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

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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.

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