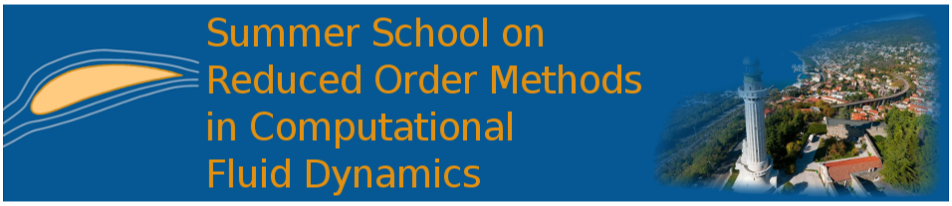

Contribution ID: **43**

Type: **Poster**

Model-Order Reduction for 3D Turbulent Mixing T-junction

Wednesday, July 10, 2019 4:12 PM (3 minutes)

We consider a model-order reduction approach to approximate scalar transport and mixing in a T-junction using spectral-element-based large-eddy simulation (LES) for the full-order model. One such LES simulation of 100 convective-time units can cost hundreds of thousands of core-hours on a supercomputer. For the reduced-order model, we apply Galerkin projection using POD-generated global basis functions to reproduce the quantity of interest, the concentration profile of the passive scalar. For turbulent flows, the Galerkin formulation applied to a small number of dominant POD modes may not be sufficient to remain in the basin of attraction of the underlying dynamics. The reason that is typically cited for this behavior is the inability of this combination to sufficiently dissipate energy since the POD modes lack the small-scale structures found in such flows. By introducing a stabilization mechanism, significant improvement in accuracy can be achieved. Here, we describe recent results using POD-Galerkin projection with constrained optimization to ensure that the flow evolves within the dynamical range observed in the full-order model. With this approach, we address the turbulent flow reproduction problem, which is a first step towards parametric model order reduction for turbulent thermal transport.

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Session Classification: Poster blitz