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STREAMLINED BOUNDARIES FOR FLUID-STRUCTURE INTERACTION IN VEHICLES

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Abstract.

Choosing an appropriate computational domain for moving vehicles with strong fluid-structure interaction (FSI) is a challenging task. Typically, the vehicle follows a very long trajectory (compared to its size) in the longitudinal direction, but it can also experience significant lateral displacements, or even changes in direction, due to the fluid's action. If a fixed, earth-bound domain is used, it would need to be excessively large, demanding substantial computational effort. In this article, we propose a strategy to have a computational domain that follows the body, while keeping the lateral boundaries as streamlines so that standard slip boundary conditions can be applied there. Standard Arbitrary Lagrangian-Eulerian (ALE) terms are added to account for the mesh movement. This approach allows for the consideration of very complex vehicle movements with a computational cost roughly similar to that of a standard FSI problem. Note that ALE terms must be included anyway due to the body's movement caused by the FSI. Details of the numerical implementation of the streamlined boundaries are discussed, and several numerical examples are presented.

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