

Automatic Constraint-Based Capability Matching for Cooperative Robotic Processes

Master's Thesis

Develop a framework for matching required abstract functionalities with concrete robot capabilities based on the cooperation constraints.

Motivation

Cooperative robotics allows more diverse and flexible range of tasks in an industrial environment. Be it handling or transporting heterogeneous objects with a wider variation of forms and sizes or flexibly adjusting force and stability for handling power-tools, it enables industrial systems to be more adaptable. However, planning for cooperative processes remains a challenge, since their integration and programming require expertise that a process planner might not have. To enable ease of integration, skill-based engineering separates between the abstract required functionalities of a process and their concrete implementation. The required and offered functionalities are then matched at time of planning. Nevertheless, a framework that matches required cooperative capabilities with the cooperating agents does not exist yet. This causes the planning to become less flexible by locking robotic agents together or hardcoding cooperative functionalities, reducing portability. One key factor for matching cooperating agents and the required capability is the fulfillment of their cooperative constraints.

Your work in this thesis will be to develop a capability matching framework that automatically matches multiple robotic systems together to complete a cooperative task based on the defined constraints for the cooperation. The framework should allow to flexibly match robots to complete a larger task checking if they are able to cooperate under the required constraints set by the context of the task.

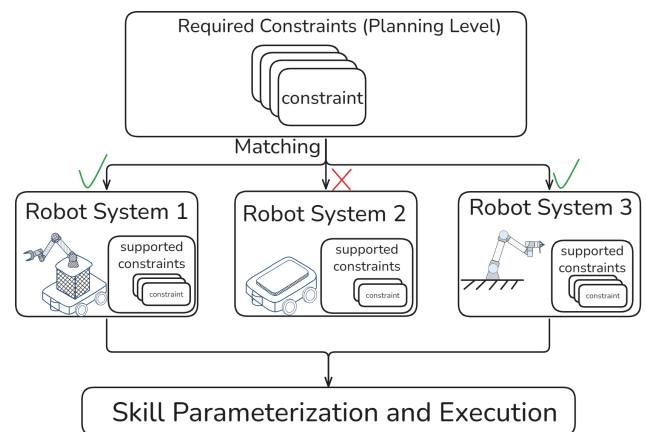


Figure 1: Constraint-Based Capability Matching

Goals

- Analysis of state-of-the-art automation frameworks for cooperative robotic tasks.
- Familiarization with skill-based engineering principles, especially capability matching methods.
- Development of a framework that matches the abstract requirements for a process based on the cooperation constraints with the correct cooperating robotic agents.

Interests and Prior Knowledge

- 🤖 Interest in robotic industrial processes
- Ideally programming skills in Python and/or C++
- 📖 Knowledge in robotics, particularly motion planning beneficial



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Tags: Skill-based Engineering, Capability Matching, Cooperative Robotics, Constrained-Based Planning