



# **CYBER-PHYSICAL SYSTEMS LAB AT UPPSALA UNIVERSITY**

Master Thesis Projects at the  
Cyber-physical Systems Lab

## About us

### Cyber-physical Systems Lab (CPS-Lab)

Cyber-physical Systems Lab at Uppsala University is dedicated to advancing the field of cyber-physical systems (CPS) through cutting-edge research, innovation, and collaboration.

Cyber-physical systems represent a paradigm shift in technology, bringing together the realms of physical and computational elements to create interconnected systems that interact with the physical world. These systems encompass a wide range of applications, including intelligent robots, smart cities, autonomous vehicles, industrial automation, connected healthcare systems, and more.

At our lab, we strive to explore the vast potential of CPS and shape its future impact on these various domains by proposing methods, methodologies, applications and frameworks for improving their interoperability, sustainability, complexity, autonomy and intelligence.

Our team of interdisciplinary researchers, comprised of experts from computer science, electrical engineering, mechatronics, control systems, and other relevant fields, is at the forefront of CPS research. We undertake studies to develop novel theories, algorithms, and practical solutions that bridge the gap between the physical and virtual worlds. Below you can see the photos of some of the systems we have at the lab.



At the CPS-Lab, we are pushing the boundaries of what's possible with autonomous systems, robotics, and artificial intelligence. As a master's thesis student here, you will have the chance to work on cutting-edge technologies and real-world applications that can make a difference. We have prepared three challenging and impactful thesis projects that align with our lab's focus areas. These projects offer you the opportunity to develop technical skills, publish research (we will also fund conference attendance, travel and accommodation if you get accepted to present the research), and lay the foundations for a career in intelligent and autonomous systems.

***We are seeking talented, motivated students who want to be at the forefront of innovation with the vision to change the world. If you are eager to test your abilities, gain hands-on experience, and expand the horizons of autonomous robots, computer vision, or multi-agent systems, we encourage you to apply for one of the following projects:***

- **Collective Intelligence Unleashed: Build New Multi-Agent Reinforcement Learning Algorithm**  
Dive into the cutting-edge world of reinforcement learning! Design and implement advanced multi-agent actor-critic algorithms to tackle complex, real-world problems. Experiment with various network architectures and training techniques to optimize agent performance. Analyse the emergent behaviours and strategies developed by your AI agents. Present your groundbreaking findings in a thesis that pushes the boundaries of artificial intelligence and machine learning.
- **Ethical by Design: Craft new AI with a Moral Compass**  
Shape the future of responsible AI! Develop innovative algorithms that prioritize ethical considerations from the ground up. Explore techniques to embed fairness, transparency, and accountability into machine learning models. Test your algorithms against real-world scenarios and ethical dilemmas. Contribute to the critical field of AI ethics with a thesis that combines technical expertise with philosophical insights, ensuring that tomorrow's AI systems are not just powerful, but also morally sound.
- **BeachBot: AI-Powered System for Litter Detection and Collection**  
Help keep our beaches and oceans clean using AI and robotics! Develop computer vision techniques to identify litter on beaches. Program our robotic arm to pick up trash of various shapes and sizes. Run experiments, refine algorithms, and measure success. Share your solutions in a thesis that combines engineering and sustainability.
- **RoboAlliance: Engineering Trust in Collaborative Machines**  
Can robots work together safely? Find out by orchestrating complex interactions between two robotic arms. Implement algorithms for seamless collaboration on shared tasks. Identify key factors for reliable, trustworthy teamwork. Optimize performance through rigorous testing and data analysis. Showcase your insights on enabling robots to cooperate, not compete, in your thesis.

If you are interested in any of these thesis project opportunities, please send your CV and a short statement of interest to Dr. Didem Gurdur Broo at [didem.gurdur.broo@it.uu.se](mailto:didem.gurdur.broo@it.uu.se)

In your email, please specify which project(s) you are most excited about and why you believe you would be a good fit. We will review applications and schedule 30-minute discussions with promising candidates to further describe the projects, answer questions, and determine alignment with student interests and capabilities. Spots are limited, so we encourage you to apply early if you would like to secure a position.

We look forward to hearing from you!