

MAE Departmental Seminar
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1402 Truitt

Past, present, and future advances in
gas turbine combustor simulation

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Computational fluid dynamics continues to boast many successes for improving the design of the compression and turbine subsystems of jet engines. Not so for the combustor. In this seminar, I review some practical issues, successes, and fundamental modeling challenges which still remain for modeling and simulating this practical flow system. Results from fundamental laboratory and direct numerical experiments are used to illustrate why micro-physical, but leading-order processes occurring in the combustor are not amenable to traditional, deterministic moment methods (including both RANS and LES). These leading-order processes include chemical reaction, pollutant (soot) emissions, and liquid (jet fuel) spray dynamics. Even popular subgrid-scale mixing models which partly or wholly drive these unresolved processes are shown to be inadequate! I also describe some modeling ideas, which have long-existed outside engineering circles, newly applied to improve the modeling capabilities and/or computational turn-around in simulating this multi-scale system.

For my talk, some background in turbulence is assumed. Although motivated by practical design issues, much of the talk will also focus on concepts of a fundamental, academic flavor. Thus those studying general multi-scale, non-linear/non-conservative systems may find a new application in gas turbines, or just enjoy some of my nice pictures and animation!