Abstract Submitted
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Least-Squares Petrov–Galerkin Reduced-Order Models for Hypersonic Flight Vehicles[1] PATRICK BLONIGAN[2], Sandia National Laboratories, FRANCESCO RIZZI, NexGen Analytics, MICAH HOWARD, JEFF FIKE, KEVIN CARLBERG, Sandia National Laboratories — High-speed aerospace engineering applications rely heavily on computational fluid dynamics (CFD) models for design and analysis due to the expense and difficulty of flight tests and experiments. This reliance on CFD models necessitates performing accurate and reliable uncertainty quantification (UQ). However, it is very computationally expensive to run CFD for hypersonic flows due to high grid resolution requirements. Additionally, UQ methods are many-query problems requiring many runs with a wide range of input parameters. One way to enable computationally expensive models to be used in such many-query problems is to employ projection-based reduced-order models (ROMs) in lieu of the (high-fidelity) full-order model. In particular, the least-squares PetrovGalerkin (LSPG) ROM (equipped with hyper-reduction) has demonstrated the ability to significantly reduce simulation costs while retaining high levels of accuracy on a range of problems including subsonic CFD applications. This work presents the first application of LSPG to hypersonic CFD problems including the Blottner sphere and HiFIRE experimental flight vehicle. This shows the ability of LSPG ROMs to significantly reduce computational costs while maintaining high levels of accuracy in computed quantities of interest.

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