Tire Aerodynamic Analysis and Verification with the Space–Time Slip Interface Topology Change Method and Isogeometric Discretization

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ABSTRACT

Tire aerodynamic analysis is computationally challenging because the tire rotation is without rotational symmetry and the contact between the tire and the road creates topology change (TC) in the mesh. The Space–Time Slip Interface (ST-SI) method [1] allows in a consistent fashion slip at the interface between the mesh covering a rotating solid surface and the rest of the mesh, and with this, we maintain high-resolution representation of the boundary layers near the tire surfaces. The ST-TC method [2] addresses the TC challenge and still maintains the high-resolution representation of the boundary layers near solid surfaces. The ST-SI-TC method [3] integrates the ST-SI and ST-TC methods. It enables accurate flow analysis when we have a spinning solid surface that is in contact with a solid surface. With the ST Variational Multiscale (ST-VMS) method [4] as the core technology, we integrate Isogeometric Discretization with the ST-SI-TC method to address the computational challenges of tire aerodynamic analysis. The analysis we present is for a model that includes both the longitudinal and lateral tread grooves and a prescribed tire deformation. Following that analysis with our standard mesh, we conduct a verification study by also computing with a refined mesh that is 8 times larger (Figure 1) and comparing the results from the two meshes.

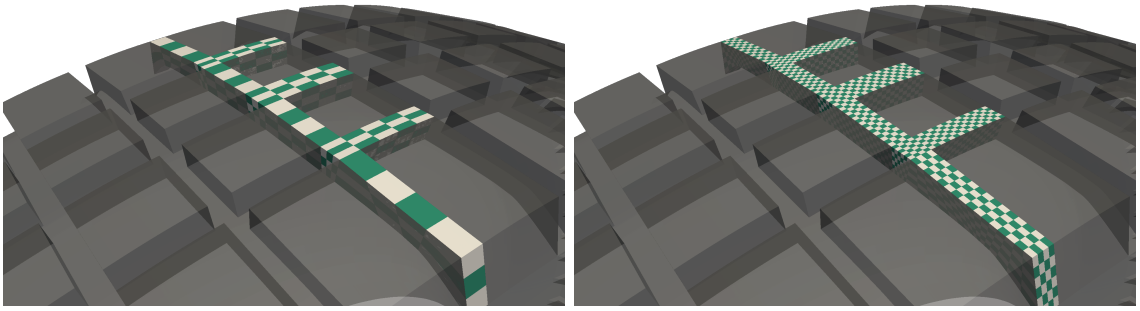

Figure 1: Standard mesh (*left*) and refined mesh (*right*).

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