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OPTIMAL CONTROL OF A ROBOTIC SYSTEM WITH TWO DEGREE OF FREEDOM

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ABSTRACT

A simple improvisation technique for designing a linear quadratic regulator (LQR) optimal controller for a robotic pan and tilt platform (PTP) with two degrees of freedom (DOF) has been proposed in this paper. Newton-Euler linear model of this robotic system has been stabilized to obtain the desired performance criteria via LQR. The performance of the proposed LQR controller is highlighted through comparisons with the existing proportional derivative (PD) and lead Compensator controllers on account of both steady state and transient response parameters.

KEYWORDS: Linear Quadratic Regulator, Newton-Euler Equation, Robotic System With 2- DOF, Transient Response Analysis

1. INTRODUCTION

Camera robotics is an enormous field of engineering for identifying threat, reducing catastrophic events, to follow a moving object and also for automation and manufacturing. Pan and tilt platform (PTP) are widely used for these purpose. Pan and Tilt mechanism is basically a robotic manipulator having two degree of freedom [1]. A camera can be mounted on tilt platform as shown in Figure 1.

Figure 1: A Digital Camera Mounted on PTP

These cameras have been consistently used for representation of entire space. They are also used in border patrolling, recording of a moving object, search and rescue operation, automation and manufacturing. Modelling of PTP has been done by Newton-Euler equation [2,3].

Three dimensional representation of PTP has been presented in Figure 2. All physical parameters of the system havebeen obtained from experiments using Computer aided design (CAD) [2,3]. A linear model has been obtained after neglecting centrifugal forces and coulomb friction.