The tabulated Premixed Conditional Moment Closure (Tâ€“PCMC) method has shown the capability to predict turbulent, premixed methane flames with detailed chemistry and reasonable run times in a RANS environment. Here the Tâ€“PCMC method is extended in a Large Eddy Simulation (LES) framework for non-adiabatic premixed flames, allowing heat loss to occur in the mixture before, during and after combustion. It is proposed that the LES framework is a more suitable representation for both chemical and turbulent scales in premixed combustion. The LES Tâ€“PCMC model is implemented using the open source CFD software OpenFOAM for its open access to C++ source code and large library of turbulence and thermo-physical models. The proposed model is validated with PIV and Raman laser measurements of a turbulent, enclosed reacting jet from the DLR experimental group. The DLR data sets provide both unity (E.g. Methane) and non-unity (E.g. Hydrogen) Lewis number fuels, allowing for the proposed numerical model to be validated with the inclusion of differential diffusion effects in the reacting mixture. Velocity, temperature and major/minor species are compared to the experimental data. LES results match the experimental data better than the Reynolds Averaged Navier-Stokes (RANS/URANS) solution and is able to better resolve the transient features of the flame with an increase in run time of only 50%, when compared to URANS. The inclusion of heat loss in the Tâ€“PCMC model is introduced from first principles and provides better predictions of temperature and species mass fractions when compared to experimental data sets.

Major: Mechanical Engineering

Educational Career:
Bachelor's of Aerospace Engineering, BS, 2011, University of Central Florida
Master's of Aerospace Engineering, MS, 2012, University of Central Florida

Committee in Charge:
Subith Vasu, Chair, Mechanical and Aerospace Engineering
Scott Martin, Co-Chair, Aerospace Engineering
Alain Kassab, University of Central Florida
Tuhin Das, University of Central Florida

Approved for distribution by Subith Vasu, Committee Chair, on July 10, 2015.

The public is welcome to attend.