EngOpt2018 - 6th International Conference on Engineering Optimization
Instituto Superior Técnico, Lisbon Portugal • 17-19 September, 2018
Editors: H.C. Rodrigues, J. Herskovits, C.M. Mota Soares, et al.

Abstract ID 1014

SURROGATE-ASSISTED OPTIMIZATION WITH ONLINE SELECTION OR AGGREGATION OF MODELS

Charlotte Beauthier, Caroline Sainvitu, Tariq Benamara

Cenaero, Belgium
charlotte.beauthier@cenaero.be, caroline.sainvitu@cenaero.be, tariq.benamara@cenaero.be

Keywords: Surrogate-based optimization Surrogate models Selection of models Ensemble of models

Abstract: A globally effective approach to high-fidelity optimization problems based on computationally expensive analysis lies in the exploitation of surrogate models. They act as cheap-to-evaluate alternatives to the original high-fidelity models reducing the computational cost, while still providing improved designs. Since several surrogate types can be available, a priori choosing the most suitable one for a given problem is a difficult task for the user. Therefore, the aim of this work is to investigate some online strategies that can help to select the ``best'' surrogate model, or to aggregate several surrogate models by combining them. These strategies of selection and ensemble of models allow to overcome the a priori choice of the type of surrogate model. Indeed, one unique choice of surrogate model can not be suited to all kind of problems. Moreover, the same choice for all responses (objective(s) and constraint(s)) can be inadequate since the different responses can have very different behaviors and therefore require different types of approximation. Either in selective or combined approaches, it is important to define adequate performance measures of the surrogate models. The quality indicators used in this work are the ''Determination Coefficient (R^2)`` and the ''Ranking/Relation Preservation (RP)``. The metric R^2 gives a quantitative measure of the predictability of a surrogate while the RP metric refers to the ability of a surrogate model to preserve the same rank of the solutions with respect to the real function. Surrogate model selection methods consist in assessing the performance of various surrogate models and select one of them. Our considered selection strategy is based on the sum of these performance metrics. One drawback of a selection approach is that it does not take into account complete advantage of the computational resources used to train the different surrogate models. Therefore, the second approach consists in considering a combination of surrogate models. The performances of the online selection and aggregation strategies have been demonstrated in a Surrogate-Based Optimization (SBO) process in comparison with a classical SBO process exploiting a static a priori chosen surrogate model. The results reveal that the selection and aggregation strategies give globally better results in terms of convergence than a static surrogate model that would be chosen a priori. Finally, being able to select a surrogate model or aggregate several ones for each response (objective(s) and constraint(s)) at each iteration is a definite advantage of the considered approaches.