

Flow Field Characteristics for Parachute-projectile System

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Abstract: In the current research for parachute flow field nowadays, the size of parachutes in previous research are so large compared with their carriers that the effects of the carriers wake flow to parachute are always neglected. Different from such large parachutes, the parachute size in this paper is on the same magnitude with the carrier, thus, the carrier can obviously affect the parachute flow field. In this paper, flow field characteristics of small parachute for projectile decelerating are researched through two approaches, namely, computational fluid dynamics (CFD) simulation and wind tunnel tests. Three parachutes with various sizes are chosen for study. Firstly, the CFD simulation of flow field around these parachutes is carried out, and then the CFD simulation of parachute-projectile systems is executed. According to the simulation results, the phenomenon is observed that in the simulations of parachutes there are two vortex-rings at the wind shadow of parachutes, however, in the second simulations of parachute-projectile systems, two additional vortex-rings emerge inside the parachutes. Due to these two inner vortex-rings, the pressure inside parachutes decreases. As a result, the drag of parachute in simulation of parachute-projectile systems is about 20% smaller compared with the prior one. In order to verify the numerical results of CFD simulations, wind tunnel tests are employed. In terms of the data of the wind tunnel tests, the CFD simulation for flow field characteristics is reasonable and feasible. The results of both CFD simulation and wind tunnel tests demonstrated the influence of projectile wake flow to parachute drag can not be neglected if the parachute size is on the same magnitude with projectile. The influence to parachute drag from the ratio of projectile diameter to parachute diameter is also analyzed both in CFD simulations and wind tunnel tests. The approach combined CFD simulation and wind tunnel tests proposed can be used to guide the design of such parachute whose size is on the same magnitude with carrier.

Key words: parachute, projectile, flow field, computational fluid dynamics (CFD), wind tunnel test

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