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Three-Dimensional Compressor Blading Design Improvements in Low-Speed Model Testing

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Abstract

Low-speed model testing (LSMT) plays a key role in multistage axial-compressor design due to that utilizations of low-speed large-scale compressor to perform three-dimensional (3D) blading design are fast, convenient and cost-saving. This paper mainly focuses on numerical investigations of 3D blading improvements for LSMT with several design techniques. Firstly, numerical method is verified with existed experimental data. Then, revised techniques for both of the rotor and stator are presented, involving circumferential stacking principles, compressor blade row matching, loaded leading edge (LE) and unloaded trailing edge (TE), and bowed stator technology, *et al*. The flow mechanisms for these techniques are briefly discussed. The final revised scheme for the model stage (the 3rd stage) is determined with abovementioned methods. Flow loss near the hub are largely alleviated for the revised stage, the efficiency for the model stage and corresponding compressor are raised by 2.2% and 0.5% at design point, while stable operating range is slightly widen.

Keywords

Axial flow compressors, Low-speed model testing, Blading improvement, 3D stacking, Loaded LE, Unloaded TE

Introduction

The core compressor plays a vital role in the development of modern gas turbine engines, so thorough understanding of its internal complex flow field and flow mechanism will certainly improve the design capacity of high-performance compressors. In consideration of its advantages of great accuracy, low cost and risk, LSMT [1] evolves into an important means to the aerodynamic investigations of subsonic stages in high pressure compressors, such as new blading design and flow loss mechanism investigations.