Robust Optimization methods by density comparison

P.M. Congedo, O. Le Maître
Platon Team, Center for Applied Mathematics, Ecole Polytechnique

Context

Robust Optimization (RO) is a fundamental axis of research nowadays, due to both the evergrowing computational power available and the need for efficiency, reliability and cost optimality. Among others, a challenge is the formulation of a suitable metric for the optimization problem of interest and the search for an ideal trade-off between computational cost and accuracy in the case of problems involving complex and expensive numerical solvers.
Minimizing the mean of a given Quantity of Interest (QoI) might suffer from a lack of control on the performance variability. Alternative formulations are possible to enhance the control of the QoI variability, for instance accounting for its standard deviation in the definition of the optimization objective function, or using more complex statistics, such as quantile, super-quantile or conditional value at risk.

Usually, the choice of the metrics relies on user's experience or a specific interpretation of the optimization problem of interest. On the contrary, there are cases where the choice for a specific metric is not clear. Our interest here lies in optimization problems where we are not able to precisely formulate the objective function.

Objective

The objective of this work is to propose a methodology permitting to compare and rank the designs according to their distribution within a robust optimization framework, without explicitly formulating a specific metric. The potential use of Order Statistics and the transportation problem [1] for defining a suitable ranking function will be explored. Specific connections and differences with moments, quantiles, conditional value at risk (CVAR) formulation will be explored.

This work will be held in the Platon Team at CMAP-X. It will be supervised by P.M. Congedo, and O. Le Maître.

For further details, please contact P.M. Congedo or O. Le Maître (pietro.congedo@inria.fr, Olivier.le-maitre@polytechnique.edu).

References

[1] Y. Rubner, C. Tomasi, and L. J. Guibas. *A metric for distributions with applications to image databases*. In IEEE International Conference on Computer Vision, pages 59-66, January 1998.