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(Research Article)
Modeling and design of a three-degree-of-freedom stabilized platform for acoustic systems to compensate disturbances caused by vehicle

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Abstract

This paper proposes the kinematics and dynamics modelling of a three degree of freedom platforms, initially. Equations from this modelling are extracted in the form of input-output without any simplification. Given the application of these platforms in the stabilization of acoustic systems on movable systems, linear and nonlinear controllers are designed based on the extracted equations. Since the adaptive fuzzy controller is considered as an effective way for controlling uncertainties in nonlinear systems, a new algorithm is proposed in this paper based on the adaptive direct fuzzy control because of its robust tracking performances, ensured stability, and high-accuracy responses. In the design process of the adaptive direct fuzzy controller, the consistencies of the proposed algorithm and the validity of the control method are confirmed by the stability analysis and simulation results. This control method ensures the stability of the platform when it is subjected to disturbances from its carrier platform. The proposed algorithm is then compared with the proportional-integral-derivative controller. The simulation result shows the superiorities of the proposed approach. In addition, based on the simulation results, the stabilization accuracies of the adaptive fuzzy control method is estimated to be 1000 times higher than that of the proportional-integral-derivative control method.

Keywords: Three degree of freedom platform, Acoustic systems, Gimbal stabilized platform, Nonlinear model, Adaptive direct fuzzy controller, Proportional-integral-derivative controller.

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