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PROMETHEUS: A GEOMETRY-CENTRIC OPTIMIZATION SYSTEM FOR COMBUSTOR DESIGN

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ABSTRACT

The following paper presents an overview of the Prometheus design system and its applications to gas turbine combustor design. Unlike a traditional "optimizer-centric" method, Prometheus aims to reduce both the level of workflow complexity and rework by taking a more "geometry-centric" approach to design optimization by shifting the control of script generation away from the optimization program to the computer aided design (CAD) package. Prometheus therefore enables significant geometry changes to be automatically reflected in all subsequent scripts necessary for the analysis of a combustor. Prometheus' current capabilities include automatic fluid volume generation and aero-thermal and thermo-acoustic network generation as well as automatic mesh and computational fluid dynamics (CFD) script generation.

1 INTRODUCTION

Gas turbine combustor design methodologies have evolved from "trial and error" approaches to include semi-empirical, analytical and experimental evaluation approaches [1]. Recently multidisciplinary design optimization (MDO) techniques have also begun to be applied to automatically improve a combustor design [2, 3]. While such techniques succeed in automating the design process to some extent, thereby reducing both development costs and time-to-market, some human interaction in the creation of such optimization workflows is unavoidable [4, 5] and can be quite time consuming when developing a workflow to cope with complex topology changes.

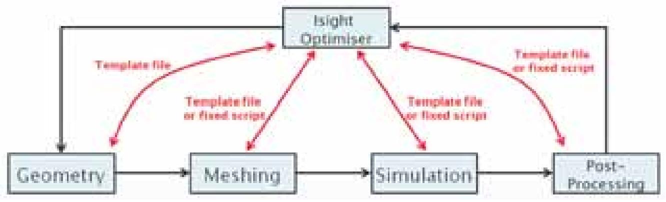
Isight Optimiser
Template file
Template file or fixed script
Template file or fixed script
Template file or fixed script
Geometry
Meshing
Simulation
Post-Processing

FIGURE 1. A TRADITIONAL OPTIMIZATION WORKFLOW

A typical traditional "optimizer-centric" optimization workflow, illustrated in Fig. 1, usually employs the optimization program to control each component and manage the generation of any necessary script files [6]. For simple design problems such an approach may be adequate, however, this "optimizer-centric" approach limits the designer's ability to consider topological changes which may, in some cases, invalidate the remaining steps in the workflow.

The optimization workflow of Kenworthy and Jensen [6], for example, requires the user to manually provide input and output files for various workflow components. The manual redefinition of each script is therefore required when considering a different topology or, alternatively, a complex system to auto-

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