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SPACE–TIME COMPUTATIONAL ANALYSIS: IT ADDS ANOTHER DIMENSION

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Space–Time (ST) Variational Multiscale (ST-VMS) method [1] and its predecessor ST-SUPS [2] have a good track record in computational analysis of complex fluid–structure interactions (FSI) and flows with moving boundaries and interfaces (MBI). The classes of challenging problems with successful analysis range from spacecraft parachute FSI to wind-turbine aerodynamics, from flapping-wing aerodynamics of an actual locust to fluid mechanics of heart valves. When an FSI or MBI problem requires high-resolution representation of boundary layers near solid surfaces, ALE and ST methods, where the mesh moves to follow the fluid–solid interface, meet that requirement. Moving-mesh methods have been practical in more classes of complex FSI and MBI problems than commonly thought of. With a number of complementary methods introduced recently, the ST methods can now do even more. They can handle contact between solid surfaces or other topology changes, as enabled by the ST-TC method [3], or a spinning solid surface that is in contact with a solid surface, as enabled by the ST Slip Interface TC (ST-SI-TC) method [4]. The ST Isogeometric Analysis (ST-IGA) [5] is further increasing the accuracy and scope of the ST methods. The ST-SI method [6], which also provides mesh generation flexibility in a general context by accurately connecting nonmatching meshes, and a general-purpose NURBS mesh generation method introduced recently make spatial NURBS basis functions more practical in ST computations with complex geometries.

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