot interaction for assembly line based on artificial potential field and reinforcement learning”
- ◆ **F.K. Ying et al.**, “A human-robot collaboration assembly system based on deep reinforcement learning”
- ◆ **F.K. Ying et al.**, “A robot calibration method based on vision and closed-loop transformation of multi-coordinate system”
- ◆ **F.K. Ying et al.**, “An online photometric calibration method based on direct monocular SLAM”
- ◆ **F.K. Ying et al.**, “An implementation method of efficiency optimization for automatic assembly line system”

## **Miscellaneous**

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- ◆ **Language:** English (IELTS overall band: 7.5), Mandarin (Native)
- ◆ **Computer skills:** Python, V-REP/CoppeliaSim, MATLAB, SolidWorks, PLECS, Arduino, Microsoft Office
- ◆ **Scholarships:**
  - Recipient of 1<sup>st</sup> tier Embry Group Scholarship (2020)
  - Recipient of 1<sup>st</sup> tier Postgraduate Academic Scholarship (2019, 2020)
  - Recipient of Postgraduate Full Scholarship (2019)
  - Recipient of National Encouragement Scholarship (2016, 2017, 2018)
- ◆ **Awards and honorable mentions:**
  - National Excellent Master’s Thesis Award (2023)
  - National first award at the 25th China Robotics and Artificial Intelligence Competition (2023)
  - Outstanding graduate in Shanghai (2022)
  - Top ten honorary students in Academic Excellence of Donghua University (2022)
  - National first award at the 23rd China Robotics and Artificial Intelligence Competition (2021)
  - 2<sup>nd</sup> tier awardee of the 16th "Zhaoyi Cup" China Postgraduate Electronic Design Competition (2021)
  - 3<sup>rd</sup> tier awardee of the 18th Shanghai "Tomorrow's Science and Technology Star" Contest (2020)
  - Outstanding graduate at Huaqiao University (2019)
  - Recipient of Merit Certificate at the 7<sup>th</sup> Zhejiang University Control Journey Summer Camp (2018)
  - Outstanding volunteer at Huaqiao University (2017)
- ◆ **Others:**
  - Speaker on Fundamentals of Deep Reinforcement Learning and Its Applications at Donghua University (2022)
  - Speaker on Deep Reinforcement Learning and Its Application Instances on Trajectory Generation for Manipulators at the University of British Columbia – ACIS laboratory (2021)
  - Vice-chairman of the Student Union of Huaqiao University, College of Information Science and Technology (2017, 2018)