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Simulation, Control and Testing of Advanced Hydraulic Hybrid Transmissions

Italo Ramos
Department of Electrical and Computer Engineering, Purdue University.

Michael Sprengel and Monika Ivantysynova
Department of Agricultural and Biological Engineering, Purdue University.

ABSTRACT

Hydraulic hybrids transmissions have the potentially to substantially improve the fuel efficiency of on road vehicles. In fact recent studies have demonstrated that this technology can improve fuel economy by upwards of 30% over competing electric hybrids. To further improve the fuel economy and performance of this technology a novel blended hydraulic hybrid transmission has been constructed at the Maha Fluid Power Research Center. While this novel hybrid architecture created by the Maha lab has many benefits over conventional systems, there are a number of control challenges present due to several discrete modes of operation. And though improving fuel economy is quite important, in order for a vehicle to gain wide spread acceptance in a global market positive driver perception and comfort must be assured. Thus it is important to develop control schemes which enhance and optimize drivability. Controller development began by improving an existing hydraulic hybrid powertrain model constructed in MATLAB Simulink. Control schemes for individual modes of operation were then proposed and investigated in the improved simulation model. Finally once sufficiently well-developed these control scheme were applied, tuned, and evaluated on the Maha lab's hydraulic hybrid demonstration vehicle. The controllers developed showed an overall improvement in drivability as well as a great improvement in the transitions between discrete modes of operations. This held true for both the simulation model and more importantly when implemented in the demonstration vehicle. The new controls proposed in this work help to enhance the driver's perception of a novel and highly efficient hydraulic hybrid transmission.

KEYWORDS

Hydraulic hybrids, control, blended hydraulic hybrid, Matlab, fuel efficiency, simulation.