

PHD THESIS OFFER

- **Title:** Hybrid metaheuristics and learning methods
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- **Location :** University of Haute-Alsace
- **Duration:** 36 months
- **Keywords :** Metaheuristics, Artificial Intelligence, Deep Learning, Machine Learning

Topic

Solving large optimization problems often requires using approximate optimization methods, in particular metaheuristics, which make it possible to obtain optimized solutions in a reasonable time. In the literature, a wide variety of metaheuristic-based optimization methods are proposed, thanks to their successful applications in various fields, whether academic or industrial (health, automotive, chemistry, broadcasting, chemistry, etc.).

These optimization methods have the advantage of being very generic, which facilitates their use to solve various difficult optimization problems. Nevertheless, this genericity also represents a drawback since it takes a great deal of expertise and technicality to adapt them adequately to obtain the best possible results for each new problem studied.

To overcome this problem, researchers are trying to propose new hybrid methods [1,2], combining metaheuristics with each other, or with exact methods, for instance. Unfortunately, this kind of hybridization is mainly carried out statically, and its parameters are set experimentally. Thus, one of the limitations of this type of method concerns the set of hybridization parameters to be defined (how to combine two approaches? When to instantiate a particular approach? How to optimize the hyperparameters [3]? What can we learn from exploration / exploitation phases of the search space? Etc.).

Through this PhD thesis, we wish to answer these questions by developing new metaheuristics that integrate one or several learning methods in order to better guide the search towards the best possible solution in the search space, which is often exponential.

Indeed, the recent development of machine learning methods opens several ways of investigation which can lead to (1) the development of more efficient optimization algorithms integrating the ability to learn [7], and also to (2) the use of metaheuristics to optimize the performance of learning tools for Deep Learning [8].

Workplan

This work will go through the following phases:

- Make a state of the art on learning methods and metaheuristics.
- Study the exploration process of the developed hybrid methods in order to extract useful information / knowledge.
- Propose new hybrid methods integrating learning mechanisms.
- Validate the developed approaches on one or more problems studied in our team (proteins [4], chemistry [5], electric motors [1], sensor networks [6], health [9], etc.).

Prerequisites

- The candidate must have a research master's degree or equivalent in computer science or applied mathematics. The candidate must have a good knowledge in the following fields: metaheuristics and learning techniques.
- Programming language: C++ / Python.
- Good mastery of development under Linux.
- The candidate must have a good level in English.

Required documents

- CV
- Transcripts (marks) for the last three years of study
- Cover letter
- Two references of people to contact if needed

Planning

- Please send the required documents by email to lhassane.idoumghar@uha.fr, mathieu.brevilliers@uha.fr, julien.lepagnot@uha.fr
- Applications close on April 25, 2021
- Convocation of the selected candidates by the doctoral school on May 11, 2021
- Hearing of the selected candidates on May 26, 2021

References

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