TECHNISCHE UNIVERSITÄT MÜNCHEN
LEHRSTUHL FÜR STEUERUNGS- UND REGELUNGSTECHNIK
ORDINARIUS: UNIV.-PROF. DR.-ING./UNIV. TOKIO MARTIN BUSS

April 8, 2015

B A C H E L O R T H E S I S
for
Sebastian Getz
Mat.-Nr. 03623589, field of study EI

Analysis of faults in lightweight robotic joints and evaluation of possible fault detection techniques

Problem description:

Flexible, distributed, and smart automation, involving close and physical human-robot interaction (pHRI) has become one of the core concepts of the Industry 4.0 initiatives. The ultimate goal is to have a flexible and dynamic production environment where robots and humans work side by side. In order to enable direct physical cooperation between human and robot, there has recently been strong interest in removing classical safety barriers, such as fences or light curtains for novel human-friendly robots made for direct interaction. Therefore, modern robotic systems have particularly high requirements for safety-critical operations. Especially, in the case of human-robot interaction, robots have to ensure a safe behavior. One important aspect is the fault-tolerant operation. In this thesis a concept of safety-critical operation of a robotic system should be investigated. First, a given simulation of a robotic joint should be adapted with respect to common faults, which may occur in a real mechatronic system. Then, possible fault detection techniques have to be implemented and validated based on basic experiments. Finally, experiments on a real robotic system have to be carried out and compared to simulation results.

Tasks:

- Literature review of appropriate faults in robotic systems and related fault detection techniques
- Modeling and simulation of faults using on a given robot joint simulation
- Simulation and evaluation of possible fault detection techniques
- Comparison of simulation results and basic experiments on existing robotic joints

Bibliography:

[1] S. Haddadin, *Towards Safe Robots: Approaching Asimov's 1st Law*, PhD thesis, 2011
[2] M. S. Madi, K. Khayati, and P. Bigras, *Parameter estimation for the lugre friction model using interval analysis and set inversion,* pages 428-433, 2004
[3] R. Isermann, *Model-based fault-detection and diagnosis - status and applications*, Annual Reviews in Control, 29(1):71-85, 2005
[4] Luc Le Tien, Alin Albu-Schäffer, Alessandro De Luca, and Gerd Hirzinger, *Friction observer and compensation for control of robots with joint torque measurement*, 2008

Supervisor:	Prof. Dongheui Lee, Prof. Sami Haddadin
Start:	20.02.2015
Intermediate Report:	16.04.2015
Delivery:	21.05.2015

(D. Lee)
Univ.-Professor