SIAM CONFERENCE ON NUMERICAL COMBUSTION 2017

April 3-5, 2017

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Portable Tabulation for Thermochemical and Radiation Properties in Combustion Simulations

# Abstract

Tabulation is common in combustion applications to reduce computational time by performing expensive calculations a priori and looking up tabulated results during the CFD simulation. We present two open-source libraries that perform tabulation of thermochemical properties as well as radiative properties. The thermochemical tabulation library (TabProps) supports one to five independent variables and a variety of thermochemical models including flame sheet, equilibrium (adiabatic and with heat loss), steady laminar flamelets, etc. The radiative properly library (RadProps) provides grey gas property calculations for reacting gas mixtures over a wide range of temperatures and compositions. These libraries support various order of interpolants based on Lagrange polynomials. In addition, derivative calculations are also provided to enable Jacobian information to be obtained from the tabulated quantities. Both libraries support CPU and GPU calculations. We present performance results for these libraries, showing significant speedups on GPU of up to 120x over serial CPU calculations for table retrieval.

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