CHAPTER 7

CONCLUSIONS

This chapter aims to summarize the dissertation. The main objectives of this dissertation is to design and develop a model for predicting a specific water quality parameter of Chaophraya River using the two-dimension artificial neural network. According to results and discussions in 5.7 and 6.7, the EC, TDS and PO_4^{3-} models which based on space and time neural network were successfully developed by the real water quality parameter of the Chaophraya. They outperform the traditional neural network (time delay neural network and distance neural network) in term of predictive performance.

Furthermore, the purposed models also select the most probable sets of input parameters for predicting water quality parameters using genetic algorithm which was satisfied the second objective. The selected input parameters for each model is also reported in Chapter 5. Moreover, the purposed models can be used in different management scenarios of water quality parameter of Chaophraya River by Rapid miner studio software.

7.1 Water quality prediction framework

In this study, water quality parameter of the Chaophraya River which collected over a period of 17 years were used to identify water quality prediction framework. Frameworks was trained and tested to find an appropriate method in each step. This study found that the optimal water quality prediction framework consist of combination between genetic algorithm and artificial neural network and prepossess using K-nearest neighbour with k = 5 for imputation and range normalization. This framework was successfully applied to predict the water quality parameters in Chaophraya River (RMSE = 1.642 and Spearman correlation = 0.638).

This framework was developed based on Chaophraya River data. However, it have been designed as general framework for predict water quality in any water

resource. Therefore, it could be applied for predicting the water quality of other rivers or watersheds similar to the Chaophraya.

7.2 Space and time neural network model

The objectives of this dissertation are to design and develop a model for predicting water quality of Chaophraya River using artificial neural network and to determine the most probable sets of input parameters for used in proposed model. The new model called space and time neural network (STNN) was proposed to forecast water quality of Chaophraya River. This study compared the predictive performance of proposed model, time delay neural network (TDNN) and distance neural network (DNN) in modelling 16 water quality parameters monitoring along the Chaophraya. Upstream water quality and historical data were used as inputs to the applied models. A number of input parameter combinations was determined by genetic algorithm in the experiment. Average performances of the models indicated that STNN performed better than the traditional model (TDNN and DNN) in electrical conductivity (EC), total dissolved solids (TDS) and phosphate (PO_4^{3-}) modelling. RMSE and Spearman correlation clearly indicated that proposed model is the most capable than the alternative models in estimating those three water quality parameter in the future.

However, this proposed model had some limitation. Firstly, the space and time neural network model was developed based on the assumption that the river flow in one direction, from upstream to downstream. Thus, this model cannot used in the river which can flow back to the opposite side. Secondly, the proposed model was developed using only the water quality data collected by the Pollution Control Department, Ministry of Natural Resources and Environment. In fact, there are a lot of related information which may increase the precision of the model, such as meteorological data and structural data of the river (depth and location of curve of the river etc.). Thirdly, this model runs with limited computing resources. In order to make the simulations much accurate and usable in river quality management, more computation resources are required for large environmental systems equivalent to the Chaophraya River.

The water quality prediction framework and space and time neural network model showed the good performance for forecasting and simulation the Chaophraya River quality. Moreover, the proposed model could determine the relation of parameter which can be used as the recommendation of water management regulations. Therefore, the proposed framework and model could be used as an efficient tool for managing natural resource and environment, and maintaining compliance with water management regulations and policy.

7.3 Future works

This dissertation can continue research in three issues which are parameter relation, model optimization and input data. Parameter importance showed the relationship between input parameter and output parameter only in term of predictive performance. More investigation is required to clarify the actual relationship between those parameters in the river system.

Space and time neural network take a lot of computational resource, because of a big number of input parameter in 3 dimensions. The better optimization is required in order to shorten modelling time. This can be researched further on parameter selection or modelling step.

The prediction in this study based on only water quality parameter, time and distance. In fact, there are a lot of related information which may increase the precision of the model, such as meteorological data, waste water release profile and hydrological data of the river.