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A new discrete mechanics approach to swing-up control of the cart-pendulum system.  
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Summary: This paper develops a new swing-up control method for the cart-pendulum system via discrete mechanics. The swing-up control law consists of two parts: the swing-up stage and the stabilization one. In the swing-up stage, we use a controller based on a discrete Lyapunov function and it can swing up the pendulum. Then, in the stabilization stage, we utilize a stabilizing controller based on the linearized system and discrete-time optimal regulator theory. In addition, transformation methods from discrete control inputs into continuous zero-order hold inputs are introduced. From some simulation results, we can confirm that the cart-pendulum system is swung up and stabilized by our new method.

MSC:
70Q05 Control of mechanical systems  
70E55 Dynamics of multibody systems

Keywords:
cart-pendulum system; discrete mechanics; swing-up control; stabilization; solvability analysis; zero-order hold input

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