Surrogate Models of Geometrically Parameterized Flow Systems

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ABSTRACT

Detailed simulations of complex flow systems to determine critical quantities of interest (QoI) are often unaffordable due to their computational cost. At the same time, simplified models are usually not sufficiently accurate to achieve the precision required by physicists and engineers to provide reliable estimates of QoI. This computational bottleneck is a major challenge for the effective conception, design and operation of industrial systems, especially when geometric parameters are involved.

A brief overview of recent a priori and a posteriori ROM strategies for geometrically parametrized incompressible flows is recalled first [1,2]. Then, the optimal strokes for the push-me-pull-you (PMPY), simplified model of an euglenoid micro-swimmer, are determined thanks to the explicit separated expression of the forces and velocity calculated by virtue of the non-intrusive Encapsulated PGD [3].

An alternative strategy is also explored to construct response surfaces of QoI, explicitly depending on the design parameters. The resulting methodology to treat complex systems is demonstrated through parametric studies involving viscous incompressible flows of interest in science and the automotive industry for many-queries problems like shape or path optimization.

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