

Doctoral School of Information and Biomedical Technologies Polish Academy of Sciences

Subject

Interpretable benchmarking for metaheuristic optimization

Supervisor

Dr hab. inż. Karol Opara (karol.opara@ibspan.waw.pl)

Institute, in which the topic will be conducted

Systems Research Institute, Polish Academy of Sciences, ul. Newelska 6, 01-447 Warszawa, Poland

Scientific discipline Information and Communication Technology

Recruitment form Interview

Available positions 1 (one person)

Project description

Nature-inspired metaheuristics, such as swarm and evolutionary algorithms, form an important branch of artificial intelligence. Although according to the *no free lunch* theorem, the universally best optimizer does not exist, some algorithms perform much better for particular groups of tasks. One of the significant research challenges is the identification of these groups. This project aims to develop a systematic method for selecting algorithms for particular tasks [1].

Commonly used benchmarks [2, 3] provide an overall performance measure, but the possibility of mining higher-level information is limited. The proposed project will address this issue by creating new test instances differing from the existing ones by interpretable characteristics. These include high-level features, such as rotation or scaling of the whole objective function, and sampling-based, low-level features known from the exploratory landscape analysis [4].

Extended benchmarks with a balanced experimental design will enable the quantitative assessment of relative strengths and weaknesses of optimization algorithms. Decomposing the overall performance into the partial influences of different task properties will unpack the mechanics of the algorithms facilitating their further development. Finally, one can also parametrize swarm and evolutionary algorithms leading to insights into the roles of their constitutive elements.

The completion of this project will provide experience in state-of-the-art metaheuristics and the application of advanced statistics and machine learning techniques. Computations will be conducted in supercomputing centres. This research project can include collaboration with renowned Slovenian scholars.

Bibliography

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3. N. Hansen, A. Auger, O. Mersmann, T. Tusar, D. Brockhoff. (2016). COCO: A platform for comparing continuous optimizers in a black-box setting. arXiv preprint arXiv:1603.08785.
4. O. Mersmann, B. Bischl, H. Trautmann, M. Preuss, C. Weihs, G. Rudolph, (2011). Exploratory landscape analysis. In proceeding of Genetic and Evolutionary Computation Conference, (pp. 829-836).

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