Simulation analysis of load sensitive system based on AMESIM

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Abstract: This paper focuses on the closed loop speed governing system of pump controlled motor, which is based on hydraulic simulation software AMESim. The corresponding dynamic simulation models are also simulated and analyzed on the factors that affect the dynamic performance of the system. The analysis shows that it is necessary to design appropriate control strategies to improve the dynamic performance of the speed governing system.

Keywords: AMESIM, closed, loop simulation model.

1. Introduction

Load sensing system is a kind of hydraulic circuit which can sense the pressure-flow demand of the system and only provide the required flow and pressure. The closed hydraulic system is composed of two-way variable pump and quantitative motor or variable motor. The pump is directly connected with the motor. There is no hydraulic valve between the working oil circuit. The variable displacement pump realizes the reversal function. When the swash plate swings over the middle, the direction of fluid flow can be changed smoothly and the rotation direction of the motor can be changed.

The stepless speed regulation of the system is realized with the stepless change of the displacement of the variable pump [1]. When the external load changes, the motor first receives the signal and transmits it to the control structure of the variable displacement pump. The control mechanism of the variable displacement pump controls the output flow of the variable displacement pump by controlling the swash angle. Therefore, the variable displacement pump can provide the appropriate flow rate according to the change of the external load, realizing the complex and sensitive requirements.
2. **AMEsim Simulation Steps**

AMESim is a multi-disciplinary modeling and simulation platform for complex systems, providing a perfect, superior simulation environment and the most flexible solution for hydrodynamic, mechanical, thermal and control systems. Hydraulic system simulation using AMESIM generally includes the following four steps: sketch mode, sub-model mode, parameter mode and operation mode [2].

(1) Sketch mode: The sketch mode is shown in Figure 4-2. In the sketch mode, the system can be established by selecting graphics from the AMESIM model library. AMESim provides a total of 15 model libraries, more than 400 components, click the model library, you can choose the components in the model library to build the system.

(2) Sub-model mode: After the sketch mode is completed, it enters the sub-model mode. In this mode, a mathematical sub-model is selected for each component according to the actual needs. If the system is unreasonable and can not form a normal cycle according to the requirements of AMESim, it can not enter the sub-model mode [3]. Normally, if there is no special requirement to click on the simplest child model icon, AMESim selects the default simplest child model for the system components.

(3) Parameter mode: After the sub-model collocation is completed, enter the parameter mode and click the component icon that you want to set the parameters directly to set the required specific parameters for each sub-model of the component; in this mode, AMESim can compile the system and the compiler generates the executable file containing the system parameters so that we can The system is simulated.

(4) Operation mode: After setting the main parameters such as start time, end time and sampling period, the simulation of hydraulic system can be carried out.

3. **Simulation of Closed Hydraulic System Based on AMESim**

Based on AMESim simulation software, according to the modeling steps, select the appropriate module in the sketch mode, connect it, select the hydraulic sign, and
establish the closed hydraulic system simulation model as shown in Fig. 2[4].

![Fig. 2 AMEsim simulation model of closed hydraulic system](image)

The hydraulic pump control signal is set to a fixed value of 1, so that the pump displacement is the maximum; the load step signal is set to a fixed value of 0 without loading. The simulation time is set to 10s and the sampling period is 0.01s. At this time, the speed response of the motor can be observed without loading. The simulation results are shown in Fig. 3.

![Fig. 3 Motor speed without load](image)

It can be seen that the system without control has a large overshoot and a slow response. The simulation time is set to 2S for re-simulation. The control signal of the hydraulic pump is sectionally expressed to represent the change of pump displacement. The load is set to a fixed value of 320N.M, the simulation time is 30s, the sampling period is 0.01s, the load signal and system flow, pressure and other parameters are loaded. The results are shown in Fig.4-8[5].
Fig. 4 Pump control signal (variable displacement of pump)

Fig. 5 Pressure drop of variable pump

Fig. 6 Torque change of motor

Fig. 7 Motor speed variation
It can be seen from the diagram that the motor speed is directly proportional to the inlet flow of the motor, and the motor torque and system pressure difference are right ratio. When the load signal jumps, the impact of the system is greater; when the reverse change to the maximum, the pressure increases sharply, and the torque changes greatly, the maximum is 500N·M. Especially when the swing angle of the pump swash plate changes from the reverse to the forward, the system produces a larger oscillation.

4. Conclusion

In this paper, the basic characteristics, toolbox and operation method of AMESim are introduced. The simulation model of hydrostatic transmission vehicle is established. The variation of system parameters under three conditions of no load, load and pump displacement is analyzed. The simulation results show that the system has certain instability and oscillation. It needs to be controlled.

References