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RHYTHMIC SWING MOTIONS OF A TWO-LINK ROBOT WITH A NEURAL CONTROLLER

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Abstract. *Some motion characteristics of the rhythmic swings of a two-link robot, which is controlled by a specially designed rhythmic neural controller, are investigated. The system model is composed of the differential dynamic equation of the upper link and state equations of the controller. With plenty of numerical simulation, the regular angle swing and giant rotating motions of the two links are achieved and illustrated in time history trajectories, amplitude spectra and phase plane portraits, respectively. The effects of the controller parameters on swing motions, including controller time constants and system damping, are analyzed. Finally, the transition behaviors between the above two motion patterns are also studied.*
Keywords: Rhythmic swing, Two-link robot, Neural controller, Nonlinearity

1. **Introduction.** Regular angular swing and giant rotating swing are two typical swing motions of a two-link robot referred as the pioneering paper [1]. In order to achieve the swings, special control strategies, namely rhythmic controls, are required. Some rhythmic control methods related to nonlinear or robust control are proposed in the past works [2,3]. Some properties of energy based control strategy are also described [4]. Recently, many innovative intelligent controls are adopted in robot swings. Heuristic control is used in [5] for the robot to achieve optimal swing motion performances. A target dynamics controller is developed based on their previous works and implemented on the study of so-called two-link brachiating robot [6,7]. In addition, development learning method [8] and variable structure control [9] are also proposed to for such robot motions.

In many other researches, neuron controllers are widely used to mimic the human body walking [10], to realize rhythmic swings of the humanoid arm [11] and special gymnastic movement [12]. Especially in [1], Matsuoka K proposed the mutual inhibition neuron controller and applied it to a two-link robot to realize giant swings, where the small swing and giant swings were achieved with certain control parameters and validated by experiments [13].

From the viewpoint of dynamical theory, these two kinds of the swing motions are corresponding to different periodic attractors in phase space respectively and with complex nonlinear characteristics. However, the dynamic phenomena of the swing motions of a two-link robot with a neural controller have not been studied and discussed thoroughly