6th European Conference on Computational Mechanics (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
11-15 June 2018, Glasgow, UK

Efficient optimization under uncertainty within the SABBa framework

M. Rivier[1,2*] and P.M. Congedo[1]

[1] Inria Bordeaux Sud-Ouest, Talence, France, {mickael.rivier,pietro.congedo}@inria.fr
[2] ArianeGroup, Le Haillan, 33185 Cedex, France, mickael.rivier@ariane.group

Keywords: *Optimization under uncertainty, Bounding-Boxes, Surrogate-Assisting strategy, Multi-objective optimization*

This work is devoted to tackle multi-objective optimization under uncertainty problems using the SABBa framework (Surrogate-Assisted Bounding-Box approach). It aims at efficiently dealing with robust optimization problems with approximated robustness measures. The Bounding-Box (BB) approach has notably been formulated in [2] and [1]. Here, a Bounding-Box (or conservative box) is defined as a multi-dimensional product of intervals centered on approximated objectives and containing the associated true values. It is supplemented with a surrogate-assisting strategy, which is very effective in order to reduce the overall computational cost, notably during the last iterations of the optimization.

In [3], we have provided a mathematical proof of the robustness of the framework and of its convergence under some assumptions. A strong coupling between the refinement of the uncertainty quantification (UQ) process and the quality of the associated design has been highlighted. Intuitively, UQ refinement is only performed on promising designs, which allows quick convergence toward the most promising area. The surrogate-assisting strategy model is then automatically refined and used at a negligible computational cost.

This paper is focused on the application of SABBa to robust and reliability-based constrained optimization problems. This implies a redefinition of the Boxed Pareto dominance introduced in [3], which will be discussed in details. In order to compare strategies from a quantitative point of view, the convergence of the algorithm will be measured by means of a probabilistic modified Hausdorff distance to the Pareto optimal set.

Several comparisons on analytical and applicative test cases will be provided against the nested-loop strategy and a decoupling approach through metamodels built a priori.

REFERENCES

[1] F. Fusi and P. M. Congedo. An adaptive strategy on the error of the objective functions for uncertainty-based derivative-free optimization. *Journal of Computational Physics*, 309:241–266, Feb. 2016.

[2] M. Mlakar, T. Tusar, and B. Filipic. Comparing solutions under uncertainty in multiobjective optimization. *Mathematical Problems in Engineering*, 2014:1–10.

[3] M. Rivier and P. M. Congedo. Surrogate-Assisted Bounding-Box Approach for Optimization Problems with Approximated Objectives. Technical Report RR-9155, 2018.