LMI-based H∞ Controller Design for a Line of Sight Stabilization System

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Abstract

This paper is concerned with the design of LMI-based H∞ controller for a line of sight(LOS) stabilization system. This system which is even linearized to analyse nonlinear characteristic has also a lot of uncertainties. In addition, the angular velocity disturbance from the vehicle's driving deteriorates the stabilized LOS, main purpose of this system. In case of fast driving, particularly, all components which are ignored and skipped to make mathematical modelling act as the uncertainties against this system. The robustness against these uncertainties has been also continuously demanded including the well tracking performance for the target. Therefore, this paper employed H∞ control theory to satisfy these problems and LMI method to make suitable controller with few constraints for this system. Although this system matrix doesn't have full rank, this method make it possible to design H∞ controller and deal with R and S matrices for reducing its order. Consequently, this paper shows that the re-analyses on the real disturbances are achieved and the proposed robust controller for them has better disturbance attenuation and tracking performance. This paper contributes the applicability of reduced order H∞ controller to real system by handling LMI.

1. Introduction

Modern arms system is precise sophisticated and automated as scientific techniques develop. A line of sight(hereafter we call it LOS) stabilization system mounted on ground vehicles is operated as both synthetic sensor package and mechanical stabilization system. Even though the vehicle is moving, its LOS stabilization system is used as a device which enables the operator to fire exactly for target recognition and detection. This LOS plays an important role in keeping recognition at the target and stably tracking the operator's handle command. the LOS stabilization system is thereby important in that it provides a stabilized LOS to operator and sends the target's position into fire-control system. In the guidance indication system, the LOS stabilization system enables the operator to control the gun and turret by tracking the target well.

2. System Descriptions

The gimbal is, as shown in Fig.1, composed of the gimbal housing, platform, stabilized mirror and inertial balancer and the object is observed through the stabilized mirror. Also, it uses the 2-axis driving mechanism. The gimbal system used in this study is a type of belt-driving, which has a simple mechanism and is able to employ the inertial balancer to improve the stabilization performance at elevation.

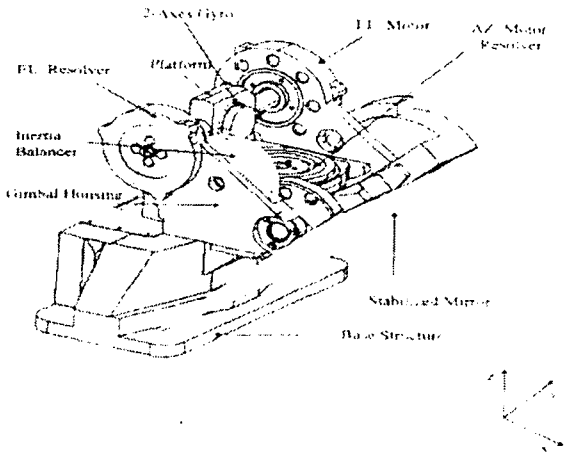

Fig. 1. A line of sight stabilization system

The velocity control loop in a stabilization system can be shown as Fig. 2.

Mathematical Modeling

If there is no slip between inertial balancer and wire band, the inertial balancer stabilizes the platform inertially by the dynamic relations under no other forces. If considered with the kinetic energy of rigid