



Science Arts & Métiers (SAM)

is an open access repository that collects the work of Arts et Métiers Institute of Technology researchers and makes it freely available over the web where possible.

This is an author-deposited version published in: <https://sam.ensam.eu>
Handle ID: <http://hdl.handle.net/10985/21860>

To cite this version :

Mathieu SACHER, Régis DUVIGNEAU, Olivier LE MAITRE, Mathieu DURAND, Elisa BERRINI, Frederic HAUVILLE, Jacques Andre ASTOLFI - Surrogates and Classification approaches for Efficient Global Optimization (EGO) with Inequality Constraints - In: The SIAM Conference on Optimization, Canada, 2017-05-22 - Proceedings of The SIAM Conference on Optimization(OP17) - 2017

Any correspondence concerning this service should be sent to the repository

Administrator : scienceouverte@ensam.eu



Surrogates and Classification approaches for Efficient Global Optimization (EGO) with Inequality Constraints

Matthieu Sacher^{a,*}, Régis Duvigneau^b, Olivier Le Maître^c, Mathieu Durand^d, Élisabeth Berrini^{b,e},
Frédéric Hauville^a, Jacques-André Astolfi^a

^a*Naval Academy Research Institute - IRENAV CC600, 29240 BREST Cedex 9, France*

^b*Université Côte d'Azur, Inria, CNRS, LJAD, 2004 Route des Lucioles, 06902 Valbonne, France*

^c*LIMSI - CNRS, Rue John Von Neumann, 91400 Orsay, France*

^d*K-EPSILON, 1300 Route des Crêtes, 06560 Valbonne, France*

^e*MyCFD, 29 Avenue des Frères Roustan, 06220 Golfe-Juan, France*

Abstract

In this work, we compare the use of Gaussian Process (GP) models for the constraints [Schonlau 1997] with a classification approach relying on a Least-Squares Support Vector Machine (LS-SVM) [Suykens and Vandewalle 1999]. We propose several adaptations of the classification approach in order to improve the efficiency of the EGO procedure, in particular an extension of the binary LS-SVM classifier to come-up with a probabilistic estimation of the feasible domain. The efficiencies of the GP-models and classification methods are compared in term of computational complexities, distinguishing the construction of the GP-models or LS-SVM classifier from the resolution of the optimization problem. The effect of the number of design parameters on the numerical costs is also investigated.

The approaches are tested on the optimization of a complex non-linear Fluid-Structure Interaction system modeling a two dimensional flexible hydrofoil. Multi-design variables, defining the unloaded geometry of the foil and the characteristics of its elastic trailing edge, are used in the minimization of the foil's drag, under constraints set to ensure minimal lift force and prevent cavitation at selected boat-speeds.

References

- M. Schonlau, Computer Experiments and Global Optimization, Ph.D. thesis, University of Waterloo, Waterloo, Ont., Canada, Canada, aAINQ22234, 1997.
- J. Suykens, J. Vandewalle, Least Squares Support Vector Machine Classifiers, Neural Processing Letters 9 (3) (1999) 293–300, ISSN 1573-773X, doi:\bibinfo{doi}{10.1023/A:1018628609742}, URL <http://dx.doi.org/10.1023/A:1018628609742>.

*Corresponding author

Email address: matthieu.sacher@ecole-navale.fr (Matthieu Sacher)