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RINGSAIL-PARACHUTE DESIGN STUDIES BASED ON AERODYNAMIC-MOMENT COMPUTATION

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For reliable design and performance studies of ringsail parachutes, fluid–structure interaction (FSI) analysis, which is computationally challenging, is essential. That is because parachute aerodynamics depends on the parachute shape, which in turn depends on the aerodynamic forces. Because of the difficulty involved in moving the fluid mechanics volume mesh as required by the motion of a very complex structure at the fluid–structure interface, we developed the Homogenized Modeling of Geometric Porosity (HMGP-FG) [1]. The HMGP-FG is used in conjunction with the FSI Geometric Smoothing Technique (FSI-GST) [2]. The FSI-GST brings smoothness to the fluid mechanics mesh at the interface, and that makes the mesh generation and mesh motion easier. This also enables obtaining fluid mechanics solutions with meshes that are not too refined to be practical. We discuss two techniques as alternatives to the FSI-GST and HMGP-FG. The first one is using isogeometric analysis [3] for the parachute, which is an alternative to the FSI-GST (see Figure 1).

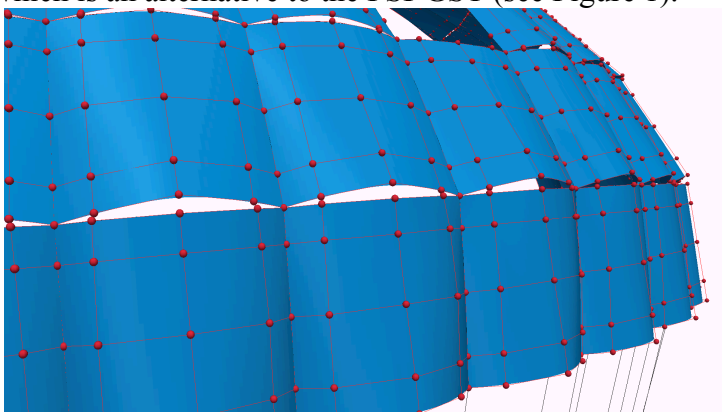

Figure 1. Parachute geometry represented by NURBS basis functions and control points.

The second one is computing the fluid mechanics with resolved geometric porosity, using a highly-refined mesh; this is an alternative to the HMGP-FG (see Figure 2). Figure 3 shows the preliminary results from the fluid mechanics computation with resolved geometric porosity.

Figure 2. Highly-refined mesh resolves the gaps and slits. The computational domain and the mesh (left) and a part of the mesh (right).

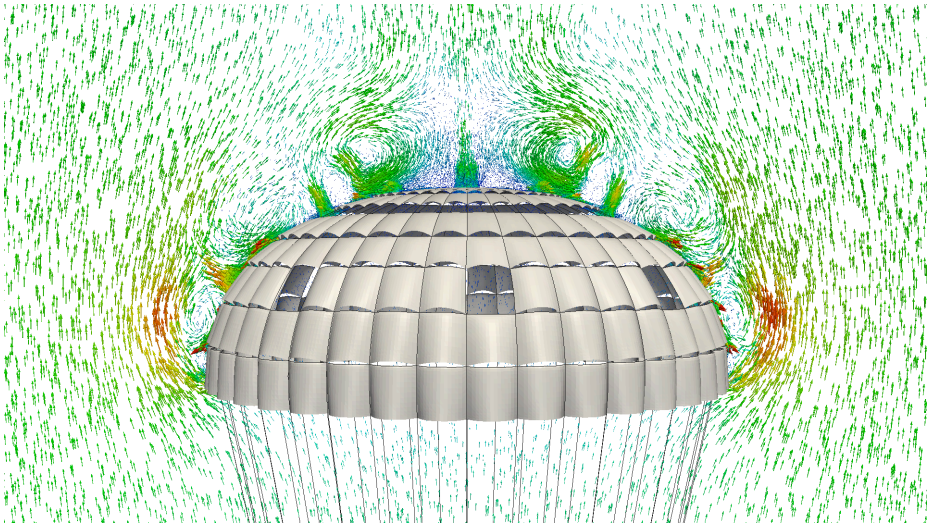

Figure 3. Flow visualization from the fluid mechanics computation with resolved geometric porosity (the velocity vectors are colored by their magnitude).

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