TECHNISCHE UNIVERSITÄT MÜNCHEN
Human-centered Assistive Robotics
UNIV.-PROF. DR.-ING. DONGHEUI LEE

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B A C H E L O R T H E S I S
for
Matthias Schöffel
Student ID 3676813, Degree EI

Exploiting internal and external force-sensing in human robot interaction

Problem description:

Most collaborative robots have the capability to sense interaction forces based on their internal joint torque sensors [1]. Although these sensors might be sufficient to estimate the forces during execution, external force-torque (FT) sensors can be employed to sense contact forces more accurate and also while the robot is in gravity compensation. Exploiting this two signal sources allows us to generate robot behaviors, which depend on the contact location with the human or the environment. As an example, the operator can press against the tool within a collaborative assembly while the robot remains stiff. Alternatively, the operator can push directly at a robot link above the external FT sensor to move the robot around. Furthermore, the robot can maintain a desired contact force onto the environment while the human is able to influence the execution at any time.
Your task is to implement and validate the described behavior on a robot equipped with internal joint torque sensors and an external force sensor at the wrist. If we assume that the human touches the robot at only one point, we can estimate which link is in contact. The robot is controlled with a C++ interface while the external sensor works under ROS.

Tasks:

- Reading and comparing the external and internal force signals
- Estimate on which link the robot is in contact
- Implementation of an admittance controller in C++, allowing the user to move the robot
- Teach robot desired interaction force profile with the environment
- Experimental evaluation of the approach with at least one human robot collaboration task
- Discussion of the benefits and drawbacks of the solution based on your experiments

Bibliography:

[1] Emanuele Magrini, Fabrizio Flacco, and Alessandro De Luca. Estimation of contact forces using a virtual force sensor. In *Intelligent Robots and Systems (IROS 2014), 2014 IEEE/RSJ International Conference on*, pages 2126–2133. IEEE, 2014.

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(D. Lee)
Univ.-Professor