Data-Driven PID Tuning Based on Safe Experimentation Dynamics for Control of Double-Pendulum-Type Overhead Crane

Nor Sakinah Abdul Shukor and Mohd Ashraf Ahmad

Abstract This paper reports an investigation of Data-Driven PID tuning based on Safe Experimentation Dynamics (SED) for control of the Double-Pendulum-Type Overhead Crane (DPTOC) system. The SED algorithm is used to find the optimal PID parameters such that the hook and load swing angles are minimized. Performance comparison between the SED based method and Simultaneous Perturbation Stochastic Approximation (SPSA) based method for data-driven PID tuning is observed and discussed. The performance is evaluated by numerical example in terms of trolley trajectory tracking, hook and load swings reduction and control input energy. The findings demonstrated that the SED based data-driven PID is capable to reduce the hook and load swing angles while maintain the desired trolley trajectory position. In addition, faster settling time for control input energy is obtained.

Keywords Safe experimentation dynamics · Data-driven PID tuning
Double-pendulum-type overhead crane

1 Introduction

An overhead crane is a type of crane systems used in various type of industrial environment such as, automotive, manufacturing, chemicals and warehouse. Overhead crane commonly assists in transporting large, heavy and hazardous loads. However, the movement of the trolley with load along the bridge girder lead to undesirable load and hook swing angles (double-pendulum effect) that can affect the system dynamics and performance. Besides, an overhead crane control system

N. S. A. Shukor (✉) · M. A. Ahmad (✉)
Faculty of Electrical & Electronics Engineering (FKEE),
Universiti Malaysia Pahang (UMP), 26600 Pekan, Pahang, Malaysia
e-mail: sakinah_shukor@yahoo.com

M. A. Ahmad
e-mail: mashraf@ump.edu.my

M. H. A. Hassan (ed.), *Intelligent Manufacturing & Mechatronics*,
Lecture Notes in Mechanical Engineering,
https://doi.org/10.1007/978-981-10-8788-2_27