Using Piecewise Affine PID Control Scheme for Double Pendulum Overhead Crane

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Abstract:
This paper proposes a new Piecewise Affine Proportional-Integral-Derivative (PA-PID) controller for cart position tracking and hook and load sway angle suppression of a double pendulum overhead crane (DPOC) system. A Safe Experimentation Dynamics (SED) algorithm is utilized as a model-free optimization tool to find the optimal PA-PID controller parameters such that the integral square of error and input are reduced. The essential feature of the PA-PID controller is that the parameters of proportional, integral and derivative gains are adaptive to the error variations according to the Piecewise Affine (PA) function. Moreover, the proposed PA function is expected to produce better control accuracy than the conventional PID controller. In order to justify the efficacy of the PA-PID controller, a widely known nonlinear model of DPOC plant is considered. The performances of the proposed controller are observed based on the integral square of error and input, and the responses of the cart position, the hook and load sway angle and the control input. The numerical results verify that the proposed PA-PID controller yields higher control accuracy than the conventional PID controller of DPOC system.

Keywords: Crane System; PID Controller; Safe Experimentation Dynamics.

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