Marie Skłodowska Curie Action – Postdoctoral Fellowship 2023
Expression of interest – Hosting offer
(MSCA-PF-2024)

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Laboratory /Department /Institute /Centre / *(data of the centre/department where the fellow would be located* **Name**	Control and Automation Engineering Department, Faculty of Electrical and Electronics Engineering, Istanbul Technical University
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Research Area *(Please select the research area: corresponding to the eight MSCA evaluation panels. You can select between one and up to three scientific areas per EOI)*	Information Science and Engineering (ENG) Mathematics (MAT)
Brief description of the Centre/Research Group *(max. 1,600 characters including spaces: information about the research centre or research group, scientific staff. Please include URL if possible)*	Welcome to the vibrant hub of innovation and exploration, the Control Engineering Department at Istanbul Technical University (ITU). Our research group is at the forefront of cutting-edge advancements in networked control, telerobotics, multiagent systems, active perception of networked robots, and switching control of converters. Situated in the heart of Istanbul, a city known for its rich history and dynamic energy, we embody the spirit of progress and excellence in engineering. **Networked Control:** In an era defined by interconnectedness, our research delves into the intricate dynamics of networked control systems. We investigate how information flows across networks impact control performance, addressing challenges such as communication delays, packet loss, and networked-induced constraints. Our work not only enhances the stability and robustness of networked control systems but also paves the way for applications in diverse fields including industrial automation, transportation, and smart grids. **Telerobotics:** Revolutionizing human-robot interaction, our research in telerobotics focuses on bridging the physical and digital realms. From remote surgical procedures to space exploration, we explore novel control strategies that enable seamless teleoperation of robots over vast distances. By integrating advanced sensing, haptic feedback, and real-time communication protocols, we empower users to manipulate and interact with remote environments with unparalleled precision and dexterity. **Multiagent Systems:** In an increasingly complex and interconnected world, the study of multiagent systems lies at the intersection of artificial intelligence, game theory, and control theory. Our research

	group investigates decentralized decision-making algorithms and coordination strategies for teams of autonomous agents operating in dynamic environments. Whether it's coordinating swarms of drones for search and rescue missions or optimizing traffic flow in urban environments, our work aims to unlock the full potential of multiagent systems in real-world applications. **Active Perception of Networked Robots:** Perception forms the bedrock of intelligent robotic systems, enabling them to interpret and interact with their surroundings effectively. Our research explores innovative techniques for active perception, where robots actively gather and process sensory information to adapt their behavior in real-time. From environment mapping and object recognition to human-robot interaction, we develop algorithms that empower networked robots to perceive, learn, and collaborate autonomously in diverse environments. **Switching Control of Converters:** Power electronics play a pivotal role in modern energy systems, enabling efficient conversion and control of electrical energy. Our research focuses on the design and analysis of switching control strategies for converters, ranging from DC-DC converters to grid-connected inverters. By leveraging advanced control techniques such as model predictive control and sliding mode control, we aim to enhance the efficiency, reliability, and performance of power electronic systems, thereby accelerating the transition towards a sustainable energy future. At the Control Engineering Department of Istanbul Technical University, we are driven by a passion for discovery and innovation. Through interdisciplinary collaboration and hands-on experimentation, we strive to push the boundaries of knowledge and create impactful solutions that address the challenges of our time. Join us in shaping the future of control engineering and robotics, where imagination knows no bounds, and the possibilities are limitless. The complete list of publication conducted by Dr. Hashemzadeh can be found at https://scholar.google.com/citations?user=U-ODlfAAAAAJ&hl=en
Project description *(max. 1,800 characters including spaces: short description of the research project / research line where the fellow would be hosted and develop his /her project)*	Multiagent robotic systems such as telerobotics and also microgrids represent two critical domains in contemporary technology and engineering. Telerobotics consists the remote control of robotic systems, enabling operations in hazardous environments, while microgrids are localized grids that can operate independently or in connection with the main power grid. Significant optimization challenges exist for both systems in order to increase effectiveness, dependability, and safety. This proposal aims to investigate optimization techniques for multiagent based microgrid systems in these contexts, to enhance their performance and resilience. In the first phase, we will begin by developing comprehensive mathematical models of networked control systems that take into account key factors such as network latency, control precision, and real-time feedback mechanisms. Following this, we will design and implement advanced optimization algorithms, including evolutionary algorithms as well as machine learning models such as reinforcement learning to enhance control strategies, minimize latency, and improve

	robustness against network disruptions. A crucial part of these systems is the observer, which estimates the state of the system based on available measurements and model predictions. Precise observer design is essential for ensuring precise control, stability, and responsiveness. In this project we also seeking for enhancement of the robustness and adaptability of observers against time delays, sensor noise, and model uncertainties. The effectiveness of these algorithms will be validated through simulation tools, which will allow us to test various scenarios and network conditions to ensure the reliability and precision of the optimized networked systems. In the second phase, we will focus on developing detailed and precise models of microgrids, including elements such as distributed energy resources (DERs), energy storage systems, and varying load profiles. Microgrids are becoming more and more popular as a practical option for decentralized energy generation and distribution as a result of the introduction of renewable energy technologies and improvements in energy storage technologies. To maximize microgrid performance, dependability, and economic feasibility, site selection is crucial for their effective deployment. The goal of this research is to solve the microgrid siting optimization problem by determining the best locations while taking into account a number of variables, including the availability of renewable resources, load demand, infrastructure limitations, and economic considerations. We intend to utilize a blend of evolutionary algorithms and machine learning methodologies to enhance crucial facets of microgrid administration, such as energy control, load balancing, and fault identification. These optimization strategies will be tested in real-world settings through collaboration with industry partners, allowing us to evaluate their performance, adaptability, and impact on efficiency and stability in actual microgrid environments. This implementation will provide valuable insights and refinements, ensuring the developed strategies effectively enhance microgrid operations. The primary objectives of this research are: ● Developing optimization methods based on machine learning techniques for networked control systems that reduce latency, enhance control precision, and improve robustness against network disruptions. ● Designing adaptive optimization strategies for microgrids to maximize efficiency, integrate renewable energy sources seamlessly, and maintain stability under fluctuating loads.
Applications: documents to be submitted and deadlines *(Please indicate the documents that the candidate fellow should submit to establish contact: CV, letter of motivation, letter of references, etc., please indicate deadline. Recommended deadline: April 2023)*	Interested researchers must email the CV and two-page brief research program to fhashemzadeh@itu.edu.tr for evaluation. Deadline: April 30