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A NEW TYPE OF ELECTRO-HYDRAULIC COMPLEX SERVO ACTUATOR AND ITS ALGORITHM RESEARCH BASED ON LAUNCH VEHICLE

Abstract

As the progress of science and technology, the attitude control system of launch vehicle has several new requirements in future, which must have not only high power, small steady state error and good dynamic characteristics , but also low energy loss and high reliability. As a new type of servo actuator, electro-hydraulic complex servo actuator has become hot spots and focus, which belongs to variable pressure control system and can improve energy efficiency greatly. However, it has lower dynamic characteristics than that of traditional electro-hydraulic actuator (TEHA). The target orbit and track of launch vehicle are fixed in principle so that the movement of servo actuator can be pre-settled. Based on flight characteristics of launch vehicle, a new type of electro-hydraulic complex servo actuator is proposed, which adopts load-sensitive technology and segmented pressure control algorithm. So it can not only improve the energy efficiency but also have very good dynamic characteristic as that of TEHA. The motor works fixed speed and the servo valve controls the speed output of cylinder. The variable pump controls the system pressure by the pressure compensator and the shuttle valve, which can vary as the load at a fixed pressure difference. When the actuator has no power output, the pump can work at a smallest displacement. When the actuator requires very quick response speed, the ECU controls the pressure compensator for adding the fixed value of pressure difference and even reaching 33.3 percent of the system pressure in theory. So the dynamic characteristic of this actuator can reach that of TEHA. When the actuator requires low response speed, the ECU controls the pressure compensator for reducing the fixed value of pressure difference and even reaching 1-2Mpa. According to the statistical, the time percentage of high response speed of servo actuator is very low in whole flight time of launch vehicle. So the energy efficiency of this actuator can be improved greatly. In this paper, the energy efficiency and the dynamic characteristic will be analyzed firstly at several different fixed pressure difference values by researching the working characteristics of the actuator. And then the segmented pressure difference values will be confirmed for having high energy efficiency and good dynamic characteristic based on a flight track of launch vehicle. The contradictions of the energy efficiency and the dynamic characteristic are resolved perfectly in above scheme, which has great significance of servo actuator development.