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Clutch by wire: effortless clutch mechatronic system
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In the area of mechanical and electrical engineering, the technical processes show an increasing integration of mechanics with digital electronics and information processing. This integration of hardware components and software information and driven function, result in integrated system called mechatronic systems. In the way of simplify mechanical structures and increase the functionality of the system, the mechanical functions are replaced by electronically controlled functions witch permit decentralised and autonomous control.

A clutch is a system located between the engine and the gearbox of an automotive vehicle. It is controlled by a pedal and is used to transmit engine torque to the transmission shaft. Nowadays the clutch pedal is linked to the clutch via a mechanical cable or hydraulic system witch results in a pedal effort about 7 to 12 kg according to the vehicle. Repetitive use of the clutch pedal is one of the more uncomfortable aspects of driving. The clutch pedal features a position sensor linked to an electronic control unit. This unit controls the clutch actuator and operates the clutch directly.

In the paper we intend to introduce the development of a clutch by wire mechatronic system, by considering the dynamic modelling of the components, their interactions and resulting behaviour, and by analysing the information components from sensors to actuators through microprocessor.

The clutch by wire system refer to different physical domains, is for what we have to consider the subsystems and their interaction in the energy exchanged for the motion.

The clutch displacement is generated by a constrained spring transmitting the moving force through a camshaft jointed to the nut of a jackscrew. A Direct Courant motor powered by a Pulse Width Modulation four quadrant converter, active the screw through a servo nut position controller. A hydraulic transmitter and the clutch throw-out fork send the nut displacement and force to the clutch.

In the clutch system, some sensors and the associated measuring system provide the required measurable information about the process. A force sensor and LVDT position sensor in the clutch diaphragm, pressure sensor in the hydraulic transmitter, potentiometer position sensor in the cam shaft, and current monitoring in the converter have been implemented. This instrumentation of the clutch by wire process is realized by some redundant sensor in strictly clutch position control point of view, but is necessary for the behaviour knowledge of the inter connected subsystems witch realise the overall clutch task.

The control synthesis is program with Matlab/Simulink and the code for acquisition card is obtained with Real Time Workshop and XPC Target toolbox. This last software is a turnkey capability for real-time rapid control prototyping, hardware-in-the-loop (HIL) simulation, and deployment on PC hardware. Thus student can easily compare in real time simulated and experimental results, in aim to tune the control law and to identify some models parameters.

Keywords : Mechatronic system, clutch control, experiment and simulation