University of Stuttgart

Institute for Control Engineering of Machine Tools and Manufacturing Units

Master Thesis

to assign

Energy Efficiency of Highly-configurable Robotic Systems

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Background

Industrial activities constitute a significant proportion of global energy demand, directly impacting greenhouse gas emissions. Such activities depend massively on robots, whose energy efficiency is a key factor in a greener industry. Robots are orchestrated under complex software, which entails significant amounts of energy consumption, making it one of the outstanding aspects of energy-efficient robotic system design.

Problem description

The Robotic Operating System (ROS), a standard framework for robotics software engineering, is highly configurable. ROS public packages usually result in thousands of combinations of configuration parameter values. This enables tuning for target hardware and workloads, potentially improving the quality and energy efficiency of robotic systems. The challenge lies in identifying optimal configurations at runtime for workload fluctuation. We envision the use of machine learning-based strategies to help in automating the identification of optimal trade-offs between the robotic system's performance and energy efficiency.

Tasks

- Deploy simulated and real autonomous robotic systems
- Design and conduct empirical experiments
- Build Machine Learning models
- Write packages and plug-ins for the Robotic Operating System (ROS)

Requirements

- Student of computer science, software engineering, mechatronics, or similar
- Experience in Machine Learning
- Experience in Python and/or C++ programming
- Motivation to learn and perform challenging tasks
- Ability to work independently
- Creativity and problem solving skills
- Basic knowledge of robotics is an advantage

Knowledge gain

- Robotic systems' architecture
- Work with real autonomous robots
- ROS programming
- Applied Machine Learning
- Independent scientific work