

Combustor Design Optimization Using the Prometheus Design System

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ABSTRACT

Employing a novel feature recognition based approach, the Prometheus combustor design system enables geometry manipulation, automated aerothermal network analysis and automated fluid volume creation, meshing and CFD boundary condition definition irrespective of topological variations in the combustor configuration. To date the system has been demonstrated with respect to the isothermal optimisation of a combustor prediffuser shape and the cross-sectional shape of a fuel injector feed arm. The following paper extends this approach and presents the application of the system to the design optimisation of a single skin rich burn combustor module with reacting flow CFD simulations. A multi-objective design optimisation whereby dilution port diameters are varied to simultaneously reduce combustor pressure losses and achieve a target exit radial temperature distribution is presented. A multi-fidelity framework combining CFD and aerothermal network simulations for reducing the cost of pressure loss optimisations is also briefly explored.

Keywords: Combustor; Multi-objective; Multi-fidelity; Optimisation;