ACTIVE VIBRATION SUPPRESSION WITH DISTURBANCE FORCE ESTIMATION

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(148031V)

Degree of Master of Science

Department of Electrical Engineering

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DECLARATION

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The above candidate has carried out research for Masters Dissertation under my supervision. I endorse the declaration by the candidate.

Dr. A.M.Harsha S.Abeykoon Date:

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ABSTRACT

Vibration is a basic phenomenon that has attracted control engineering's attention for many decades. Vibration rejection in control systems is implemented with passive, semi active and active vibration suppression systems. These methods commonly use multiple redundant sensors. Multiple sensor usage and complex control has implemented the cost of operation and complexity. Minimal sensor usage to provide vibration suppression within the commonly used acceleration or deflection observation could be used to reduce the complexity and cost of the system. This dissertation proposes a novel methods which uses either the acceleration or motor deflection measurement based disturbance force observers for vibration observations and to suppress the vibrations with active vibration suppression. The proposed system is capable of estimating the disturbances and compensate disturbances using the only a acceleration or suspension deflection sensory data. Proposed system still could work as a traditional vibration suppression system in case of a failure to active system. Active force to be injected is calculated based on the disturbance forces acting on the sprung mass. A novel method is proposed for spring and damper parameter measurement with electromagnetic actuators which enhance the overall system performance. A Quarter car model is used to illustrate the adaptability, robustness, and the vibration suppression capabilities of the system. Performance of the active vibration suppressor and disturbance observer is measured using system simulations and practical results. Simulation and practical system responses provide evidence of robust vibration suppression capabilities of the proposed method under different conditions.

Keywords:
Active Suspension, Active Vibration Suppression, Disturbance Observer, Reaction Force Observer, Disturbance Rejection.

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LIST OF ABBREVIATIONS

Abbreviation	Description
DOB	Disturbance Observer
RFOB	Reaction Force Observer
DOF	Degree of Freedom
BLDC	Brushless Direct Current
SPI	Serial Peripheral Interface
QEI	Quadrature Encoder Interface
ppr	pulses per revolution
FPGA	Field Programmable Gate Array