Variational multiscale stabilized FEM formulations for stochastic advection-diffusion equations

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An extension of the deterministic variational multiscale approach with subgrid scale modeling is considered for developing stabilized finite element formulations for the stochastic advection-diffusion and the incompressible stochastic Navier-Stokes equations. The stabilized formulations are numerically implemented using the spectral stochastic formulation of the finite element method. Generalized Askey polynomial chaos and Karhunen-Loève expansion techniques are used for the representation of uncertain quantities. The proposed stabilized formulations are numerically evaluated against standard fluid-flow and natural convection examples with uncertainties in material data and boundary conditions. The stochastic version of Rayleigh-Bènard convection problem is used to illustrate the limitations of the Generalized polynomial chaos approach in simulating convection phenomena near critical equilibrium points. Approaches to avoid these limitations are then briefly discussed.

References

[1] Velamur asokan Badri narayanan and N. Zabaras, "Variational multiscale stabilized FEM formulations for transport equations: stochastic advection-diffusion and incompressible stochastic Navier-Stokes equations", *J. Computational Physics*, submitted for publication.