Advanced Robotics Simulation and Control in NVIDIA Isaac Sim

Level: Bachelor/Master (1-2 students possible)
Duration: 3 months
Start: By agreement
Mentor: Anastasija Rakić
Institution: ETF Robotics

Overview and Technology:

NVIDIA Isaac Sim is a powerful robotics simulation platform that enables the creation of realistic, physics-based environments for testing and developing robotic systems. By offering a highly accurate simulation of the physical world, it opens up a wide range of possibilities for robotics research, from training AI models using reinforcement learning to designing complex robotic behaviors and testing sensors in dynamic, real-world conditions. This project focuses on leveraging Isaac Sim and Isaac Lab to develop intelligent agents capable of interacting with their environment through manipulation or navigating through complex spaces. Due to the GPU-intensive physics, a PC with an NVIDIA RTX graphics card is required. While the work is software-focused, it provides essential skills for modern robotics development.

Platforms / hardware	Software & tools
• **PC with NVIDIA RTX GPU**	• Isaac Sim / Isaac Lab • Python 3: Conda environments, NumPy, PyTorch • ROS

Project options (projects can be modified based on student interests**)**

• Reinforcement Learning for Robotic Manipulation (Reach and Grasp, Pick-and-Place/Stacking)
• Autonomous Navigation (Implement a navigation stack that utilizes real-time sensor data to traverse dynamic environments.)

Expected outcomes	Recommended background
• Literature Review • Documented code, setup guides and video demonstrations in a public GitHub repository • Final report in IEEE research paper form	• Introductory knowledge of robot kinematics, dynamics, and motion planning. • Strong Python 3 skills: Proficiency in object-oriented programming.

Literature
• The Role of Physics-Based Simulators in Robotics, C. Karen Liu and Dan Negrut
• NVIDIA Isaac Sim & Isaac Lab Official Documentation.
• A Survey of Robotic Navigation and Manipulation with Physics Simulators in the Era of Embodied AI, Lik Hang Kenny Wong, Xueyang Kang, Kaixin Bai, Jianwei Zhang