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PARAMETER FLUCTUATION EFFECTS OF BLUNT-NOSED REENTRY PLASMA SHEATH ON ELECTROMAGNETIC WAVE PROPAGATION

Abstract

Parameter fluctuations of the reentry plasma sheath can affect the propagation of Electromagnetic waves. The relations between parameter fluctuations and the propagation of Electromagnetic waves are analyzed and the effects are studied using methods derived by synthesizing the compressible turbulent flow theory, plasma theory, and electromagnetic wave theory together. Adopting stratified modeling method, such effects on wave propagation at S-band and Ka-band during a typical reentry process (RAM C-II reentry process) are studied. Take the electron density as measurement. The reentry plasma condition can be divided into three states, the low electron density state (N_e=10^9cm^{-3} as example), the middle electron density state (N_e=10^{11}cm^{-3} as example) and the high electron density state (N_e=10^{13}cm^{-3} as example). Thus, the simulation results show that, at S-band, the effects of parameter fluctuations on the reflected properties are obvious when electron density are low and the effects on the transmission properties are obvious when electron density are middle and high. While at Ka-band, the effects on the reflected properties are obvious in low and middle electron density states and the effects on the transmission properties are obvious in high electron density state. In most cases, the effects increase with the parameter fluctuations. The effects on the transmission properties are significantly larger than that of the reflection properties. Besides, the effects at different altitudes during the reentry process are also studied. At S-band, the effects are most obvious when the altitude is about 50 km, while Ka-band is at 30 km. The studies above indicate that the parameter fluctuations can affect the wave propagation significantly under proper conditions. And the extent of the effects vary with the plasma conditions. This suggests that the communication links between the reentry vehicles and the base stations could be susceptible to the plasma parameter fluctuations, and the effects should be taken into careful consideration in order to mitigate the blackout.