

Adaptive Robust Control of Variable Displacement Pumps

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Hydraulic drive technology offers a variety of different system solutions for a wide range of applications. To increase efficiency is one challenge for new generation fluid power system because improved efficiency will significantly reduce both petroleum consumption and pollution. One advantage of a pump displacement controlled actuator is higher efficiency. However, research and applications upon now focuses on valve controlled actuator systems and load sensing control. With an increasing volume of research on fast response variable displacement pumps and related production on the market, the direct pump control technology research is a burgeoning area of interest.

Studies on adaptive robust control have been done by a number of researchers. However, many critical considerations for practical application are not well studied such as stiffness of ODE equations, availability of system states, and parameter convergence. Using singular perturbation theories, the simplified model presented in this work is well suited for real time control and industry applications. Instead of using instantaneous estimations, a recursive least square (RLS) method is implemented in the adaptation algorithm. Furthermore, a modified fast RLS algorithm is applied to further reduce computation load. Thus, a robust control law can be designed in order to track the desired trajectories.

The research will yield a new variable displacement pump control strategy. Since statistical estimation replaces instantaneous estimation, good convergence and stability are expected. Experimental validation will be performed and results will be further applied on an excavator. The work also gives a theoretical explanation to account for bulk modulus of fluid in control design. The work can be applied in practice without large modifications.