Title: Development of a software/hardware driver to control and interface with an hydraulic robotic joint.

Motivations and Goals:

Generally the control architecture for a robot can be divided in two main levels: the high level control system charged to coordinate the joints in order to perform a certain task inside the robot workspace, and the low level control system that regulates the position and the velocity of each single joint unit.
From an implementation point of view, each joint should be equipped with a micro-controller that runs locally the real time routines required to generate the control signal for the power unit of the actuator and to read the sensory information coming from different interfaces (amplifiers, filters, etc.).
The goal of this thesis is to develop the software/hardware interface suppose to connect an hydraulic joint with a micro-controller board.
A test bed, equipped with all the hydraulic components and sensors and a micro-controller board are available to evaluate this interface and to test different simple control strategies.

Details goals:

- The first goal is to design and develop a prototype of an interface board that integrates all the electronic systems necessary to build a bridge between the actuator components and the micro-controller unit. Some of these electronic systems are already designed and tested.
  The board will include:
  - Two channels instrumentation amplifier
  - Quadrature encoder interface
  - Pneumatic valves power driver
  - Hydraulic valve stepper motor driver

- The second goal is to code (in C language) some features of the driver. The real time routines will run on a 32 bit ARM micro-controller (STM32 **Cortex™-M3** family from ST microelectronics®) and will :
  - Read the sensory data coming from the sensor interfaces
  - Pilot the actuation components (Valves)
  - Communicate with a control module running on a PC.

- The third goal is to experiment the driver and measure the performances in term of robustness and precision in controlling the joint position via simple control strategy. The test bed consists in a customized rotative hydraulic actuator equipped with an encoder and a proportional valve; Additionally it will be possible to measure the pressure in both the actuator chambers and the external torque applied to the actuator. Data will be acquired from a PC via USB interface.

TimeLine: Starting 1/04/2009 Ending: 30/07/2009

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