ON THE PERFORMANCE INDEX OPTIMIZATION OF A RHEOLOGICAL DYNAMICAL SYSTEM VIA NUMERICAL ACTIVE CONTROL

Pawel Olejnik[1], J. Awrejcewicz[1],

[1]*Technical University of Lódź,*
Department of Automatics and Biomechanics,
Lódź, Poland

Keywords: LQR, active control, numerical methods, multidimensional dynamical system

Methods of active control can be adopted in optimization of fast impulsive response systems occurring in body interacting biomechanics. Active control of some mechanical or biological structures is not a new topic but can be still explored and successively used. The work focuses on application of one controlling force to minimize a relative compression of human chest cave that has been caused by some impacting action of an elastic external force. A virtual actuator controlling deformation in the analyzed rheological dynamical system of three degree of freedom acts between humans back and a supporting it fixed wall. Reduction of internal displacements in the thorax has been estimated solving the linear quadratic regulator (LQR) optimization problem. Solution of the system dynamics, Riccati's equation and the objective function's $J(t_0, t_f)$ minimization have been conducted in a numerical way with the use of Python programming language. Time histories of the controlled and non-controlled system responses, evaluation of the response's shape after changing coefficients of the control method as well as dependency of the objective function's estimation on the proportional gain vector are presented and discussed.