Ph. D. Defense

by

Principio Tudisco
(Advisor: Suresh Menon)

"Numerical Simulations of Real-Gas Flows with Phase-Equilibrium Thermodynamics"

July, 13
11:00 am (ET)
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Abstract:
Motivated by the complex physics of multi-component mixtures in strongly nonideal, real-gas (RG) conditions reported in the field of chemical engineering and supported by several studies conducted in different fields of physics and engineering, in this work, the objective to address the behavior of RG mixtures with multi-phase thermodynamics has been addressed from a broader point of view. The focus has been to evaluate the differences, as well as the possible sources of errors that would arise in a CFD simulations when conventional single-phase and multi-phase equilibrium RG thermodynamics are employed: an area of research that despite the active interest in many communities (especially CFD), has not been completely understood.

Knowledge of the effects that multi-phase RG thermodynamics with the assumption of vapor-liquid equilibrium (VLE) can have on a flow dynamics is important because it establishes the relevance of the fully coupled CFD-VLE solver that goes beyond the stand-alone calculation of a multi-phase condition, providing important insights about the physics that may not be captured if the single-phase assumption is invoked at all the time. This work provides an extensive study or RG mixtures from a physical and numerical point of view. The difficulties associated with their modeling are discussed in detail and solutions are provided accordingly. The resulting model is applied to non-reacting and reacting flows of canonical setups where emphasis is devoted to the discussion of the differences and sources of errors that would occur if this multi-phase behavior is not taken into account. Results show that the different thermodynamic states reached by this advanced model can have an impact on the flow physics, especially in a non-reacting (or more in general cold) regime.

Committee:

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