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Design Optimization of a Micro Compressor for Micro Gas Turbine Using Computational Fluid Dynamics

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Abstract : The use of Micro Gas Turbine (MGT) as the engine in Unmanned Aerobic Vehicles (UAVs) and power source in Robotics is widespread these days. Research has been conducted in the past decade or so to improve the performance of different components of MGT. This type of engine has interrelated components which have non-linear characteristics. Therefore, the overall engine performance depends on the individual engine element's performance. Computational Fluid Dynamics (CFD) is one of the simulation method tools used to analyze or even optimize MGT system performance. In this study, the compressor of the MGT is designed, and performance optimization is being done using CFD. Performance of the micro compressor is improved in order to increase the overall performance of MGT. A high value of pressure ratio is to be achieved by studying the effect of change of different operating parameters like mass flow rate and revolutions per minute (RPM) and aerodynamical and geometrical parameters on the pressure ratio of the compressor. Two types of compressor designs are considered in this study; 3D centrifugal and 'planar' designs. For a 10 mm impeller, the planar model is the simplest compressor model with the ease in manufacturability. On the other hand, 3D centrifugal model, although more efficient, is very difficult to manufacture using current microfabrication resources. Therefore, the planar model is the best-suited model for a micro compressor. So. a planar micro compressor has been designed that has a good pressure ratio, and it is easy to manufacture using current microfabrication technologies. Future work is to fabricate the compressor to get experimental results and validate the theoretical model.

Keywords : computational fluid dynamics, microfabrication, MEMS, unmanned aerobic vehicles
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