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螺旋桨黏性流场非定常数值模拟

Unsteady numerical simulation of the viscous flow fields of the propeller

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英文关键词:propeller viscous flow fields unsteady structure of the wake field axis velocity

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中文摘要:

基于多块结构滑移网格，采用多参考系模型（MFR），对某六叶螺旋桨黏性流场进行了非定常数值模拟.分别建立包围螺旋桨的旋转区域和螺旋桨以外的静止区域，很好地解决了螺旋桨的相对旋转问题.计算结果与实验结果吻合良好，验证了计算方法的正确性.对前进比为0.90和0.75情况下的桨后复杂流场进行分析，得到了螺旋桨尾涡的一些静态和动态特征，螺旋桨尾涡中包含正负两层，与实验观察到的现象一致.获得了螺旋桨对桨后轴向速度分布的影响规律：螺旋桨对桨叶45%和70%半径处轴向速度增加远大于90%半径处轴向速度；随前进比减小，该区域内轴向速度继续增加，90%半径处轴向速度几乎不变.

英文摘要:

The viscous flow fields of a propeller with six blades have been numerically simulated with unsteady N-S equations based on structured sliding grids of multiple blocks. The rotational subzone containing the propeller and the stationary subzone was constructed separately based on MFR(multiple frames of reference),proving this is an effective approach to resolve the problems involving relative rotation of the propeller. The data of the calculation and the experiment agreed very well and proved that the method had good accuracy to simulate the fluids of a propeller. Then the complicated flow fields behind the propeller with advanced ratio of 0.90 and 0.75 were analyzed, and the static and dynamic features of the propeller trailing vortex the same as the phenomenon in the test were achieved: two opposite layers were incorporated into the propeller trailing vortex. The rules influenced by the propeller on the axial velocity were obtained: the increase of the income flow velocity in the area of 45% and 70% of the radius of the blade after the propeller is larger than the area of 90% of the radius; with the decrease of the advance ratio, the axial velocity still increases, and the area of the 90% of the radius almost keep unchanged.

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