COMPARISON OF RADIATIVE HEAT TRANSFER MODELS FOR THE MARTIAN RE-ENTRY VEHICLE

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ABSTRACT. The Imaginary Plane Method (IPM) has been implemented within the framework of OpenFOAM software. This code has the capability to solve the radiative heat transfer for any arbitrary three-dimensional geometry. The Monte Carlo Method (MCM) is employed to calculate the direct exchange areas in an absorbing non-gray nonhomogeneous medium with gray walls. This study involves the calculation of heat flux due to radiation over the Martian Crew Exploration Vehicle (CEV). The chemical composition of the Martian atmosphere during re-entry has been determined to 98.07% CO_2 and 1.93% of N_2 gases [1]. The main radiative species in the Martian atmosphere is CO with CO^{4+} band as the strongest source of emission and absorption of radiative energy. For gray gases, the calculated heat flux using the IPM is compared with the existing and well-known methods such as the method of spherical harmonics (P_1)[2]. During the re-entry process in the atmosphere, the shock layer contains gases like CO_2, CO, C, O, and others. The CO_2 and CO gases absorb and emit radiation over a range of narrow spectral lines. The absorption coefficient of these gases varies with temperature. For non-gray gases in an inhomogeneous medium, the value of heat flux will be calculated using the P_1 and the IPM method with the *k*-distribution model [3]. The figure 1 shows the temperature profile over the CEV entering the Martian atmosphere.

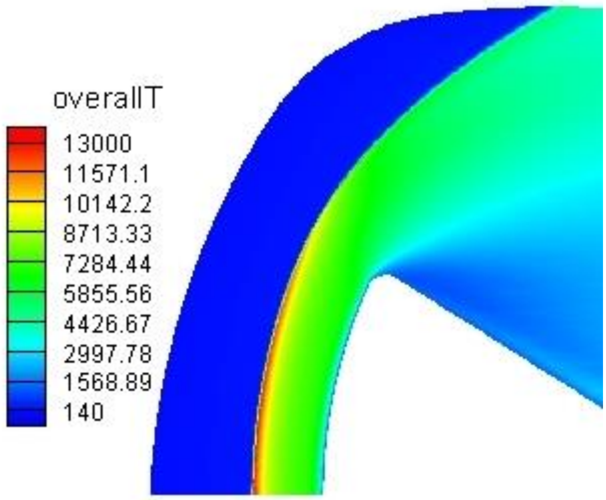

Figure 1. Temperature profile over CEV in the Martian atmosphere

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