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PROCEEDINGS

A New Flow Regulation Strategy by Coupling Multiple Methods for High Efficiency Turbine with Wide Conditions

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ABSTRACT

In the future, the wide speed and altitude range aviation engine will have features such as "wide range of high-bypass-ratio adjustment" and "wide range of high-pressure-ratio adjustment". Therefore, its turbine will work in a very wide range of operating conditions, with a large flow regulation range. Under conditions of high-rate flow regulation, existing flow control technologies can significantly reduce turbine efficiency. To support the performance and technical specifications of future engines, their low-pressure turbines need to maintain high operational efficiency within a flow regulation range and power output range that exceed those of current aircraft engines.

This paper focuses on the low-pressure turbine of aero-engines with wide range of speeds and altitudes. By coupling two individual flow control technologies, namely adjustable guide vanes and partial admission, the study aims to reveal the internal flow characteristics and aerodynamic loss mechanisms within the turbine during high-rate flow regulation. Furthermore, it explores a new flow regulation strategy by multiple methods for high efficiency turbine with wide massflow conditions.

On the one hand, a fast simulation method for this flow coupling regulation turbine is established. On the other hand, the efficient regulation ranges and coupling methods for the two flow control technologies, namely adjustable guide vanes and partial admission, have been clearly defined. Under high-rate flow regulation, specifically when the flow rate is relatively low compared to the design point, the flow coupling regulation method significantly enhances turbine efficiency compared to other flow regulation methods. Under this coupled flow regulation method, the turbine guide vanes do not need to rotate a very large angle, thereby avoiding profile losses caused by adverse attack angle and also reducing clearance leakage losses. This technique achieves the effects of "Coupling," "high flow regulation range," and "high efficiency", providing technical support for the development of future aircraft engine turbines.

KEYWORDS

Numerical simulation; adjustable guide vanes; partial admission; variable cycle engine

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