Master Thesis proposal

Title: Accurate modeling, stability analysis and control of a hydraulic actuation system for applications in wearable robotic systems.

Abstract: The goal of this thesis is to formalize and validate a dynamic model for a hydraulic actuation system intended for applications in the fields of wearable robotics. To be able to meet this objective, a valve-actuator setup of the Vi-Bot Exoskeleton will be the subject of research. To facilitate the representation of such a complex system, proper modeling environments like Simscape (Matlab) and system identification techniques will be used, in particular the Recursive Least Squares (RLS) Algorithm will be used for identification of model parameters.

Detailed goals:

- The first goal is to implement a proper algorithm in order to model a hydraulic actuation system of the exoskeleton. For that the main components of the actuation system will be modeled separately first. The main components are:
    - A hydraulic proportional valve
    - A hydraulic rotatory actuator

- The second goal is to analyze the stability of obtained models. Since the dynamics of the system is expected to be nonlinear, a suitable stability criterion has to be defined.

- As a third goal, the obtained model of the actuation system will be used in a control loop in order to compensate the nonlinear dynamics of the target system.

- Online adaptation of the model´s parameters would be desirable, in order to follow unexpected changes in system´s dynamics, for example in presence of disturbance forces.

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