Emek Barış Küçüktabak

Robotics Applied Scientist
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TLDR

Current Focus	Online planning and data-efficient real-world learning for multi-fingered manipulation
Experience	Model Predictive Control (MPC), Reinforcement Learning (RL), Real-time digital twin, Whole-body control, Force control, Bilateral teleoperation, Arms, Legs, Multi-fingered hands, Wearable Robots
Software	C++, MuJoCo, Python, ROS
Hardware	Franka, Allegro hand, Honda multi-fingered hand, Fourier bipedal exoskeleton, ANYmal with Kinova, Torque-controlled upper-limb exoskeleton (ANYexo), Cable-driven systems

Experience

Honda Research Institute USA
San Jose, CA

Applied Scientist
October 2024 - now

- Lead and core contributor to a project on **real-world online learning** for dexterous manipulation.
- Built a primitive-informed sampling-based MPC framework for multi-fingered dexterous manipulation, integrating a real-time MuJoCo digital twin with structured action primitives to execute **contact-rich tasks impractical for teleoperation**.
- Co-built an MPC-guided real-world RL pipeline for multi-fingered manipulation, using MPC-guided exploration to train policies **directly on hardware in 10–30 minutes** and achieving 99.8% success on a contact-rich task.
- Developed and verified stability-guaranteed controllers for the **bilateral teleoperation** of robotic manipulators.

  Related skills: Model Predictive Control, Reinforcement Learning, Real-time digital twin, Bilateral teleoperation, C++

Center for Robotics and Biosystems, Northwestern University
Chicago, IL

PhD (Dissertation). Advisers: Kevin Lynch and Jose Pons
September 2019 - August 2024

- Built core codebases and standards for controlling different robots as the lab's first PhD student; used by 10+ researchers.
- Developed a novel, **whole-body** closed-loop interaction force controller for a floating-base bipedal exoskeleton (Paper).
- Built the first bilateral teleoperation framework between lower-limb exoskeletons; verified on 8 stroke patients (Video).
- Collaborated internationally to develop an open-source **C++** software stack for real-time robot control (GitHub).

  Related skills: Real-time control, Whole-body dynamics, Hardware deployment, Interdisciplinary collaboration, C++

Robotic Systems Lab, ETH Zurich
Zurich, Switzerland

Master's (Thesis). Advisers: Marco Hutter, Farbod Farshidian, Yves Zimmermann
September 2017 - July 2019

- Developed a whole-body planner for door opening with a quadrupedal manipulator (ANYmal) (Video).
- Developed and implemented algorithms for dynamic transparency for a 6-DoF upper-limb exoskeleton (ANYexo) (Paper).

  Related skills: Controller design, Whole-body control, Hierarchical Optimization, Force control, C++

Education

Northwestern University
Chicago, IL

PhD in Mechanical Engineering
August 2024

- GPA: 4.00/4.00
- Relevant Courses: Robotic Manipulation (TA), Machine Learning

ETH Zurich
Zurich, Switzerland

MS in Mechanical Engineering
June 2019

- GPA: 5.84/6.00 - Graduated with distinction. Top 5%.
- Relevant Courses: Robot Dynamics, Recursive Estimation, Probabilistic AI, Model Predictive Control

Tokyo Institute of Technology
Tokyo, Japan

Exchange Student
September 2015 - August 2016

- Worked on modeling and control of a cable-driven physical earthquake emulator (Video).
- Relevant Courses: Robust Control, Nonlinear and Adaptive Control, Theory of Robotics

Middle East Technical University
Ankara, Turkey

BS in Mechanical Engineering
June 2017

- GPA: 3.95/4.00 - Graduated as the top-ranking ME student (1/333).
- Graduation Project: Cable Driven Aerial Camera System (Video).
- Relevant Courses: Control Systems, System Dynamics, Mechatronic Design

Selected Publications

(Google Scholar)

- **Küçüktabak, E. B.**†, Vianello, L.†, Short, M.†, Ludvig, D., Hargrove, L., Lynch, K., and Pons, J. L. *Therapist-Exoskeleton-Patient Interaction for Gait Therapy*. **Science Robotics** (In Press), 2026.
- **Küçüktabak, E. B.**, Wen, Y., Kim, S. J., Short, M., Ludvig, D., Hargrove, L., Perreault, E., Lynch, K., and Pons, J. L. *Haptic Transparency and Interaction Force Control for a Lower-Limb Exoskeleton*. **IEEE Transactions on Robotics (T-RO)**, 2024.
- **Küçüktabak, E. B.**, Wen, Y., Short, M., Demirbaş, E., Lynch, K., and Pons, J. L. *Virtual Physical Coupling of Two Lower-Limb Exoskeletons*. IEEE International Conference on Rehabilitation Robotics (ICORR), 2023.
- Vianello, L., **Küçüktabak, E. B.**, Short, M., Lhoste, C., Amato, L., Lynch, K., and Pons, J. L. *Exoskeleton-Mediated Physical Human-Human Interaction for a Sit-to-Stand Rehabilitation Task*. IEEE International Conference on Robotics and Automation (ICRA), 2024. **(Best Medical Robotics Paper, Best Paper Finalist)**
- Lhoste, C., **Küçüktabak, E. B.**, Vianello, L., Amato, L., Short, M., Lynch, K., and Pons, J. L. *Deep-Learning Estimation of Weight Distribution Using Joint Kinematics for Lower-Limb Exoskeleton Control*. IEEE Transactions on Medical Robotics and Bionics, 2024
- Fong, J., **Küçüktabak, E.B.**, Crocher, V., Tan, Y., Lynch, K., Pons, J., Oetomo, D. *CANopen Robot Controller (CORC): An open software stack for human robot interaction development*. Wearable Robotics: Challenges and Trends, 2020.
- Zimmermann, Y., **Küçüktabak , E.B.**, Farshidian, F., Riener, R., Hutter, M. *Towards Dynamic Transparency : Robust Interaction Force Tracking Using Multi-Sensory Control on an Arm Exoskeleton*. IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2020.

Patents

- **Küçüktabak, E. B.**, Patel, K., Sasabuchi, K., and Cui, J., *Primitive-Informed Sampling-Based MPC for Multi-Fingered Dexterous Manipulation*, 2026 *(Patent Pending)*.
- Patel, K., **Küçüktabak, E. B.**, Sasabuchi, K., and Cui, J., *Real-World Reinforcement Learning with Sampling-Based MPC Guidance for Multi-Fingered Dexterous Manipulation*, 2026 *(Patent Pending)*.
- **Küçüktabak, E. B.** and Soltani Zarrin, R., *Adaptive Energy-Aware Stability for Bilateral Teleoperation*, 2025 *(Patent Pending)*.
- Wang, J., **Küçüktabak, E. B.**, Soltani Zarrin, R., Erickson, Z., *CoRI: Communication of Robot Intent for Physical Human-Robot Interaction*, 2025 *(Patent Pending)*.
- **Küçüktabak, E. B.** and Soltani Zarrin, R., *Robot-Mediated Physical Human-Human Interaction*, 2023.