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

July 23, 2014

M A S T E R   T H E S I S
for
Torsten Engler
Mat.-Nr. 03636900, field of study EI

A realistic dynamic, sensor and fault model of a torque controlled lightweight robotic joint

Problem description:

Lightweight robots are a new type of robot arms which are capable of direct physical interaction with humans and thus can be employed as multi-functional tools. Such robots often have a mechanical flexibility in the joints due to the lightweight structure. Although the dynamical behavior of flexible joints is a well studied research topic, the majority of existing models lack the realism of the simulation (show low degree of reality in the simulation?) for such applications as simulation of collision detection and human-robot interaction.
The goal of this thesis is the development of a mathematical model of a generic flexible robotic joint. The model should include electrical and mechanical parts. The electrical part consists of an electrical synchronous motor and appropriate power electronics to control the motor. The mechanical part describes the gearbox connected to the motor shaft. Additionally sensor models should be included in both electrical and mechanical parts. In order to control the joint a control scheme should be developed and implemented. The model of a flexible joint will be implemented in Matlab®/Simulink®.
The developed model of the robot joint and control performance should be validated experimentally. Finally the degree of realism of the simulation should be analyzed.

Tasks:

- Literature research about simulation of robot joints
- Development and implementation of a mathematical model of a generic flexible robotic joint
- Validation based on experimental data of real joint prototypes
- Investigation, modeling and simulation of disturbance and related compensation techniques
- Analysis of the simulation realism degree

Bibliography:

[1] Albu-Schäffer, A., "*Regelung von Robotern mit elastischen Gelenken am Beispiel der DLR-Leichtbauarme*", PhD Thesis, 2002
[2] Craig, J.J. "*Introduction to Robotics: Mechanics and Control*", Addison-Wesley series in electrical and computer engineering: control engineering, Pearson Education, Incorporated, 2005
[3] Drinĉić, B., "*Mechanical Models of Friction That Exhibit Hysteresis, Stick-Slip, and the Stribeck Effect*", PhD Thesis, 2012

Supervisor:	Prof. Dongheui Lee, Prof. Sami Haddadin
Start:	01.07.2014
Intermediate Report:	01.10.2014
Delivery:	01.01.2015

(D. Lee)
Univ.-Professor