Project work description

Title:
Collision detection and avoidance for multi-body systems.

General description:
Automatic robotic missions are fundamental key factors in the field of on-orbit servicing and active debris removal. The control of space manipulators represents a challenge because of the dynamics coupling between the robot and the satellite motion. The coupled satellite-manipulator motion may lead to collisions between the manipulator and the satellite or to arm self collisions. For advanced automatic operations, a collision managment system is required for safety.
Two main techniques are adopted in the field: collision prediction and collision detection. The former uses a geometric model of the robot to predict the collision beforehand, the latter is used to detect a collision to implement a suitable reaction strategy.
The main objective of the internship is to implement both approaches with application to space robotics. In particular, the work will be related based to ongoing space robot development of the DLR On-Orbit Servicing Simulator (OOS-Sim) Facility. The analysis will be conducted by the student in simulation and eventually integrated in the OOS-SIM (see Fig.1) together with the supervisor.

Interrelation with lecture: The project is highly related to the lecture “Modellbildung und Regelung Humanoider Laufroboter” because of the multi-body formulation derived therein. Additionally, the project is also relevant to the lecture “Orbitdynamik und -Robotik” which focuses on a space robot, which is the specific multi-body system targeted in the practical implementation.

Main tasks and MileStones (MS):

1. Implementation and validation of an EE force estimator for space robots in simulation. (MS1: project start + 1 month)
2. Implementation and validation of the estimator in the OOS-Sim facility (MS2: project start + 1.5 months)
3. Implementation, tuning and validation of a collision predictor in simulation (MS3: project start + 1 months)
4. Implementation, tuning and validation of a collision predictor in the OOS-Sim facility (MS4: project start + 1.5 months)

Location: DLR Instute for Robotics and Mechatronics in Oberpfaffenhofen (Munich)
Project duration: 5 months.

Fig 1. The DLR OOS-SIM experimental facility.