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基于Kriging模型的翼型气动性能优化设计

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Aerodynamic Optimization Design for Airfoil Based on Kriging Model

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摘要

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摘要 将基于Kriging模型的近似技术引入气动优化设计。通过计算两个测试函数的全局极值以及翼型几何形状的重构,比较了基于Kriging模型的优化方法与传统的梯度类优化方法、标准遗传算法的特点。结果表明基于近似模型的优化方法不仅全局性良好,而且有效节约了计算资源。用此方法进行了翼型的气动优化设计,目标函数为来流马赫数为0.7、攻角为3°时升阻比最大。设计结果表明,与参考翼型相比,优化翼型升阻比提高了81%,而翼型截面积减少不到1%,优化效果非常明显。

关键词: 空气动力学 优化设计 Kriging模型 试验设计

Abstract: The approximation technology based on Kriging model is applied to the aerodynamic optimization design. The characteristics of the optimization method based on the approximation technology, the traditional gradient-based search algorithm and the standard genetic algorithm are studied, through calculating global extreme of two test functions and re-constructing the geometry of airfoil. The result shows that the optimization method based on approximation technology has good global performance and also can greatly save the calculating resources. This method is applied to the aerodynamic optimization design of airfoil, defining the lift-drag ratio as the goal function, when Mach number is 0.7 and the angle of attack is 3°. The application indicates that the lift-drag ratio of optimized airfoil is increased by 81% comparing with the original airfoil, and the cross section area of the optimized airfoil is decreased less than 1%.

Keywords: aerodynamics optimization design Kriging model design of experiments

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