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Experimental Characterization and Modelling of Energy Efficient Fluid Supply Systems

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ABSTRACT

In applications such as in agriculture, construction, and aerospace applications, high pressure hydraulics is the preferred technology to transmit mechanical power. As a consequence, the energy efficiency of the hydraulic system used to perform the mechanical actuations is of primary concern to reduce the energy consumptions in the abovementioned applications. In an hydraulic system, the primary component determining the energy efficiency is the hydraulic pump. This work focuses on the study of a particular pump design, also referred as external gear pump, particularly used in applications in which the cost of the hydraulic system has to be minimized. The large use of this type of pump calls for research towards more efficient designs solutions. In particular, new designs for external gear pumps have been developed by Dr. Andrea Vacca's research group at Purdue using a detailed pump model. This study is intended to gain detailed understanding about the fluid dynamic part of this model by performing detailed comparisons between the simulation results obtained by a different simulation tool, based on a computational fluid dynamics (CFD) approach to simulate the entire pump operation (including the primary displacing action and the internal leakages). After the comparison is made for a commercial geometry, the study will focus on a innovative prototype design, developed to reduce the noise generation while increasing energy efficiency. The results from the CFD approach were validated against the experimentally-backed lumped parameter approach result. The differences between the modeling methods produced differences in the results which were analyzed for both the unit efficiency and flow ripple production.

KEYWORDS

Fluid power, Gear Pump, CFD model, External gear machines, Flow and pressure ripple