Disk-Gap-Band Parachute Supersonic Flow Analysis with High-Fidelity Geometry and Boundary-Layer Representation

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ABSTRACT

The disk-gap-band parachute (DGBP) is potentially suitable for capsule deceleration of Mars exploration systems. Its flight speed in the Mars atmosphere would range from supersonic to subsonic. Reliable computational analysis of parachutes requires taking into account the fluid–structure interaction (FSI) between the parachute and the air [1, 2]. In this case the airflow around the DGBP will be compressible flow. For the FSI computations, we need to create a starting shape and flow field, and that is what we do here for a range of Mach numbers. In our structural and fluid mechanics computations, for spatial discretization, we use quadratic NURBS basis functions [3]. This gives us a parachute shape, seen in Figure 1, that is smoother than what we get from a typical finite element discretization. In the flow analysis, we use the NURBS basis functions in the context of the compressible-flow Space–Time SUPG method with YZβ shock capturing [4], and the flow field can be seen in Figure 1.

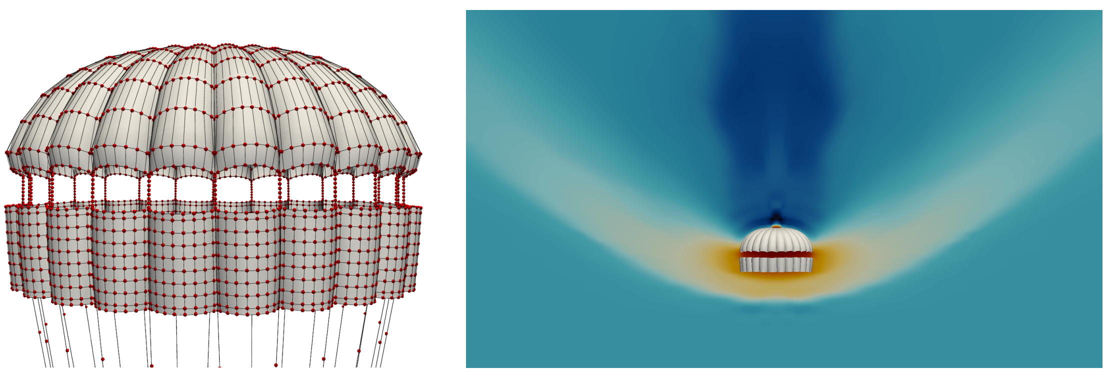

Figure 1: Structure mesh (*left*) and air density at Mach 1.4 (*right*).

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