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Performance Improvement in a Micro Compressor for Micro Gas Turbine Using Computational Fluid Dynamics

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Abstract : Micro gas turbine (MGT) nowadays has a wide variety of applications from drones to hybrid electric vehicles. As microfabrication technology getting better, the size of MGT is getting smaller. Overall performance of MGT is dependent on the individual components. Each component's performance is dependent and interrelated with another component. Therefore, careful consideration needs to be given to each and every individual component of MGT. In this study, the focus is on improving the performance of the compressor in order to improve the overall performance of MGT. Computational Fluid Dynamics (CFD) is being performed using the software FLUENT to analyze the design of a micro compressor. Operating parameters like mass flow rate and RPM, and design parameters like inner blade angle (IBA), outer blade angle (OBA), blade thickness and number of blades are varied to study its effect on the performance of the compressor. Pressure ratio is used as a tool to measure the performance of the compressor. Higher the pressure ratio, better the design is. In the study, target mass flow rate is 0.2 g/s and RPM to be less than or equal to 900,000. So far, a pressure ratio of above 3 has been achieved at 0.2 g/s mass flow rate with 5 rotor blades, 0.36 mm blade thickness, 94.25 degrees OBA and 10.46 degrees IBA. The design in this study differs from a regular centrifugal compressor used in conventional gas turbines such that compressor is designed keeping in mind ease of manufacturability. So, this study proposes a compressor design which has a good pressure ratio, and at the same time, it is easy to manufacture using current microfabrication technologies.

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