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MODELLING OF LOW-REYNOLDS-NUMBER CENTRIFUGAL COMPRESSORS: CHALLENGES IN PERFORMANCE AND FLOW CONTROL PREDICTION

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A low-Reynolds-number causes a performance deterioration in centrifugal compressors due to the relative increase in boundary layer thickness, tip clearance, and surface roughness. The degradation of the efficiency can be estimated by empirical correlations, and they provide a good foundation for evaluating the accuracy of the numerical models. In order to improve the compressor performance, four passive flow control methods, grooves, riblets, squealers and winglets have been proposed to be the most promising ones. However, to accurately simulate their influence on low-Reynolds-number machines, the specific modelling requirements should be understood. This study compares the accuracy of numerical predictions relative to an empirical correlation with a changing Reynolds number for two centrifugal compressors. In addition, challenges and possibilities in the modelling of the most promising flow control methods are analysed and discussed.

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