

Sujet de recherche Master MSIAM 2018-2019

Titre: Parallelization of Global Derivative-free Optimization Solvers

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Subject description: Derivative-free optimization (DFO) is a powerful class of optimization methods with application in several scientific and industrial areas. Nowadays, the computational power available allows an increase in the complexity of the models used to describe real systems, which often need to be optimized. The presence of nonsmooth functions, or the impossibility to efficiently approximate derivatives justify the intensive research conducted in the last two decades in DFO. Often optimization respects to different conflicting objectives and the increase in the computational power traduces in eager problem owners, frequently aspiring to global solutions.

The current thesis will address the parallelization of global DFO methods. In particular, GLODS and MultiGLODS algorithms will be considered, suited for single and multiobjective optimization, respectively. Both algorithms use a multistart strategy coupled with directional direct search. However, not all the initialized direct searches are conducted until the end. Instead, when start to be close to each other, searches are merged, only retaining the more promising, which makes the process affordable for the target problem class. The algorithms identify the several local optimums, from which it is easy to select the global one.

Although the mentioned codes presented a good numerical performance, when compared with state-of-the-art solvers at the date of the first release, their numerical efficiency could (and should) be improved. Both multistart and the poll step of directional direct search present a natural structure for parallelization, which is essential, if the goal is to have efficient algorithms, suited for DFO of real applications.

More than simply distributing current work among different processors, the idea is to use parallel techniques (and cloud computing) to anticipate algorithmic decisions, fully exploring the computational potential available. Moreover, parallel techniques and cloud infrastructure will allow an increase in the dimension of the problems solved, offered as a flexible and sharable service, accordingly to each user time requirements and budget. The parallel versions of GLODS and MultiGLODS will be included in a general DFO toolbox, already under development, which will be freely available to the community.

Skills required: Nonlinear optimization; Matlab language.

Internship place: the internship will take place part in Grenoble and part in Portugal (universidad novo of Lisboa)

Références:

1. A. L. Custódio and J. F. A. Madeira, MultiGLODS: Global and Local Multiobjective Optimization using Direct Search, Journal of Global Optimization, 72 (2018), 323 - 345
2. A. L. Custódio and J. F. A. Madeira, GLODS: Global and Local Optimization using Direct Search, Journal of Global Optimization, 62 (2015), 1 - 28