Diplomarbeit/Master's Thesis:

Towards reactive and global collision avoidance and motion planning techniques for articulated manipulators

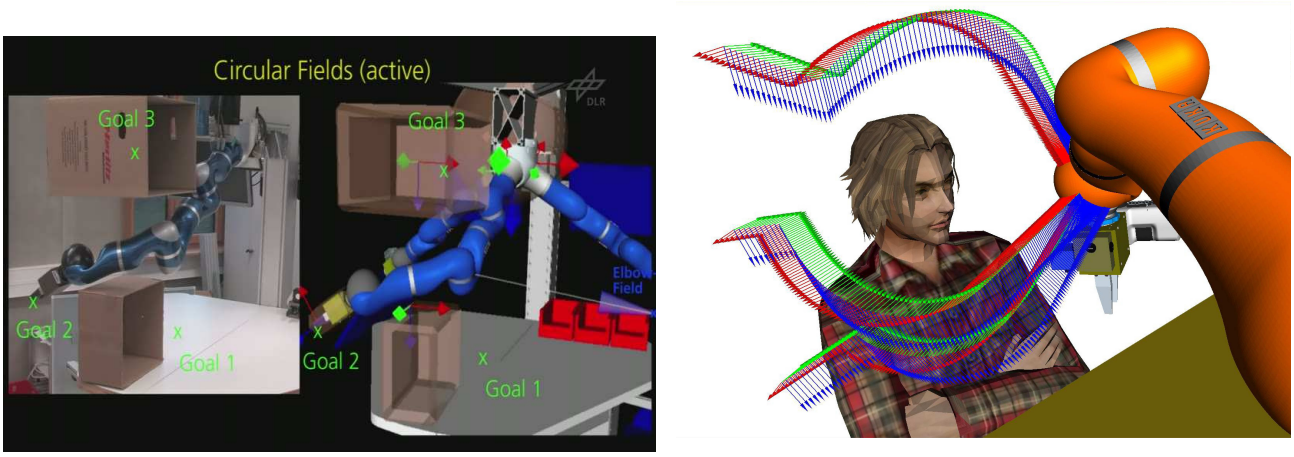

Figure 1: Novel real-time motion planning techniques tested on the DLR Lightweight Robot III (LWR-III), which is a human-friendly robot that is designed for direct physical interaction with humans (left). Real-time collision avoidance for the LWR-III for a full dynamic simulation (right).

Future robots will work closely with humans in all kinds of environments, which necessitate safe robot design [1], sophisticated control methods for realizing soft-robotics features [2], and collision detection algorithms with appropriate reaction strategies [3, 4]. In [5] a full concept of how such Robotic Assistants could be designed based on the DLR Lightweight Robot III (see Fig. 1 (left)) is outlined. Furthermore, it is of major importance to provide flexible motion generation methods, which take into account the possibly complex environment structure and at the same time can react very quickly to changing conditions, see Fig. 1 (right).

The goal of this thesis is to extend hard real-time collision avoidance methods we recently developed to the full case of an articulated manipulators as the LWR-III, see Fig. 1. The designed methods seem to overcome one of the major problem of other real-time methods: global minima. This makes the algorithm appealing in many ways and could approach one of the largest problems in robotics:

How to generate reactive and globally converging motions online?

A primary goal of the thesis aims at a solid analysis of the schemes regarding convergence and stability for a full articulated robot. Furthermore, the appropriate combination of online trajectory deformation with reactive interaction control is to be analyzed, implemented, and tested in order to design a tight coupling between these fields, which are usually treated separately up to now. The ultimate goal is to design a unified framework for reactive motion planning and interaction control (Of course not from scratch ;-) We have done a lot already).

Expected work steps

- Literature review
- Stability and convergence analysis of the developed methods for full articulated robots
- Combination of reactive motion planning and control in a unified manner.

- Implementation and testing of the schemes in full dynamics simulation
- Implementation on the LWR-III (possibly in a multi-robot setup)

Prerequesites

- Knowledge in MATLAB/Simulink
- Knowledge in C/C++
- Knowledge in nonlinear control methods and/or motion planning is advantageous
- Ability to work well structured and organized
- Creativity

Contact

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References

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