World Academy of Science, Engineering and Technology
International Journal of Industrial and Manufacturing Engineering
Vol:14, No:07, 2020

Augmented ADRC for Trajectory Tracking of a Novel Hydraulic Spherical Motion Mechanism

Authors : Bin Bian, Liang Wang

Abstract : A hydraulic spherical motion mechanism (HSMM) is proposed. Unlike traditional systems using serial or parallel mechanisms for multi-DOF rotations, the HSMM is capable of implementing continuous 2-DOF rotational motions in a single joint without the intermediate transmission mechanisms. It has some advantages of compact structure, low inertia and high stiffness. However, as HSMM is a nonlinear and multivariable system, it is very complicate to realize accuracy control. Therefore, an augmented active disturbance rejection controller (ADRC) is proposed in this paper. Compared with the traditional PD control method, three compensation items, i.e., dynamics compensation term, disturbance compensation term and nonlinear error elimination term, are added into the proposed algorithm to improve the control performance. The ADRC algorithm aims at offsetting the effects of external disturbance and realizing accurate control. Euler angles are applied to describe the orientation of rotor. Lagrange equations are utilized to establish the dynamic model of the HSMM. The stability of this algorithm is validated with detailed derivation. Simulation model is formulated in Matlab/Simulink. The results show that the proposed control algorithm has better competence of trajectory tracking in the presence of uncertainties.

Keywords : hydraulic spherical motion mechanism, dynamic model, active disturbance rejection control, trajectory tracking
Conference Title : ICAIM 2020 : International Conference on Automation and Intelligent Manufacturing
Conference Location : Copenhagen, Denmark
Conference Dates : July 15-16, 2020