

水田驱动叶轮仿生叶片机理数值模拟分析

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关键词: 仿生学 牛蹄 水田驱动叶轮 仿生叶片 数值模拟

摘要: 根据水牛蹄独有的几何外形适于水田等松软地面行走和行走阻力低的特性,运用逆向工程技术提取仿生信息,并设计水田叶轮仿生叶片。通过数值模拟的方法研究仿生叶片性能改善的机理,以进一步指导叶轮的设计。仿生叶片与平面单叶片轮叶的计算机模拟对比分析表明,仿生叶片提高推进力的机理主要为:有效延缓叶片表面流体速度突变造成的流体介质冲击与分离,减小分离流对叶片的撞击阻力,提高叶轮驱动力;仿生叶片可增加叶片驱动扭矩,使叶轮驱动力增加。The particular geometric shape of the buffalo hoof is suitable for walking on the paddy-field and has low resistance during working. The bionic information of the buffalo hoof was extracted by reverse engineering technology, and then the bionic blade for paddy-field impeller was designed. To guide the design of paddy impeller, the mechanism of performance improvement of bionic blade was studied by numerical simulation. The simulation results show that the fluid medium impact and separation of blade surface fluid velocity mutation can be delayed by the bionic shape effectively. The bionic shape can reduce impact endurance test resistance of the separated flow, and improve the driving force of impeller. Moreover, the bionic blade may increase its driving torque.

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