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A NOVEL THERMAL PROTECTION SYSTEM VIA OPPOSING JET ARRAYS FOR REUSABLE REENTRY VEHICLES

Abstract

The reusable thermal protection design for a reentry vehicle is a huge challenge and key technology in hypersonic technology development. Usually, the nose ang flap leading edge will endure severe aerodynamic heating environment during reentry, where the ablative thermal protection systems are applied. A novel thermal protection system via opposing jet arrays is proposed to improve the thermal protection performance in such critical regions. An injector array model is constructed with small scale holes in the nose and flap of a concept vehicle. To begin with, the influence of key relevant parameters, the Mach and Reynolds numbers of the freestream, the jet blowing ratio, the jet gas specie, and the injection hole geometry, is examined using numerical simulation. Then, the injection array configuration is optimized based on the commutation analysis. Furthermore, a light non-ablative thermal protection structure is developed via opposing injectors. Finally, the novel thermal protection system performance is evaluated through thermal-mechanical coupling analysis. It is proposed that the new approach has potential applications in thermal protection system of reusable reentry vehicles.