Summary (So Far...)

This thesis addresses the issue of the important but not trivial Stochastic Local Search (SLS) Design and Tuning Problem (DTP). The SLS DTP can be informally defined as a **meta-level** problem of finding a good-working, fine-tuned, SLS algorithm for attacking a given Combinatorial Optimization Problem (COP). The objective of addressing SLS DTP is obvious: to obtain a better performing SLS.

From literature reviews, we found out that current approaches to address this SLS DTP can be classified into white-box approaches that analyzes the SLS and/or the COP being attacked; or black-box approaches, automated tuning algorithms that aim to get the best SLS configuration given an initial configuration set that may work for the SLS. Logically, existing approaches have their strengths and limitations.

In this thesis, we present an integrated white+black box approach that combines the strengths of both approaches.

We invented and developed a white-box Fitness Landscape Search Trajectory (FLST) visualization that allows us to investigate the fitness landscape structure of the COP being attacked, develop insights on what should be a good search strategy to explore such landscape, as well to observe how our current SLS behaves on that landscape. This allows the algorithm designer to design the SLS in a more intuitive manner than existing white-box approaches.

The resulting SLS algorithm are then fine-tuned using black-box approaches, stepping up its performance more. The insights gained from the previous white-box step will likely have pruned the possible configuration set substantially, easing and indirectly improving the performance of the black-box tuning algorithm.

To implement this integrated approach, we have built an SLS engineering tool Viz. We have used Viz to develop several SLS algorithms for several COPs with the most notable results on the Low Autocorrelation Binary Sequence (LABS) problem where we managed to get state-of-the-art Tabu Search SLS.

In overall, this thesis have produced 7 papers: 1 chapter in book, 3 conference full papers, 1 workshop full paper, and 2 conference poster papers.

Contributions (So Far...)

Parts of the materials presented in this PhD Thesis are based on the following works that were carried out by the author together with his supervisors and colleagues during his PhD candidature at School of Computing, National University of Singapore from August 2004 to December? 2008:

Chapter in Book:

1. S. Halim and H.C. Lau. Tuning Tabu Search Strategies via Visual Diagnosis. In *Metaheuristics: Progress in Complex Systems Optimization*, ch 19, pp 365-388, 2007. Springer. [1]. **Rank 3** according to SoC, NUS.

Conference Full Papers:

1. S. Halim, R.H.C. Yap, and H.C. Lau. An Integrated White+Black Box Approach for Designing and Tuning Stochastic Local Search. In *Principles and Practice of Constraint Programming (CP)*, pp 332-347, 2007. [6]. **Rank 2** according to SoC, NUS.
2. S. Halim, R.H.C. Yap and H.C. Lau. Viz: A Visual Analysis Suite for Explaining Local Search Behavior. In *User Interface Software and Technology (UIST)*, pp 56-66, 2006. [5]. **Not yet ranked** according to SoC, NUS.
3. H.C. Lau, W.C. Wan, S. Halim. Tuning Tabu Search Strategies via Visual Diagnosis. In *Metaheuristics International Conference (MIC)*, pp 630-636, 2005. [7]. **Rank 3** according to SoC, NUS.

Workshop Full Paper:

1. S. Halim and R.H.C. Yap. Designing and Tuning SLS through Animation and Graphics - an extended walk-through. In *Engineering Stochastic Local Search Workshop (SLS)*, pp 16-30, 2007. [2]. **Not yet ranked** according to SoC, NUS.

Conference Poster Papers:

1. S. Halim, R.H.C. Yap, and F. Halim. Engineering Stochastic Local Search for the Low Autocorrelation Binary Sequence Problem. In *Principles and Practice of Constraint Programming (CP)*, pp 640-645, 2008. [3]. **Rank 2** according to SoC, NUS.
2. S. Halim, R.H.C. Yap, and H.C. Lau. Visualization for Analyzing Trajectory-based Metaheuristic Search Algorithms. In *European Conference on Artificial Intelligence (ECAI)*, pp 703-704, 2006. [4]. **Rank 2** according to SoC, NUS.

Oral Presentations at International Conferences/Workshops:

1. 1st Stochastic Local Search Workshop: September 6-8, 2007, Brussels, Belgium. Presenting [2].
2. 19th User Interface Software and Technology: October 15-18, 2006, Montreux, Switzerland. Presenting [5].
3. 6th Metaheuristics International Conference: August 22-26, 2005, Vienna, Austria. Presenting [7].

Bibliography

[1] Steven Halim and Hoong Chuin Lau. Tuning Tabu Search Strategies via Visual Diagnosis. In *Meta-Heuristics: Progress in Complex Systems Optimization*, pages 365–388. Kluwer Academic Publishers, 2007.

[2] Steven Halim and Roland Hock Chuan Yap. Designing and Tuning SLS through Animation and Graphics: an Extended Walk-through. In *Engineering Stochastic Local Search*, pages 16–30, 2007.

[3] Steven Halim, Roland Hock Chuan Yap, and Felix Halim. Engineering Stochastic Strategies for the Low Autocorrelation Binary Sequence Problem (under review). In *Principles and Practice of Constraint Programming*, 2008.

[4] Steven Halim, Roland Hock Chuan Yap, and Hoong Chuin Lau. Visualization for Analyzing Trajectory-Based Metaheuristic Search Algorithms. In *European Conference on Artificial Intelligence*, pages 703–704, 2006.

[5] Steven Halim, Roland Hock Chuan Yap, and Hoong Chuin Lau. Viz: A Visual Analysis Suite for Explaining Local Search Behavior. In *19th User Interface Software and Technology*, pages 57–66, 2006.

[6] Steven Halim, Roland Hock Chuan Yap, and Hoong Chuin Lau. An Integrated White+Black Box Approach for Designing and Tuning Stochastic Local Search. In *Principles and Practice of Constraint Programming*, pages 332–347, 2007.

[7] Hoong Chuin Lau, Wee Chong Wan, and Steven Halim. Tuning Tabu Search Strategies via Visual Diagnosis. In *6th Metaheuristics International Conference*, pages 630–636, 2005.