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Author: Dr. Jianwei LU
China Academy of Launch Vehicle Technology (CALT), China, 327971008@qq.com

ANALYSIS OF INFRARED SIGNATURE OF SPACECRAFT PROPULSION PLUME

Abstract

This study builds on a numerical procedure for obtaining an infrared signature scale law of rocket plume. Firstly, a test design scheme for determining the signature scale laws is proposed. Then, a numerical code for predicting the infrared signature is developed based on a finite volume method. In this method, a three-dimensional radiation transfer equation with gas mixtures is employed. To validate the solution procedure, two benchmark problems are implemented. The first one is the computation of radiative heat transfer in a finite cylinder enclosure containing absorbing-emitting medium. The second one is the computation of the infrared radiation signature from rocket plume. Both results compare favorably against published solutions. Finally, according to the test design scheme, the numerical tests with various flight altitude and plume geometric size are implemented, and furthermore, the plume infrared signature scale laws as functions of flight altitude and plume geometric size are obtained by fitting method. The results can be used as a practical guide for plume infrared application.