Neural Adaptive Computed Torque Control for Robot Manipulators

N. T. Hiep[1] **and P. T. Cat**[2]

Abstract: Computed torque method is a very popular in modern robot control. It allows the cancellation of all non-linearity and cross-coupling terms in robot dynamic equations. By that, a PD or PID controller may be used in robot tracking control. However the accuracy of the computed torque method depends very much on the estimation error between real and estimated robot parameters. In practice, oscillation and overshoot always occur when the computed torque method is applied. To overcome the parameters estimation error a neural network is usually introduced in the control loop. According to the Stone-Weiertrass theorem, an artificial neural network (ANN) with limited nodes can be chosen to approximate a nonlinear function with a given accuracy. Based on this, there were many studies using neural network under different forms to compensate the differences between real and estimated robot parameters. However the convergence of neural network and the stability of overall system often were demonstrated by computer simulations only. Most of proposals haven't proved the stability of the overall control system.

In this paper we propose a robust neural computed torque method using a RBF network and prove the asymptotical stability of the overall system. The advantage of the proposed method is that the network can learn online and the robot control system can adapt to high uncertainties and noises . The learning factor of the neural network and stabilizing factors K_I, K_P, K_D of the PID controller can be optimized by simulations or using Genetic Algorithms (GAs). The whole stability of the control system is proved by the Lyapunov direct method. Simulation results on a 2 – DOF manipulator are also given to illustrate the effectiveness and applicability of the proposed method.

[1] Department of Control Engineering
Le Quy Don University
100 Hoang Quoc Viet Road, Hanoi, Vietnam
hiepnguyentran@vnn.vn

[2] Institute of Information Technology
Vietnamese Academy of Science and Technology
18 Hoang Quoc Viet Road, Hanoi, Vietnam
ptcat@ioit.ac.vn