Review of the Ph.D. Thesis

Bio-Inspired Computing
by
Hieu Ngoc Duong

1. Overview

The Author deals within this Ph.D. thesis with the development of unique computational intelligence based approach for solving/optimizing of two important practical problems from the Vietnam agriculture and industry. The engineering part of the problem(s) being solved here is very supported here by the extensive research and unique workflow development hybridizing current computational intelligence approaches and tools belonging to soft-computing or bio-inspired methods paradigm. These approaches have been used here for the river runoff prediction and for the soft-sensor development in boiler efficiency optimization.

The thesis itself is divided into the several main blocks. The text-flow is very convenient and the transition between chapters and sub-chapters is very fluent. It is giving the Reader well balanced theoretical background followed by practical aspect, issues, implementations and again even more background for another components creating the hierarchy of the entire research and applied framework.

2. Completeness, up-to-dateness and difficulty of solved tasks

The given main goals of this thesis were fulfilled. Thesis represents both very compact and comprehensive description of background theory, engineering solution and intensive research joining all components into one functional unit. Presented “Related works” section contains extensive literature review covering all theoretical aspects related to the presented research. The developed and described approaches for prediction (both case studies) are representing the “ready to use solutions” helping to deal with difficult prediction/optimization problems.

Thus, it can be stated, that this topic is highly current and important from the both practical and research points of view.

3. Methodology, concepts of solved tasks, Research contribution of the work (Author’s own contribution)

From the entire thesis, it follows, that the unique workflow of latest, widely studied and intensively verified bio-inspired techniques, are implemented into the solution of two practical problems.

The first case study of river runoff prediction utilizes the scheme with RFNN – GA – clustering algorithms with chaotic sequences data-preprocessing inside MELE framework. I have to commend the developed approach and numerous experiments with different algorithmic component combinations. Presented results lend weight to the argument, that such an approach is fully competitive.

The second case study aimed at the boiler efficiency optimization represents the customized solution for soft-sensor development. It is utilizing some aforementioned components (RFNN) and it has high industrial (practical) impact.

Therefore, I have to admit the used approaches as a novel, complex, promising and surely open for a future research. Based on the presented facts, it can be stated that the Author’s research contribution is fully adequate for Ph.D. candidate.
4. Formal matters, remarks

The Ph.D. thesis is logically structured into chapters and subchapters. The text-flow within the entire thesis is very good. The thesis itself is written in good English (but some polishing would be beneficial), misprints, wrong timing or wrong cross-refs are not frequent and from the presentation point of view (structure, typography), it is also very good.

There are only few formal/technical remarks:

- The thesis title is too general.
- "Related works" section is a bit unusually at the very end of thesis – in my opinion, this section should be part of introduction, or following the introduction.
- The section 2.1.3.5 “Heuristic for Back Propagation” is a bit confusing. Not every items listed there are anyhow related to heuristics.
- Some abbreviations are not listed in the "Acronym" list in the beginning of thesis. Although, there are (maybe) mentioned somewhere in the beginning of the thesis within same chapter, but after 50 pages, reader can simply lose the orientation.
- The term "MLP coefficients" covering learning rate, No. of hidden nodes, layers... I think MLP topology (structure) and parameters will be more correct, since google searching for "MLP coefficients" leads to very heterogeneous topics/explanations.

5. Questions

- What was the reason, as to why, you have selected the hybridization between RFNN + GA, even though GAs represent the oldest and not very powerful (meta)heuristics (according to benchmark tests, etc).
- Will (May) be there a possibility to use symbolic regression approach (genetic programming, analytic programming and similar frameworks) for synthesizing of a "river behavior" model for direct long/short term prediction? Any obstacles - constrains, dynamic data, difficult features selection from data, etc?
- Please specify the possible progress in continuing of research/publication activity (mostly in journals)?

6. Final conclusion

In my opinion, the Ph.D. candidate Hieu Ngoc Duong has proposed the capability of solving the current research tasks together with practical projects and applications from the computer science/computational intelligence research field. Publications of the author are at an average level, as proved by the papers in high-quality and respected indexed sources. Therefore,

I recommend,

submitted Ph.D. thesis to be presented and defended.

In Zlin: 17.10.2016

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