論 文 の 要 旨

題　目　Design of Hierarchical Clustering CMAC Based PID Controllers
（階層型クラスタリング小脳演算モデルを用いた制御システムの設計）

氏名　廖雲濤

In recent years, the controllers that borrow ideas from biological systems develop fast. Such controllers are defined as “Intelligent Controller”. Among all the intelligent controllers, the artificial neural network (ANN) based controllers are widely applied, ANNs are inspired by concept of “neuron”, they achieve their function by updating their weights. The ANNs based controllers have desired ability in solving nonlinear problem, however, the shortcoming of ANNs based controllers is also obvious, it is the large learning time consuming.

Cerebellar model articulation controller (CMAC) is a kind of ANNs, it has fast learning ability, thus, it is selected to optimize control performance in some studies. For conventional CMAC, when a high learning accuracy is demanded, the memory requirement increases and the generalization ability of the network decreases, such structure cannot balance the requirement of memory, learning accuracy and generalization ability.

Therefore, a novel structure of CMAC is proposed in this dissertation. The newly proposed CMAC is named as Hierarchical Clustering CMAC (HC-CMAC), the HC-CAMC achieves its balancing of requirement of memory, learning accuracy and generalization ability by setting each weight table different number of labels. In this situation, the weight table with bigger number of labels increase the learning accuracy of the CMAC and the weight table with less number of labels boost the generalization ability of the CMAC. The number of labels for each weight table can be determined by users according to their requirements. And the labels of each weight table are decided by using the hierarchical clustering method.

In this thesis, the proposed HC-CMAC is utilized as a controller parameter ‘tuner’, in chapter 2, a HC-CMAC PID controller and its on-line learning method are introduced, compare with a conventional CMAC PID controller, its advantage is explained. In chapter 3, an off-line learning method of HC-CMAC is introduced, it solves the problems ‘many learning trails’ and ‘large learning time’ of the controller proposed in chapter 2. In chapter 4, a HC-CMAC based controller that improve control performances for both transient state and steady state is introduced.