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Investigation of Rarefied Open Cavity Flows in all Rarefaction Regimes using DSMC Method DEEPAK NABAPURE, RAM CHANDRA MURTHY K, BITS-Pilani, Hyderabad campus, Hyderabad, India — The hypersonic re-entry vehicles often encounter different rarefaction regimes during their flight. The flow field around them is generally investigated using the Direct Simulation Monte Carlo (DSMC) method. Surface discontinuities in the form of protuberances, notches, steps, cavities or gaps occur on various surfaces of the hypersonic re-entry vehicles. These surface anomalies can in turn increase the thermal and aerodynamic loads and hence are a major focus of the aerospace industry. Thus, there is a need to accurately estimate these loads which help in the safe design of the re-entry vehicles. The flow over an open cavity is one such anomaly with a simple geometry. The present work analyses the rarefied flow of non-reacting air over an open cavity using the DSMC method. Two-dimensional simulations are carried out for various Mach numbers ($Ma = 5, 10, 25, 30$), dimensionless cavity wall temperatures ($T_w/T_\infty = 1, 2, 4, 8$) and rarefaction regimes ($Kn = 0.05, 0.1, 1, 10, 20$) using *dsmcFoam* solver, based on the framework of OpenFOAM. The effects of Mach number, cavity wall temperature and rarefaction on the physics of the problem are illustrated. The flow and aerodynamic properties are found to depend strongly on Ma and Kn and rather weakly on T_w/T_∞ .

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