Velocity Shaped Control of a Gantry Crane System

Introduction

Cranes as one of the major equipments in industries, exist in most places - from domestic industries to naval yards to warehouses, as one example shown in Figure 1. In these places the productivity of the activities depends on how efficiently the cranes are managed. One of the challenging in the control of the cranes is to deal with swaying phenomenon introduced by the trolley motion. This swaying not only reduces the efficiency of the cranes, but also can cause safety problem in the complicated working environment.

Figure 1. A real-world crane system in the harbor

Figure 2. The AUE Crane system

Some previous projects built a physical laboratory system as shown in Figure 2. However, due to limited project time, there are still many open problems. For example, there was too large uncertainty (2 degrees) of the angular measuring system; the developed controller didn't fully reach the objective – minimizing the swing of the payload at the end of the movement; Some inconsistencies are observed between Matlab simulations and practical tests. Therefore, how to improve the performance of the current system becomes a very interesting investigation.

Objective

The objective of this project is to develop some simple but effective swaying control algorithm such that the automated cranes operation satisfies the following two requirements:

- *Minimal time*. That is, the time it takes to move an object from one position to another position is reasonably minimized.
- *Minimal sway at the end of each move*. That is, at the end of each move the amplitude of the swinging motion of the object is small or zero.

Contents

. The project will include the following parts:

- Hardware improvements: for example, improving the current measuring methods/instruments, lengthening the traveling frame, improving the pivot mechanism between the cart and the payload cable, etc;
- Development of a mathematical model of the improved crane system, and then necessary feature analysis;
- Control design based on the **velocity shaped control** strategy or some other similar strategies;
- Simulation model and tests;
- Implementation of the developed control and practical tests.

Since this is a further project based on this system, better system performance than the previous group work are expected by the end of this project.

Resources

- The system as shown in Figure 2 is available at AUE E-Laboratory;
- Some previous project reports
- Materials for Velocity Shaped Control (can be available upon requirement)

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