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结冰计算中翼面网格重构研究

孙志国, 朱程香, 付斌, 朱春玲

南京航空航天大学 航空宇航学院, 江苏 南京 210016

Research of Grid Reconstruction on Wing Surfaces for Icing Calculation

SUN Zhiguo, ZHU Chengxiang, FU Bin, ZHU Chunling

College of Aerospace Engineering, Nanjing University of Aeronautics and Astronautics, Nanjing 210016, China

摘要 对结冰数值计算中的网格生成进行了深入研究,针对结冰后几何边界的复杂性及边界依赖于时间步长变化对网格生成的影响展开了分析。网格生成是结冰计算的基础,文中基于求解椭圆形偏微分方程(PDEs)生成了未结冰时翼面周围的背景网格,采用Hilgenstock源项构造方法,合理控制了结冰边界周围的网格间距和正交性。模型表面结冰后,为了提高网格生成的效率、质量及可靠性,完成复杂冰形上的网格重构,提出了椭圆形、扇形分区及网格局部重构思想,同时保持分区内的网格拓扑结构不变、流场局部更新。最后将网格模块NI-GRID集成于结冰计算软件NUAA-ICE3D中,并对二维翼型和三维机翼的网格生成与重构进行了验证。

关键词: 结冰代码 网格重构 贴体网格 控制源项 网格分区 机翼

Abstract: This article studies grid generation for the calculation of airfoil ice accretion; in particular, it analyzes how to deal with the effect brought by geometrically complex and time-dependent leading edge accretion. As the first step of icing calculation, a grid is generated by solving the elliptic partial differential equations(PDEs). The forcing terms are automatically chosen in the manner of Hilgenstock method such that orthogonality and spacing control on the icing smoothed boundary are achieved. In order to improve the efficiency, quality and reliability of grids, two partition ideas and grid reconstruction methods are introduced and validated simultaneously. Finally, validation of the usefulness of the method developed is completed on two and three dimensional airfoils using the NUAA-ICE3D software, which has integrated the grid modules.

Keywords: ice accretion code grid reconstruction body-fitted grid forcing function terms grid partition aifoils

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