Mohamed Al-Khulaqui

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Personal Introduction

I am a highly motivated and versatile individual, If I am not already working on a project then I am researching a new one. My research areas and fields of experience include robotic vision, motion planning and control. I am passionate about robotics, automation and AI, always eager to learn more and find challenging problems to engage myself in. I'm a tech enthusiast and always try to stay up-to-date with the latest technologies.

Education

- **Beijing Institute of Technology** — Beijing, China
  ***M.S**. Mechanical Engineering; GPA: 3.6 .* — *Sep 2021 - Jul 2023*
  Thesis: Motion Planning Framework of Robotic Rat for Behavioral Interaction
  Notable Courses: Advanced Robotics, Design and Application of Robotic Systems, Micro-Nano Manufacturing and Mirco-Nano Robotic Technology.
- **Beijing Institute of Technology** — Beijing, China
  ***B.S.** Mechatronics Engineering; GPA: 3.36 .* — *Sep 2017 - Jul 2021*
  Thesis: Plane Detection and Humanoid Robot Local Path Planning Based on Depth Vision.

Research & Work Experience

- **Motion Control Algorithm Engineer**
  Xiaomi Technology Inc. Robotics Department — *Aug 2023 ∼ Current*
  - **Robotic Control and Motion Planning**:
    Developing motion control algorithms for quadrupedal robotic platforms using MPCs and deep reinforcement learning.
- **Student Researcher**
  Beijing Advanced Innovation Center for Intelligent Robots and Systems (BAICIRS) — *3 years*
  - **Bio-Inspired Robotics Team**: Prof. Qing Shi
    Conducted research on motion planning, pose detection, etc. for the rat-inspired robotic platform SMuRo. Co-authored two scientific papers.
  - **Humanoid Robotics Team**: Prof. Xuechao Chen
    Carried out the development of a depth vision local path planning algorithm for the team's humanoid robot BHR-2. Organized into bachelor thesis which received "outstanding" grade.

Projects

- **Quadruped: Cyberdog 2** — Xiaomi Inc., Robotics Department
  Motion Control Algorithm Engineer - Dr. Yangwei You — *Aug 2023 - Current*
  - **Reinforcement Learning Based Quadruped Locomotion**:
    Used Methods: Actor-Critic Methods, PPO
    Tools: Isaac Sim, Isaac Gym, Python, PyTorch, C++,
  - **Optimization Based Quadruped Skateboarding**: [3]
    Used Methods: Model Predictive Control
    Tools: ROS, C++, Gazebo
- **Robotic-Rat: SMuRo** — BAICIRS, Bio-inspired Robotics Team
  Member of Research Team - Prof. Qing Shi — *Jul 2021 - Jul 2023*

- **Motion Planning Framework of Robotic Rat for Behavioral Interaction**:
  Master Thesis: Developed motion re-targeting method for rat-robot mapping, modeled rat behaviours using ProMPs and implemented rat tracking through visual servoing.
  Used Tools: ROS, C++, ProMP, Gazebo, Ipopt Non-linear Optimization Library
- **Real-Time Rat Pose Estimation**: [1]
  Used Tools: PyTorch, Python, Gazebo
- **Imitation Learning for Motion Generation**: [2]
  Used Tools: PyTorch, Python, C++,Gazebo

- **Humanoid Robotics** BAICIRS, Humanoid Robotics Team
  Graduation Project - Prof. Xuechao Chen *Dec 2020 - Jun 2021*
  - **Footstep Planning for a Humanoid Robot Based on Depth Vision**:
    Bachelor Thesis, outstanding grade.
    Used Tools: C++, MATLAB, Point Cloud Library (PCL)

Technical Skills

- **Robot Motion Planning**: Experienced with various motion planning algorithms, probabilistic methods and non-linear optimization as well as hardware implementations using C++ and ROS.
- **Control of Robotic Systems**: Kinematic and Dynamic modeling, Trajectory Optimization, Model Predictive Control.
- **Vision & Sensors**: RGB-D Cameras, IMUs, Image processing (OpenCV), Point cloud processing (PCL).
- **Machine Learning**: PyTorch, Deep Reinforcement Learning (PPO), Imitation Learning, Object Detection & Recognition (YOLO)

Computer Skills

- **Programming**: C/C++, CMake, MATLAB, Python, OpenCV, Linux, ROS, Qt, LaTeX, Git, Bash.
- **Simulation**: Isaac Sim/Lab/Gym, MuJoCo, Simulink, Gazebo.
- **3D Modeling & CAD**: Solidworks, AutoCAD, Blender.
- **Embedded Development**: Experienced with C and C51 development of micro-controller applications (STM32, Arduino).

Publications

[1] X. Guo, G. Jia, **M. Al-Khulaqui**, Z. Chen, T. Fukuda, and Q. Shi. Real-time pose estimation of rats based on stereo vision embedded in a robotic rat. In *2023 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pages 4690–4695, 2023. DOI: 10.1109/IROS55552.2023.10342475.

[2] H. Xie, G. Jia, **M. Al-Khulaqui**, Z. Gao, X. Guo, T. Fukuda, and Q. Shi. A motion generation strategy of robotic rat using imitation learning for behavioral interaction. *IEEE Robotics and Automation Letters*, 7(3):7351–7358, 2022. DOI: 10.1109/LRA.2022.3182472.

[3] Z. Xu, **M. Al-Khulaqui**, H. Ma, J. Wang, Q. Xin, Y. You, M. Zhou, D. Xiang, and S. Zhang. Optimization based dynamic skateboarding of quadrupedal robot. In *Proceedings of the IEEE International Conference on Robotics and Automation (ICRA)*, 2024. (Accepted).

Languages

- **English**: Fluent, IELTS 8.0.
- **German**: Intermediate, Goethe B1.
- **Chinese**: Fluent
- **Arabic**: Fluent, Mother Language.
- **Japanese**: Basic

References

- **Yangwei You**: PhD,
  Xiaomi Technology Inc., Robotics Department
  Head of Motion Control for Quadruped Team.
  youyangwei1@xiaomi.com

- **Mingliang Zhou**:
  Xiaomi Technology Inc., Robotics Department
  Head of Motion Control Sub-department.
  zhoumingliang@xiaomi.com

- **Qing Shi**: PhD, Professor,
  Beijing Institute of Technology, School of Mechatronics
  Beijing Advanced Innovation Center for Intelligent Robots and Systems, Bio-Inspired Robotics Team
  shiqing@bit.edu.cn

- **Xuechao Chen**: PhD, Professor,
  Beijing Institute of Technology, School of Mechatronics
  Beijing Advanced Innovation Center for Intelligent Robots and Systems, Humanoid Robotics Team
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