Research Statement

Lindawati
School of Information System, Singapore Management University
Lindawati.2008@phdis.smu.edu.sg
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Background

My main research interest is in meta-heuristic algorithm design for optimized decision support. In the last decade there has been a dramatic rise in the design and application of meta-heuristics such as tabu search and simulated annealing to solve combinatorial optimization problems (COP) in many practical applications. The effectiveness of a meta-heuristic algorithm hinges on how to design meta-heuristic components. The challenge in meta-heuristic algorithm design is not only on how to design meta-heuristic algorithm that fit a certain problem but also on how to design the meta-heuristic algorithm so that the algorithm will yield the best possible solution for each instance.

This perspective translates into major research project that I have been working on recently as well as in the near future, which I will elaborate below.

Current Research

Performance of meta-heuristic algorithm is highly dependent on the parameters value. The right choice of parameter value can have significant effect to the quality of the result. Unfortunately, parameters tuning is not easy and time consuming. As it is mentioned in meta-heuristic literature that in designing and testing new heuristic algorithms, only 10% of the total time is dedicated to algorithm development, while the remaining 90% is used for fine-tuning parameters of the algorithm. The parameters tuning problem will get more difficult when involving different problem instances, where different problem instances may require different parameter configuration. This process is done either by the algorithm designer

laborious manual exercise, or an automated procedure. The key challenge in automated tuning is the large parameter configuration space on even a handful of parameters and large number of instances.

Motivated by this phenomenon, we started our research with a research question: given a heuristic algorithm and a problem instance, how to set the algorithm parameters so that the algorithm will yield the best possible solution for that instance? To answer this research question, we propose an instance-based problem-independent automated parameter tuning framework using clustering treatment in [Lindawati, Lau and Lo 2011]. We call this framework as CluPaTra (Clustering of Patterns of Search Trajectories).

Another concern in automated parameter tuning is how to set a good initial range for the parameter values. We explore DOE (Design of Experiments) approach for good initial parameter range in [Gunawan, Lau and Lindawati 2011].

Publications

Lindawati, H.C. Lau, D. Lo, Instance-based Parameter Tuning via Search Trajectory Similarity Clustering, LION (Learning and Intelligent Optimization) 2011, to appear.

A. Gunawan, H.C. Lau, Lindawati, Fine-tuning Algorithm Parameters using the Design of Experiment Approach, LION (Learning and Intelligent Optimization) 2011, to appear.

S. Kimbrough, A. Kuo, H. C. Lau, Lindawati and D. H. Wood, On Using Genetic Algorithms to Support Post-Solution Deliberation in the Generalized Assignment Problem. In Proc. 8th Metaheuristics International Conference (MIC), Hamburg, Germany, July 2009.