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Clean Sky 2 – Project PALACE: Aeration’s Experimental Sound Velocity Investigations for High-Speed Gerotor Simulations

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Abstract : A Gerotor pump is composed of an external and internal gear with conjugate cycloidal profiles. From suction to delivery ports, the fluid is transported inside cavities formed by teeth and driven by the shaft. From a geometric and conceptional side it is worth to note that the internal gear has one tooth less than the external one. Simcenter Amesim v.16 includes a new submodel for modelling the hydraulic Gerotor pumps behavior (THCDGP0). This submodel considers leakages between teeth tips using Poiseuille and Couette flows contributions. From the 3D CAD model of the studied pump, the “CAD import” tool takes out the main geometrical characteristics and the submodel THCDGP0 computes the evolution of each cavity volume and their relative position according to the suction or delivery areas. This module, based on international publications, presents robust results up to 6 000 rpm for pressure greater than atmospheric level. For higher rotational speeds or lower pressures, oil aeration and cavitation effects are significant and highly drop the pump’s performance. The liquid used in hydraulic systems always contains some gas, which is dissolved in the liquid at high pressure and tends to be released in a free form (i.e. undissolved as bubbles) when pressure drops. In addition to gas release and dissolution, the liquid itself may vaporize due to cavitation. To model the relative density of the equivalent fluid, modified Henry’s law is applied in Simcenter Amesim v.16 to predict the fraction of undissolved gas or vapor. Three parietal pressure sensors have been set up upstream from the pump to estimate the sound speed in the oil. Analytical models have been compared with the experimental sound speed to estimate the occluded gas content. Simcenter Amesim v.16 model was supplied by these previous analyses marks which have successfully improved the simulations results up to 14 000 rpm. This work provides a sound foundation for designing the next Gerotor pump generation reaching high rotation range more than 25 000 rpm. This improved module results will be compared to tests on this new pump demonstrator.

Keywords : gerotor pump, high speed, numerical simulations, aeronautic, aeration, cavitation
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