PhD Thesis Opponent’s Report

Thesis title: Bio-Inspired Computing

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Assessment of the PhD work

1. General description:

   This thesis is written on the 111 including the relatively extensive list of bibliography and appendix. The text is accompanied with readable figures that well document and illustrate the substantiality of the thesis. Including Introduction and Conclusion, the work is divided into seven main chapters.

   Chapter one – Introduction contains motivation of the dissertation focused on two main topics: River runoff prediction and Boiler efficiency optimisation. In this chapter is described the main contribution of this work. Last part is devoted to the organisation of the thesis.

   Background of the presented problems is a subject of the second chapter. In this chapter are described Artificial Neural Networks, Recurrent Fuzzy Neural Networks and theory of Mixture of Experts. There are presented basic concepts, main equations and algorithms of selected methods.

   Chapter three – First part of the chapter describes an improvement of Artificial Neural Networks using genetic algorithms. There is proposed a hybrid learning algorithm that combines two approaches for improving a quality of a neural network. The second part of the
Chapter presents chaotic expressions which are employed to enrich the temporal characteristics of time series data. Last part is focused on the proposed hybrid approach according to the concept of a mixture of experts. There are mentioned algorithms used in the hybrid approach, such as Dynamic Time Warping, K-means, and DBSCAN.

Chapter four and five contain experiments which evaluate proposed methods. In chapter four, is used a recurrent fuzzy neural network for river runoff short and long term prediction. Chapter five is focused on the application of recurrent fuzzy neural networks for boiler efficiency optimisation. The first experiment simulates boiler efficiency by RFNN and aim of the second experiment is real time multistep ahead forecasting of boiler efficiency by RFNN and using heuristic algorithms.

Chapter six contain related work according to the problems river runoff prediction and boiler efficiency optimisation.

The last part concludes the work and presents ideas for further extension of proposed methods.

2. The objectives of the doctoral thesis

In my opinion, the thesis meet a standard as a PhD thesis. The methodology used in the thesis is adequate. The author provides a complete overview of state of the art. The thesis presents a detailed presentation of algorithms and methods, and it includes an application of proposed methods on real datasets to solve prediction of river runoff and boiler efficiency optimisation. The author introduces the following objectives of his thesis:

- The author developed an improvement of ANN by utilising Genetic algorithms and hybrid learning algorithms.
- There is offered a method based on chaotic expressions which are employed to enrich the temporal characteristics of time series.
- Presents method which combines RFNN and clustering algorithm to simulate boiler efficiency and improve RFNN by the reinforcement learning algorithm.
- All presented methods were applied in the experiments on the real data.
3. Comments

- The thesis is a quite well written and structured, but the author should reformulate a few sentences for better understanding.
- In this thesis are missing a list of tables and list of figures.
- Some equations are included inside the text paragraph; I am suggesting move it into a separate line.
- Some charts do not have descriptions of axes.
- Unusual marking of the interval (0,1) as (0÷1), 1÷N, etc.

4. Publication activities

Mr. Hieu Ngoc Duong is a co-author of seven papers directly related to the thesis. Six papers were published in the proceedings of the peer-review conference proceedings, where three papers are included in Scopus database and two in WoS. One paper was published in the Indian Journal of Science and Technology. One paper was selected as remarkable paper for improving and possibly submitting to ETRI journal.

5. Questions

Although there is in chapter 4.2 discussed performance of used methods for short and long term prediction, there is not a comparison chart these methods by a duration of the learning phase. Could you compare your methods according to the duration of learning phase?

Conclusion

I suppose that this thesis accomplish all criteria and it can be judged as a doctoral (PhD) dissertation and Hieu Ngoc Duong demonstrated his ability for scientific work. I recommended accepting this thesis for public defence.

Kostelec na Hané, 17th October. 2016

RNDr. Ing. Martin Radvanský, Ph.D., M.Sc.