



ABCDE



Scientific Report

First name / Family name

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Nationality

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Name of the *Host Organisation*

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of the *Scientific Coordinator*

Thomas Stützle

Period of the fellowship

01/09/2012 to 31/08/2013

I – SCIENTIFIC ACTIVITY DURING YOUR FELLOWSHIP

Many stochastic local search (SLS) methods manipulate a single solution at each of the search steps. Successful algorithms for hard combinatorial problems are often the result of an effective engineering of such metaheuristics or of an appropriate combination of ideas from various such metaheuristics. However, despite the plethora of possibilities, algorithm designers rarely consider but a few methods when tackling a new problem.

During the fellowship, we have proposed a semi-automatic system that, with little human effort, is able to generate powerful hybrid SLS algorithms. First, we have proposed a unified metaheuristic structure that encompasses many metaheuristics proposed in the literature. We have described this unified structure as a generative grammar, from which we may instantiate not only individual metaheuristic algorithms, but also arbitrary combinations of these individual metaheuristic algorithms. Hence, our proposed grammar defines a very large space of possible hybrid SLS algorithms. Our second proposal has been to find the best instantiation of the grammar for a given problem in an automatic fashion, by means of automatic configuration tools.

II – PUBLICATION(S) DURING YOUR FELLOWSHIP

International Conference Proceedings :

- Marie-Éléonore Marmion, Franco Mascia, Manuel López-Ibáñez, Thomas Stützle, Towards the Automatic Design of Metaheuristics. In Proceedings of the 10th Metaheuristics International Conference, (MIC'2013), 3 pages, Singapore (Singapore), August 2013

We propose here a practical, unified structure that encompasses many metaheuristics. The proposed structure is unified because it integrates these metaheuristics into a single structure from which we can not only instantiate each of them, but also generate complex combinations and variants. Moreover, the structure is practical since we propose a method to instantiate actual algorithms for practical problems in a semi-automatic fashion.

NB: A paper for a journal special issue is currently being prepared.

- Marie-Éléonore Marmion, Franco Mascia, Manuel López-Ibáñez, Thomas Stützle, Automatic Design of Hybrid Stochastic Local Search Metaheuristics. In Proceedings of the 8th International Workshop on Hybrid Metaheuristics Conference, (HM'2013), LNCS, Springer, 144-158, Ischia (Italy), May 2013

Many stochastic local search (SLS) methods rely on the manipulation of single solutions at each of the search steps. Examples are iterative improvement, iterated local search, simulated annealing, variable neighborhood search, and iterated greedy. These SLS methods are the basis of many state-of-the-art algorithms for hard combinatorial

optimization problems. Often, several of these SLS methods are combined with each other to improve performance. We propose here a practical, unified structure that encompasses several such SLS methods. The proposed structure is unified because it integrates these metaheuristics into a single structure from which we can not only instantiate each of them, but we also can generate complex combinations and variants. Moreover, the structure is practical since we propose a method to instantiate actual algorithms for practical problems in a semi-automatic fashion. The method presented in this work implements a general local search structure as a grammar; an instantiation of such a grammar is a program that can be compiled into executable form. We propose to find the appropriate grammar instantiation for a particular problem by means of automatic configuration. The result is a semi-automatic system that, with little human effort, is able to generate powerful hybrid SLS algorithms.

Conference abstract :

- Marie-Éléonore Marmion, Franco Mascia, Manuel López-Ibáñez, Thomas Stützle, Automatic Configuration of a Generalized Metaheuristic Structure. In 27th annual conference of the Belgian Operational Research Society, (ORBEL2013), KU Leuven, Kortrijk (Belgium), February 2013

We propose a generalized metaheuristics structure that unifies different metaheuristics such as iterated local search, simulated annealing, variable neighborhood search, iterated greedy and greedy randomized adaptive search procedures. From this metaheuristic structure, we can instantiate each of the above mentioned metaheuristics, but we also can generate novel combinations of the algorithmic components of those metaheuristics and embed metaheuristics within others. In fact, the possibility of embedding metaheuristics into others (or itself) leads to the ability to recursively call one metaheuristic within another one.

III – ATTENDED SEMINARS, WORKHOPS, CONFERENCES

6-7 February 2013, ORBEL Conference, Kortrijk (Belgium) – Talk : 30 min
6 March 2013, COMEX day, La-Roche-en-Ardenne (Belgium) – attended
23-25 May 2013, HM Conference, Ischia (Italy) – Talk : 30 min
5-9 August 2013, MIC Conference, Singapour (Singapour) – Talk : 30 min

IV – RESEARCH EXCHANGE PROGRAMME (REP)

- INRIA Lille, France, Dolphin Project team, El-Ghazali Talbi and Clarisse Dhaenens and Laetitia Jourdan, 10-14 June 2013

We work with ParadisEO, a framework developed in the Dolphin team. I went to visit this team during one week to discuss about the framework and its possibilities regarding

our needs. It was interesting to understand how the framework had been thought and how to use it better. As I did my PhD in this team, we had also the possibility to continue to discuss about future collaborations.

- Polytechnic University of Valencia (UPV), Spain, Applied Optimization Systems Group, Rubén Ruiz, 17-21 June 2013

Since we use a scheduling problem as a test case of our framework, I took the opportunity of this REP to meet Profesor Ruiz, as he is a leader in metaheuristics for scheduling. I visited his group and presented our work. Moreover, we discussed about the difficulty of the instances and how to generate hard instances to compare fairly algorithms.