University of Macau

Abstract

KINEMATICS CONTROL OF REDUNDANT MANIPULATORS USING CMAC NEURAL NETWORKS COMBINED WITH DESCENT GRADIENT OPTIMIZERS & GENETIC ALGORITHM OPTIMIZERS

by Leong Sio Hong

Thesis Supervisor: Dr. Li Yangmin

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The inverse kinematics problems of redundant manipulators have been investigated for many years. The conventional method of solving this problem analytically is by applying the Jacobian Pseudoinverse Algorithm. It is effective and able to resolve the redundancy for additional constraints. However, its demand for computational effort makes it not suitable for real-time control. Recently, neural networks (NNs) have been widely used in robotic control because they are fast, fault-tolerant and able to learn. This thesis presents the application of CMAC (Cerebellar Model Articulation Controller) neural networks (NNs) for solving the inverse kinematics problems in real time.

However, for real-time control without any offline training, CMAC NNs alone are not able to handle constraints effectively and provide a good solution at the beginning stage. In order to assure the quality of solutions at the beginning, Genetic Algorithms (GAs), which is one of the most powerful tools for non-linear optimization problems, are applied together with CMAC NNs to solve the inverse kinematics problems of redundant manipulators. A control system combining CMAC NNs, Descent Gradient Optimizers and GA Optimizers are developed and demonstrated in this thesis. Simulations will be presented to demonstrate the performance and characteristics of the proposed system. Experiments are made to show its effectiveness in the real practice.