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Active Vibration Isolation System for Free Space Optic Communication: Virtual Prototyping using LabVIEW-SolidWorks

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Abstract. In Free Space Optic (FSO) communication, the alignment between transmitter and receiver telescope is very important. The line of sight of their optics must be aligned during the entire communication time; this is crutial in large distance data transmission. One of the factors that causes misalignment is vibration, either at the transmitter or the receiver. In this work, active vibration isolation (AVI) system is designed and developed to tackle this issue. An AVI system isolates FSO devices from direct disturbances or ground vibrations. The LQR controller is proposed and implimented with LabVIEW. A mathematical model of the isolator is derived and the prototype model of the AVI system is designed in SolidWorks. This prototype model is integrated with LabVIEW software to perform virtual prototyping.

Introduction

The technology of free space optic (FSO) communication is developing rapidly; it has the advantage of both optical fiber communication and wireless communication [1]. A FSO link consists of optical transmitter and receiver accurately aligned to each other with a clear line-of-sight. FSO system can reach over distances of several kilometers. Usually these transmitter and receiver are mounted on the rooftop or behind the window in order to get clear line of sight [2].

The alignment of transmitter and receiver of telescope is crucial in transferring data. The line of sight of their optics must be aligned during the entire period of communication. However due to the large distance between the transmitter and the receiver, it is difficult to maintain their alignment. This problem occurs because of weather conditions and vibrations. The dominant atmospheric effect that impacts optical communication is attenuation of the signal by scatter and absorption [3]. On the other hand there are many sources of vibration such as building sway under the influence of dynamic passing traffic, wind loads, thermal expansion, and weak earthquakes. The building sway causes vibrations of the transmitter beam moving it from the line-of-sight (LOS) in the direction of the receiver [4]. Hence, to overcome this problem, an active vibration isolation system is proposed. The significance of this project is to reduce vibration in order to maintain alignment of laser beam between the receiver and transmitter telescope in real time.