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Data-Driven Geometric Filtration for Aerodynamic Shape Optimization

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The aim of the paper is to investigate the geometric filtration by Proper Orthogonal Decomposition (POD) in order to reduce the dimensionality of the design space in an aerodynamic shape optimization problem. Thanks to the capability of re-ordering the data according to decreasing variance, the Proper Orthogonal Decomposition extracts and filters the basic features of the dataset so as to formulate the optimization problem into a new, optimal and shrunk design space.

The capability of the new optimal bases in representing different airfoil and wings shapes has been already presented and critically analyzed [1, 2]. The previous studies showed that a major key point is the proper choice of the reduced design space bounds and that updating frequently the POD basis is beneficial for optimization accuracy and computational cost saving.

A series of optimization results are shown for a two–dimensional test case by using both a genetic algorithm and a surrogate based approach. Both native geometry parameterization and the filtered one are used to highlight benefits and drawbacks of the proposed approach.

Results show that, by employing the filtered parameterization and by properly adjusting the bounds of the reduced design space, it is possible to achieve and even enhance the design performance attained with the classical parameterization. Furthermore, the POD basis updating strategy has shown very promising results with respect to an *a–priori* design bounds adjustment. Details will be given also on the selection algorithm of geometries, analyzed from the aerodynamic solver during the on–going optimization, on which is based the POD bases updating, studying the influence on the optimum research, tuning the parameters that characterize the algorithm.

REFERENCES

[1] Cinquegrana, D. and Iuliano, E., "Geometric Data reduction in aeroshape Optimization," *23rd Conference of the Italian Association of Aeronautics and Astronautics*, edited by Carrera and Cinefra, AIDAA, November 2015.

[2] Cinquegrana, D. and Iuliano, E., "Efficient Global Optimization of a Transonic Wing with Geometric Data Reduction," *AIAA AVIATION Forum*, American Institute of Aeronautics and Astronautics, June 2017, pp. –.