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CONTROLLED SYNCHRONOUS MOTIONS OF A TWO-LINK MECHANISM BASED ON IMPROVED MRAC-PD CONTROLLER

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Abstract. *The application of controlled synchronization on mechanical system addresses interesting perspective recently, such as synchronization in robot systems. In this paper, a two-link mechanism, as a simple robot system was controlled to achieve special rhythmic motions. These small swing and giant rotation motions can be used for studying bionics. And it requires the two-link mechanism to keep certain relationship which is defined as synchronization motion herein. An improved model reference adaptive control with PD gain (MRAC-PD), which can obtain more accurate tracking control than conventional method is adopted. Under the assistant of Lyapunov stability criterion, the controlled system can realize the desired motion viz. synchronization. The effects due to the variation of control parameters have been investigated by numerical simulations.*
Keywords: Controlled synchronization motion, Two-link mechanism, Improved MRAC-PD controller

Nomenclature.

$\boldsymbol{C}_s(\boldsymbol{q}_s, \dot{\boldsymbol{q}}_s) \in \mathrm{R}^n$	Matrix account for the nonlinear Coriolis and centrifugal force;
d_i	Distance between Link i and joint i, $i = 1, 2$;
$\boldsymbol{e}$	Synchronous error;
$\hat{\boldsymbol{e}}$	Control item;
$\boldsymbol{\varepsilon}$	State vector of error;
H	Magnification of the amplifier;
$\boldsymbol{I} \in \mathrm{R}^{n\times n}$	Identity matrix;
I_i	Moment of inertia of link i with respect to its mass center, $i = 1, 2$;
$\boldsymbol{g}_s(\boldsymbol{q}_s) \in \mathrm{R}^{n\times n}$	Conservative force due to gravity;
g	Acceleration of gravity;
l_i	Length of Link i, $i = 1, 2$;
$\boldsymbol{M}_s(\boldsymbol{q}_s) \in \mathrm{R}^{n\times n}$	Matrix account for the nonlinear Coriolis and centrifugal force;
m_i	Mass of Link i, $i = 1, 2$;
n	Degree of freedom of the reference model and controlled system;
$\boldsymbol{P} \in \mathrm{R}^{n\times n}$	Symmetric positive definite matrix;
$\boldsymbol{Q} \in \mathrm{R}^{n\times n}$	Positive definite matrix;
$\boldsymbol{q}_d(t) \in \mathrm{R}^n$	Input of the reference model;
$\boldsymbol{q}_m(t) \in \mathrm{R}^n$	Output of the reference model;