CALCULATION OF THE STABILIZATION PARAMETERS IN FINITE ELEMENT FORMULATIONS OF FLOW PROBLEMS

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This is an overview of the calculation techniques we developed for the stabilization parameters used in the streamline-upwind/Petrov-Galerkin (SUPG) and pressure-stabilizing/Petrov-Galerkin (PSPG) methods. The SUPG and PSPG methods are used extensively in finite element formulations, including the interface-tracking and interface-capturing techniques we developed for computation of flow problems with moving boundaries and interfaces. The stabilization parameters described here are designed for the semi-discrete and space–time formulations of the advection–diffusion and Navier–Stokes equations. Some of these parameters are calculated with the element-level matrices and vectors, using expressions in terms of the ratios of the norms of the matrices or vectors involved in the definitions. The local length scales, advection field, and the element-level Reynolds number are represented in these definitions, because they are contained in the element-level matrices and vectors. Based on these definitions, a stabilization parameter can be calculated for each element, or for each element node or degree of freedom or element equation. Furthermore, based on these definitions, a stabilization parameter can be calculated for each element integration point. Some other stabilization parameters are calculated by directly taking into account the flow velocity, viscosity, and the local length scales for the advection- and diffusion-dominated limits.