

SPACE PROPULSION SYMPOSIUM (C4)  
Hypersonic and Combined Cycle Propulsion (9)

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PRECOOLER DEVELOPMENT AND PERFORMANCE ANALYSIS OF A PRECOOLING AIR  
TURBO ROCKET ENGINE

**Abstract**

For near space aircraft, pre-cooling the incoming high temperature air is considered as an effective approach to enhance the engine performance, which potentially improves the flying speed up to Mach 6. This paper introduces a pre-cooling air turbo rocket engine (PATR) based on the conventional ATR engine. A mathematical model was built and the simulation tool was developed to evaluate the PATR engine performance. In order to investigate the pre-cooler, a specific mathematical model was built to simulate the heat transfer process and evaluate the pre-cooler's performance. Depending on the engine analysis and pre-cooler investigation, the operating parameters of pre-cooler were determined for the previous ATR engine and the pre-cooler was developed as the tube bundle structure. The existing ATR engine applied an external fuel-rich rocket as the gas-generator driving the turbo. The engine performance was analyzed with and without the pre-cooler respectively. In addition, the pre-cooler is particularly studied with CFD method to understand the flow field distribution. Next, experimental evaluations about the pre-cooler and the PATR engine will be carried out.