A LOW-DENSITY WIND TUNNEL FOR MARTIAN ENVIRONMENT SIMULATION

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ABSTRACT

With development of space science and further explore to deep space, Mars has been becoming an important stop for the space activities due to its some similar characteristics to those of the earth. However, there are many big challenges for spacecraft and also humans travelling to Mars due to its severe environments as low pressure atmosphere with the main composition of CO\(_2\), large wind field and dust storm, low temperature, et al. Thus in order to overcome the challenges for safe operation of the equipment, it is critical to understand thoroughly the Martian environmental effects using the newly designed Martian environment simulator for the coming years. As to the special environment of wind field and dust storm, a low-density wind tunnel has been designed and constructed at Harbin Institute of Technology for Martian environment simulation, which will be set in the context of current and future missions to the Martian surface. This work was part of the Space Environment Simulation and Research Infrastructure (SESRI), the National Large Scale Scientific Facilities in China. The wind tunnel is driven by ejector and capable of providing controllable wind flow of air or carbonan dioxide or other specific gas, at Martian pressures (100–1500Pa), wind speeds (5–100 m/s) and dust aerosol suspension using Mars analogue materials. Crucial design features including mechanical design, ejector driven system, pressure control system, dust injection system and balance system will be presented. The ejector driven system could be used to achieve the maximum flow velocity up to 100m/s for both low pressure gas and the blended dusts. The balance system can be used to achieve the maximum flow velocity up to 100m/s for both low pressure gas and the blended dusts. The balance system can be used to achieve the maximum flow velocity up to 100m/s for both low pressure gas and the blended dusts.粒子的移动和浓度的实时监测是通过使用PIV系统来完成的。气固两相流动场的计算模型和技术被用来验证实验数据。粒子移动的实验数据被用来评估风力对火星表面的影响。最后，马格努斯效应的模型可以用来预测风力对火星表面的影响。