Themenbeschreibung / Vorschlag für eine Bachelorarbeit:

Model identification and position control of an hybrid hydraulic/pneumatic actuation system

Luis Manuel Vaca Benitez
Systems Engineering
Matrikel Nummer: 2068872

Adresse: Hauptmann-Böse-Weg 12
28213 Bremen
Tel (mobil): 0176 / 61520849

Betreuer:
Dr. Ing. Michele Folgheraiter Michele.folgheraiter@dfki.de
Dipl. Ing. Jose de Gea jdegea@informatik.uni-bremen.de

Gutachter: Prof. Dr. Frank Kirchner

DFKI Bremen

Datum: 11.02.2009

Motivation

Current state-of the art actuators fail at providing at the same time some desired properties as: being strong, compact and with the capability to actively change its impedance. Hydraulic actuators provide a number of advantages over electrical motors: higher force-to-weight ratio without the need for gearboxes, faster response time, accurate position control (the fluid is not compressible) and a compact size. In the concept we propose, the idea is to include an elastic and damping element in series with the hydraulic actuator in order to be able to change its physical properties in real time.

A test bed, equipped with all the hydraulic and pneumatic components and sensors, is now available to start evaluating this concept and to synthesize and test a proper control strategy.

Abstract

The goal of this thesis is to formalize and validate a dynamic model for an hybrid hydraulic/pneumatic actuation system intended for applications in the fields of the haptic interfaces and robotics. To facilitate the representation of such a complex system, proper modeling environments like Simscape (Matlab) and systems identifications techniques will be used.

Zielsetzung

The goals of this Thesis are in detail:

- The first goal is to study and evaluate different existing techniques for Systems Identification and use the more suitable in order to model the main components of the actuation system:
    - Hydraulic actuator
    - Pneumatic cylinder
    - Hydraulic Valve
- The second goal, after identifying all the components, is to formalize a model for the whole system. The components to be considered in this model are: the hydraulic actuator, the pneumatic cylinder, the hydraulic valve and the connecting links.
- The third goal is to test, in a simulation environment, simple control strategies, e.g. PID, in order to regulate the position, velocity, impedance of the actuator. For this task it is also necessary to define the model of the kinematic structure that connects the hydraulic actuator with the pneumatic spring.

- Finally, after applying the control strategy to the model, it will be tested on the real system. Different requirements on the closed loop system will be evaluated: system stability, static and dynamic precision, intensity of the control action, noise rejection etc. In particular a noise force will be applied to the system in order to evaluate the precision of the controller at different initial states of the pneumatic spring.