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ON EFFICIENCY OF SWITCHED INERTANCE CONTROL FOR HYDRAULIC SYSTEMS

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Throttles are widely used in modern hydraulic drives to control parameters of output component (hydraulic cylinder/motor). Energy losses during flow throttling make up to 50 % of input power. One of the ways to increase the drive energy efficiency is to apply switching control that has been extensively developed in recent years. Application of such technologies allows to improve efficiency by tens percent. In combination with an inertance tube the switching valve forms a switched inertance device which can be used as a flow or pressure booster.

The present work studies the switched inertance hydraulic system (SIHS) operating in the flow booster mode. The hydraulic system parameters were adjusted with a goal to obtain maximum efficiency. Such parameters as valve operation rate, pulse duty factor, valve effective passage area, line sizes are considered in the studies.

Mathematical modeling and simulation was used for studying the transient processes in the hydraulic system under pulse-width modulation (PWM) control and for its comparison with conventional throttle control. The SIHS simulation was performed with the LMS Imagine.Lab AMESim software (see Figure).

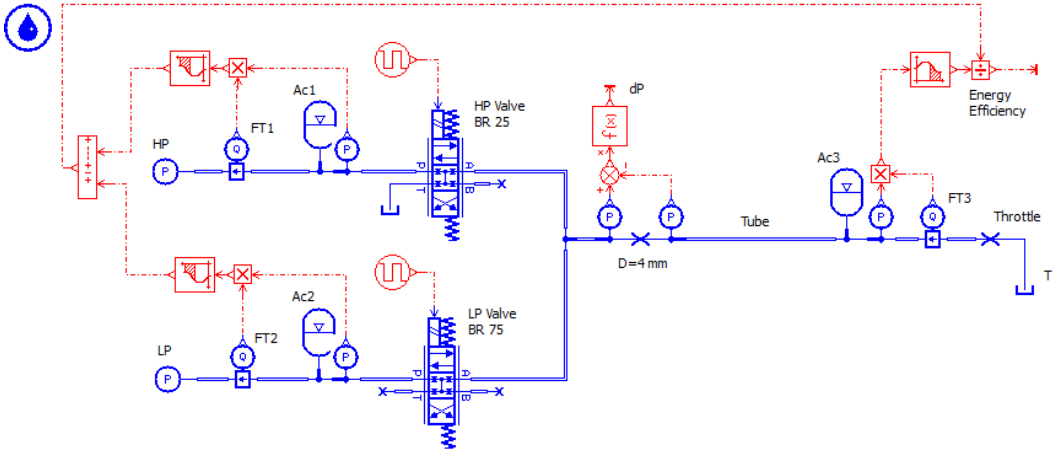

Figure – The switched inertance hydraulic system model in the AMESim software package

In order to verify theoretical results of energy efficiency of the SIHS with PWM control the experimental studies were performed using the test rig. The main elements of the system are two valves, an inertance tube and hydraulic accumulators. For control of hydrodynamic processes, experimental data review, record and processing there was developed a special program in NI LabVIEW.

On the basis of the developed mathematical model of the switched inertance hydraulic system acting as a flow booster it was proved that there is an increase of its energy efficiency in comparison with the throttle control which can reach 12-15 % depending on load, frequency and duty cycle of the low pressure valve. The developed mathematical model and experimental equipment allows evaluating the influence of the system's and the valve's parameters on the total efficiency of the switched inertance hydraulic system.