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基于动态嵌套网格技术的微型共轴式双旋翼流场的数值模拟

陆幸均，李孝伟

（上海大学 上海市应用数学和力学研究所，上海 200072）

Numerical Simulation of Flows over Micro-coaxial Rotor Based on Moving Overlapped Grids

(Shanghai Institute of Applied Mathematics and Mechanics, Shanghai University, Shanghai 200072, China)

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摘要 运用动态嵌套网格技术和双时间推进算法，对微型共轴式双旋翼的非定常粘性绕流进行数值模拟和研究.针对上、下两层旋翼间距离较小和流动粘性影响较大的特点，在动态嵌套网格技术的基础上引入滑移网格技术，保证了流动信息交换的准确性.首先，模拟低雷诺数下单旋翼的流动，结果与实验数据吻合较好，验证了算法的有效性；然后，利用该方法实现对微型共轴式双旋翼流场的数值模拟.结果表明，微型共轴式双旋翼流场中，桨尖涡起主要作用，其以螺旋方式向下运动，同时与周期性运动的旋翼相互作用，使得作用在旋翼上的总体拉力呈现出周期性的变化规律.

关键词： 微型共轴式旋翼 动态嵌套网格 滑移网格

Abstract： Unsteady viscous flows of a micro coaxial rotor are simulated and studied using moving overlapped grids and the dual time stepping method. We discuss the small space between the up- and down-rotor and large flow viscosity, and introduce a sliding mesh based on moving overlapped grids, which ensure accurate exchange of flow information. Micro-single rotor flows with a low Reynolds number are calculated. The results are consistent with experimental results, showing effectiveness of the algorithm. Micro coaxial rotor flows are then simulated with this method. The results indicate that the blade tip vortex, which moves down in a spiral way, plays a leading role in micro coaxial rotor flows. It makes the total thrust of the rotor periodic due to its interaction with the rotary rotor.

Keywords： micro-coaxial rotor， moving overlapped grids， sliding mesh

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