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三维机翼结冰模拟

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Ice Accretion Simulation on Three Dimensional Wings

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摘要 针对机翼结冰问题,利用欧拉法求解空气水滴两相流流场,通过Fluent软件用户自定义函数功能编程求解三维机翼表面水滴局部收集系数以及结冰情况。在计算中,将水溢流方向沿机翼弦向和展向分解,以此对Messinger结冰热力学模型进行改进,使之更符合三维情况,并在此基础上进行三维传质传热分析;修正传统的二维表面对流换热系数求解方法,得到求解三维表面对流换热系数的改进方法。采用沿壁面法向结冰的方式进行冰生长计算,通过与国外冰风洞试验结果及结冰计算软件LEWICE结果的比较,证明本文三维结冰计算方法是正确的。

关键词： 机翼结冰　结冰模拟　欧拉法　对流换热系数　三维水滴撞击特性

Abstract： For wing ice accretion problem,Euler method is used in calculating the air-water two-phase flow field. With the help of the Fluent's user defined function, the water local collection coefficient and ice accretion on three dimensional wings are solved. During the computation process, water runback is divided along the chordwise and spanwise direction and the classical Messinger model is modified to fit the three dimensional airfoil; the analysis of three dimensional mass and heat transfer is also investigated according to this new model. Based on the traditional method of calculating heat transfer coefficient on two dimensional surfaces, an improved method is proposed to compute the heat transfer coefficient on three dimensional wings. Ice accretion is along the direction normal to the surface. According to the comparison of the calculated results with test results of icing tunnel abroad and those of software LEWICE, the computation method in this article is proved to be effective.

Keywords： wing ice accretion　ice accretion simulation　Euler method　heat transfer coefficients　three dimensional characteristic of water impingement

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