stage-bissection_ENPC

Formation M2
Research

Title
Automatic management of bisection heuristics for global optimization.

Context
Global optimization of a non linear function under non linear constraints, i.e. finding the global minimum of this function in a box of R^n
that satisfies the constraints is in general an NP hard problem and there exist no polynomial algorithm for solving it.
The most common complete algorithm is the "Branch and Bound" algorithm, that builds a search tree, bisecting the domains of the variables.
The main researches in this area were made on linearizations and constraint propagation techniques, but
the performance is often very sensitive to the bisections.
There exist therefore general purpose bisection heuristics and the choice of a "good" heuristics is crucial.

Objectives
An analogous branching choice also occurs in solving discrete NP-hard problems, such as combinatorial optimization or constraint satisfaction problems by tree search methods. There also exist branching heuristics, but the a priori choice of a "pure" heuristics can sometimes lead to disastrous results.
In order to be more robust, diverse methods have been developed to automatically manage heuristics that selects a variable to be bisected or assigned.
Some of these methods are based on restarts, with managing heuristics portfolios, some on preprocessing and learning on a the beginning of the search tree, and finally some other on mixing or randomizing heuristics.

The objective is to study these methods and to select and adapt one of them to the continuous case of global optimization, where the domains of the variables are bounded intervals.
This method will be coded in the Ibex C++ library and tested on well known problems from the COCONUT benchmark.

Profile
Knowledge on algorithmic, on C++ programming language

References

G. Trombettoni, I. Araya, B. Neveu, G. Chabert
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Proc. of AAAI 2011, pages 99-104, San Francisco, CA, USA

C. Gomes. Complete randomized backtrack search (survey). In M. Milano, editor, Constraint and Integer Programming: Toward a Unified Methodology, pages 233-283. Kluwer, 2003.

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