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RADIAL BASIS FUNCTIONS INFLUENCE IN CORS METODOLOGY APPLIED ON AERODYNAMIC WING OPTIMIZATION PROBLEMS

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Abstract: This paper discusses the influence of different Radial Basis Function (RBF) that use a shape parameter C in metamodel construction to be applied to 3D aerodynamic wing optimization problems using the Constrains Optimization with Response Surface (CORS) methodology in conjunction with a stochastic Controlled Random Search Algorithm (CRSA). The CORS methodology is based on the iterative construction and optimization of response surfaces with a robust search pattern application. In the CORS methodology the response surface may be generate by at least three types of methods: (i) Classical (polynomials and parametric surfaces), (ii) Statistical (K-Nearest, Kriging and Gaussian Processes) and (iii) Advanced (RBF and Neural Network). The response surfaces used in this paper are constructed using three different type of RBF: Gaussian, Hardy's Multiquadric and Inverse Multiquadric, whose shape parameters are automatically, optimized using Leave One Out Cross Validation (LOOCV). The RBF's are directly applied on the response surface construction inside the CORS structure, such that the influence of their shape parameters may be significant for the efficiency of the methodology. The methodology is applied for accelerating the optimization process of wing aerodynamic designs with a solver based on a first order 3D panel method and a 2D boundary layer model. Since the main objective of this paper is of prospective nature, the choice of a relatively low-fidelity flow computation solver is justified. One considers problems of minimizing the aerodynamic coefficient relation (CD/CL) and the inverse of lift coefficient (1/CL). The comparative influence of the RBF choice on the acceleration induced by the CORS methodology is investigated taking into account the number of calls of the objective function to find the minimum value in each problem.