

PhD Proposal

Multi-wave algorithms for Binary Quadratic Optimization

Scientific Context

Multi-wave algorithms for metaheuristic optimization integrates tabu search and strategic oscillation utilizing repeated waves (nested iterations) of constructive search or neighborhood search. These approaches provide new forms of both neighborhood search methods and multi-start methods, and are readily embodied within evolutionary algorithms and memetic algorithms by solution combination mechanisms derived from path relinking. Our simple version of the multi-wave algorithm for the uncapacitated facility location problem proves highly effective. Our findings motivate an investigation of more advanced strategies of the general multi-wave algorithm that additionally exploit other conditional effects, including particularly the effect of persistent attractiveness. These methods can also be used to enhance branching strategies for mixed integer programming. These approaches offer further refinements by memory based strategies that draw on the concept of persistent attractiveness.

Keywords: metaheuristic optimization, iterated neighborhood search, multi-start algorithms, tabu search, evolutionary algorithms, Binary Quadratic Optimization

Objectives of PhD

In this subject, computational studies will be investigated by exploiting the flexibility and scope of the multi-wave algorithm to analyze the performance of its underlying strategies for solving Binary Quadratic Optimization problems. The proposed approaches will be validated on the unconstrained binary quadratic problem and some quadratic variants of the knapsack problem.

In this subject, computational studies will be investigated by exploiting the flexibility and scope of the multi-wave algorithm to analyze the performance of its underlying strategies for solving Binary Quadratic Optimization problems.

Candidate profile

Master degree or Engineering School in Computer Science or Applied Mathematics

Operational Research

Combinatorial Optimization

Mathematical Programming

Mixed Integer Linear Programming (MILP)

Metaheuristic Optimization

Implementation with C and C++, Cplex and Gurobi solvers

Supervisor: Saïd Hanafi,

INSA Hauts-de-France

Université Polytechnique Hauts-de-France

LAMIH, CNRS UMR 8201

Laboratory of Industrial and Human Automation, Mechanics and Computer Science,

email : Saïd.hanafi@uphf.fr

Expected collaborations: Fred Glover, University of Colorado (USA)

Bibliography

Glover, F., Hanafi, S., Guemri, O., & Crevits, I. (2018). A simple multi-wave algorithm for the uncapacitated facility location problem. *Frontiers of Engineering Management*, 5(4), 451-465.

Glover, F. (2016). Multi-wave algorithms for metaheuristic optimization. *Journal of Heuristics*, 22(3), 331-358.

Song, J., Wang, Y., Wang, H., Wu, Q., & Punnen, A. P. (2019). An effective multi-wave algorithm for solving the max-mean dispersion problem. *Journal of Heuristics*, 25(4), 731-752.

F. Glover (1989) "Tabu Search -Part I," *ORSA Journal on Computing*, Vol. 1, No. 3, pp. 190-206.

Hanafi, S., & Freville, A. (1998). An efficient tabu search approach for the 0–1 multidimensional knapsack problem. *European Journal of Operational Research*, 106(2-3), 659-675.