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大迎角细长体侧向力的比例控制

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Proportional Side Force Control of Slender Body at High Angle of Attack

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摘要

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摘要 介绍了一种新的大迎角细长旋成体侧向力的比例控制技术。通过在细长旋成体头部施加非正常小扰动,可以对细长旋成体非对称背涡的非对称程度进行比例控制。风洞试验研究结果表明,该控制方法能以很小的能量输入将大小和方向随机变化的侧向力加以精确控制;不仅可以控制侧向力的方向,也可以连续改变侧向力的大小,使其变成有利于飞行控制的气动力和力矩,达到变不利为有利的目的。

关键词: 前体涡控制 侧向力控制 非正常扰动 细长旋成体 大迎角 流场测量 粒子图像激光测速仪

Abstract: A new proportional side forces control technique of slender body at high angle of attack is developed. The effectiveness of the fast-swinging mini-tip strake technique for controlling forebody vortices at high angle of attack is investigated in low-speed wind tunnel experiments on a slender body of revolution with pointed nose configuration. Test results show that, at high angles of attack ($30^\circ < \alpha < 70^\circ$), the new method can make an efficient proportional control of side force with very low input power levels. The instantaneous cross plane flow field on the lee-ward of the forebody is measured by Particle Image Velocimetry (PIV), and the vorticity map and the velocity vector map reveal that the positions of forebody vortices can be manipulated under the control of unsteady micro perturbation. In this way, the yawing moment generated by the forebody vortices provides directional control of high-performance aircraft at high angle of attack.

Keywords: forebody vortices control side forces control unsteady perturbation slender body high angle of attack flow field measurements PIV

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