NASA SBIR/STTR Technologies

Advanced Nongray Radiation Module in the LOCI Framework For Combustion CFD

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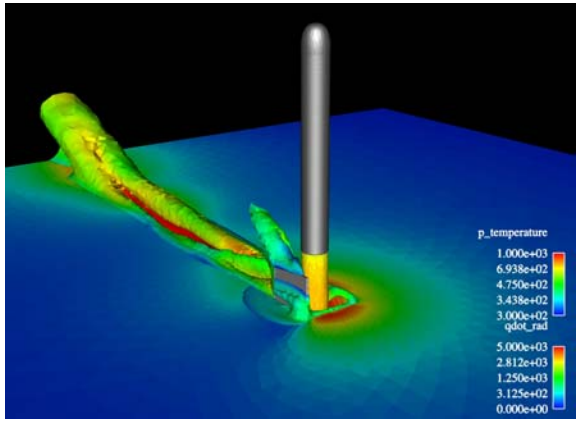
Identification and Significance of Innovation

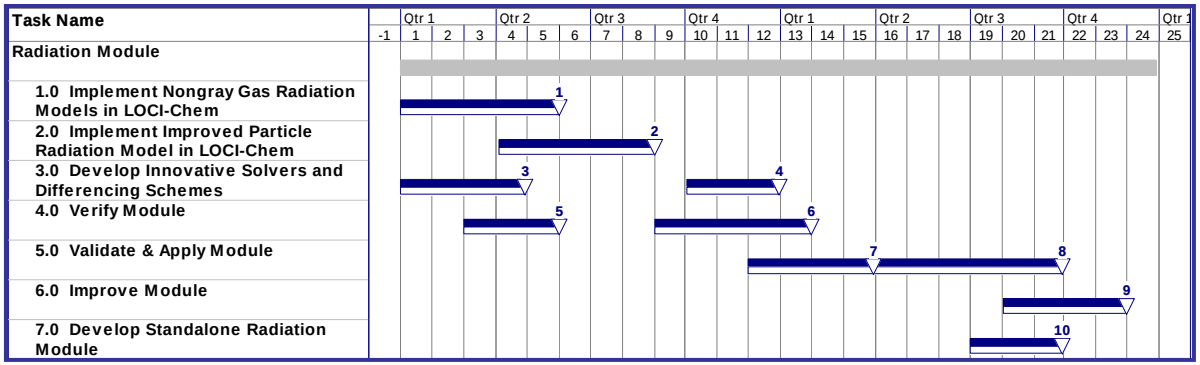
- NASA/MSFC will be lead center for designing the Ares-I and Ares-V launch vehicles for Project Constellation.
- Gaseous and particle radiative heat fluxes may contribute to launch pad heat loads and base heating of first stage of Ares-V.
- NASA cannot currently analyze radiation effects using latest multi-disciplinary CFD codes.
- CFDRC proposes to develop advanced radiation module for LOCI-Chem CFD code, in partnership with Mississippi State University (MSU).
- In Phase I, CFDRC/MSU demonstrated feasibility of developing preliminary radiation module in LOCI-Chem.



Radiative Heat Flux and Particle Temperature Contours for Phase I Demo Rocket Case, Obtained with LOCI-Chem/Radiation

Technical Objectives

- Develop and implement improved nongray gas and particle radiation models;
- Implement innovative linear system solvers, higher order differencing schemes and quantitative characterization of model uncertainties;
- Verify radiation module using Method of Manufactured Solutions (MMS);
- Validate and apply the LOCI-Chem/Radiation software to Ares-V Challenges.



NASA Applications

- Improved design of launch pads for Ares rockets.
- Improved predictions of multiple plume environments, including gas-generator dumps, RSRM-V plume and overall heat transfer to the base of Ares-V first stage.
- Improved prediction of heat loading to combustor and nozzle walls due to radiation.

Non-NASA Applications

- Radiation module will enable rocket technology development by universities and engine manufacturers. Support letters, program participation from ATK and P&W Rocketdyne
- Applicable to furnace, automotive and boiler industries

Subcontractors: Mississippi State University, ATK, and Pratt&Whitney Rocketdyne

NON-PROPRIETARY DATA