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Modelling strategies for the prediction of hot streak generation in lean burn aeroengine combustors

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Abstract

The accurate prediction of the fluid dynamic conditions at the exit of gas turbine combustors are of paramount importance in the aero-thermal design of the aero-engine. In fact, both the heat loads and the aerodynamic performance of the high pressure turbine (HPT) are substantially affected by the entry conditions, such as velocity components, temperature and turbulence intensity.

The problem is particularly serious in new generation devices based on a lean burn concept. Compared to standard Rich-Quench-Lean (RQL) scheme, the absence of dilution jets and the use of highly swirled flows for flame stabilization make the control of combustor exit temperature distribution a complex task. Therefore, the high-fidelity prediction of the hot streak formation within the combustor, as well as its propagation through the HPT, are becoming key aspects.

In this work, different strategies for turbulence modelling are tested, mainly focusing on scale-resolving approaches such as Large-Eddy Simulation (LES) and Scale Adaptive Simulations (SAS), which are becoming increasingly popular with the availability of more powerful computational resources. At the same time, classical eddy-viscosity models based on RANS approach are considered, as they still represent the standard simulation strategy in the industrial frame-

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