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A COMPARISON AMONG DIFFERENT RESPONSE SURFACE METHODS

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ABSTRACT

In this paper we perform a comparison among several different methods for generating response surface models. Response surfaces are often used to replace very complicated physical models, to generate correlations of experimental data and to be used in optimization problems in order to reduce the computational cost involved. Based on the extensive testing performed on 296 linear and non-linear test functions [1], the accuracy, robustness, efficiency, transparency and conceptual simplicity of the different methods are discussed. The methods compared in this work are Single Value Decomposition, K-Nearest, Kriging, Parametric, Gaussian Processes, Neural Networks, Radial Basis Functions [2,3] and a Hybrid Method developed by the authors [4]. Some of the methods tested were tested through the modeFRONTIER® software, which was kindly provided through the Esteco and ESSS companies. At the end, the Hybrid Method performance is compared against a well established optimization code.

In accordance with having multiple metamodeling criteria, the performance of each metamodeling technique is measured from the following aspects [5]: Accuracy, robustness, Efficiency, transparency and conceptual simplicity. For accuracy, the goodness of fit obtained from “training” data is not sufficient to assess the accuracy of newly predicted points. For this reason, additional confirmation samples are used to verify the accuracy of the metamodels. To provide a more complete picture of metamodel accuracy, three different metrics are used: R Square (R2), Relative Average Absolute Error (RAAE), and Relative Maximum Absolute Error (RMAE). The larger the value of R2, the more accurate is the metamodel.

In order to verify the accuracy of the interpolation over different number of training points, three sets were defined: scarce, small and medium. Also, the number of testing points varied, according to the number of training points. Figure 1 summarizes all the results for the R2 metric. From this figure, one can see that the average value of the R2 metric for the Hybrid method is higher among all test cases.

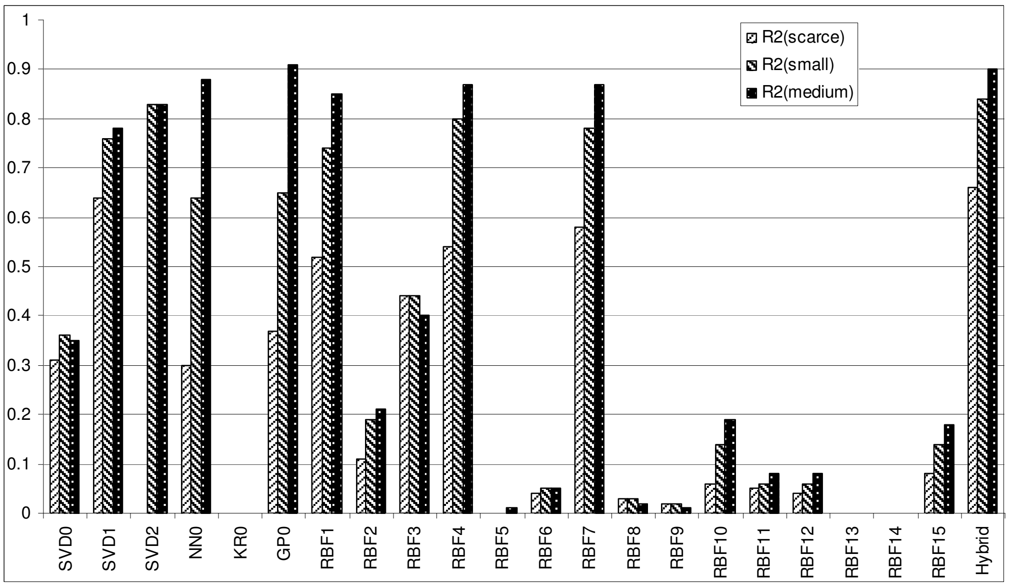

Figure 1 – Results for the R2 metric over all test cases

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