Non-intrusive Reduced Order Modeling to Accelerate Design and Optimization Processes

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Reduced order modeling (ROM) provides a consolidated approach to reduce the often high computational cost of simulation-based design and optimization problems. Proper orthogonal decomposition (POD) is a reduction technique that can be used for solving parametric PDEs in an efficient and fast way by combining a limited set of pre-computed numerical solutions. Its employment with nonlinear physics phenomena and complex geometries may require however further numerical treatments in order to keep the desired accuracy. In such a contribution, we will present several examples of applications where a POD-based framework has been adopted to reduce the computational burden of hull and propeller optimization. We will discuss the adopted deformation techniques, with a deep focus on their integration within the ROM pipeline. We will then present the non-intrusive POD frameworks, so-called since it is a family of methods that rely only on the data, allowing larger employment. The last part of the contribution is dedicated to the optimization strategy, where a genetic algorithm has been applied to explore the non-convex solution manifold of the reduced model.