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轴流风机仿生叶片降噪试验研究及机理分析

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摘要 根据长耳鸮翼前缘非光滑形态降噪特性，设计了仿生前缘非光滑轴流风机叶片。试验研究表明：仿生非光滑叶片在50～2000 Hz的频段上噪声值明显小于原型风机叶片，最大降噪率为2.52 %；影响仿生非光滑叶片降噪效果的主次因素为非光滑单元间距t、非光滑单元高度h和非光滑单元个数。计算机模拟分析表明，
仿生前缘非光滑形态降噪机理主要为：减少翼型表面紊流附面层压力脉动并延缓翼型后部涡流分离脱落；有效减少气流流经前后翼型表面时翼型间扰流作用，起到良好的导流作用，使后翼型来流平稳，气流噪声降低。

关键词 工程仿生学,非光滑表面,噪声测试,轴流风机,降噪机理分析

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Experimental research on noise reduction of bionic axial fan blade and mechanism analysis

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Abstract According to the fact that the long eared owl wing with non smooth leading edge demonstrates a remarkable reduction of the flight noise a kind of bionic axial fan blade with non smooth leading edge was designed. The pilot experiments show that the noise level of the bionic non smooth blade in the 50~2000 Hz frequency range is remarkable lower than that of the prototype blade, the maximal noise reduction rate is 2.52%. The factors affecting the noise reduction of the bionic non smooth blade are in the order of importance as follows:the interval, the height and the number of the non smooth element. The computer simulation analysis shows that the noise reduction mechanism of the non smooth leading morphology consists in the reducing the airfoil surface turbulent boundary layer pressure pulsation, retarding the rear airfoil shedding vortex separation, reducing the chaos airflow among the airfoils, thus rectifying the flow around the subsequent airfoil to control the turbulence breakaway, all these results in reduction of the turbulent flow noise.

Key words engineering bionics non smooth surface noise measurement axial fan noise reduction mechanism

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