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PARTICLE SWARM OPTIMIZATION BASED PI CONTROLLER DESIGN FOR SERVO ACTUATION SYSTEM OF REUSABLE LAUNCH VEHICLE

Abstract

Particle Swarm Optimization Based PI Controller Design for Servo Actuation System of Reusable Launch Vehicle

Abstract:Reusable launch vehicle is a system which has the ability to carry a payload from the earth's surface to the outer space more than once. The launch vehicle depends on navigation, guidance and control system for tracking a required trajectory. Electro hydraulic actuators are used in Reusable Launch Vehicle for vectoring the control surfaces about their axes. Compensation scheme for the RLV actuation system has been developed based on the requirements and plant dynamics, so as to improve the dynamic performance of the system. The open loop frequency response of the TVC system shows that even though the system is stable, the system specifications are not met. The classical design methodology is employed so as to meet the closed loop specifications. The compensation scheme consists of a PI controller, notch filter and a rate filter.The PI controller is designed to offer maximum dynamic gain and to offer relative stability for the system. The notch filter is introduced in the forward path to attenuate high frequency oscillations in the system. In order to get optimal controller parameters and to avoid the trial and error complexity in the design, a particle swarm optimization technique is implemented to design a PI controller. A particle swarm optimization technique is used to design the optimal controller parameters of PI controller taking into account the time and frequency domain specifications. The basic PSO is developed from the principles of fish schooling and bird flocking. This method eliminates the trial and error complexity of the conventional design of actuation system.A fitness function is to be formulated for the PSO algorithm. The function is designed based on the time domain specifications and it includes rise time t_r, $settling time t_s and overshoot M_p. The evaluation function is formulated as the sum of the ratios of settling time, rise time an$
$PI controller with a notch filter. By using PSO-PI controller and a notch filter, all the specifications are met and hence the rate$
$PI controller with a notch filter showed better results when compared to the conventional method.$