

Actuator torque optimization of an automotive thermal management mechatronic valve based on a hydro-mechanical modelling and experimental validation

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Abstract :

Improving fuel economy and reducing the Greenhouse-Gas emissions have been the determining factors in the development and implementation of innovative automotive technologies. Engine thermal management is one of the research fields that tries to solve these issues. It can be applied when controlling temperatures in different cooling circuits with an electronically actuated valve, which respects certain thermal management strategies. This control varies depending on several parameters such as temperature, load and engine rotational speed. This paper is part of a larger work that aims to improve the robustness of this valve design process since the early steps while minimizing the torque requirements of the DC-actuator. The first part of the paper will describe the hydro-mechanical concept of the valve. The second part will be focused on the hydro-mechanical model that has been developed in order to simulate the multi-physical environment and so was validated based on available experimental measurements. The third part is concentrated on the model experimental validation. The last part is dedicated to discuss optimization results of a particle swarm based optimization (PSO) loop applied on a simpler model, which helps to determine an optimal geometrical configuration.

Key words: thermal management / mechatronic systems / numerical simulation / experimental validation / particle swarm based optimization (PSO)