

Prometheus: Embedding Knowledge & Best Practice Within CAD for Combustor Design Optimisation

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Prometheus project overview

The main goal of Prometheus research program is to develop an efficient and effective multi-disciplinary combustor design optimisation system. It aims to reduce both the level of workflow complexity and rework by taking a more “geometry centric” approach to optimisation compared to a traditional “optimiser centric” workflow. Developed using an object-oriented approach and the Siemens NXOpen API, Prometheus uses a series of feature based geometry recognition routines to allow geometry changes to be automatically reflected in any generated scripts for a variety of operations using embedded engineering knowledge and best practice. Figure 1 illustrates the traditional optimisation workflow. Figure 2 shows the Prometheus “geometry centric” optimisation workflow.

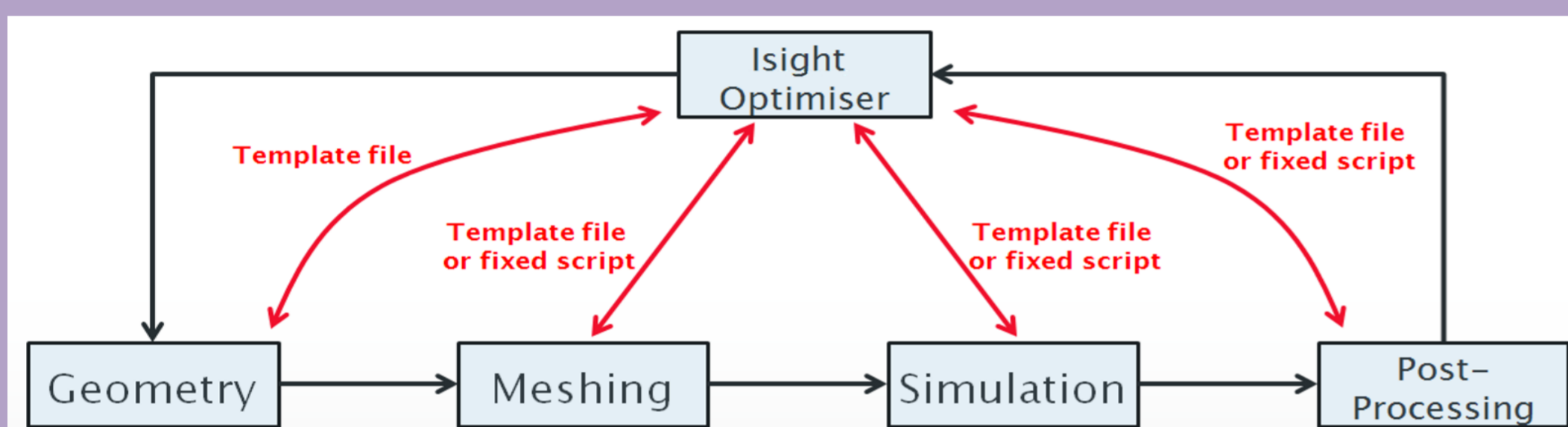


Figure 1: Traditional “optimiser centric” optimisation workflow

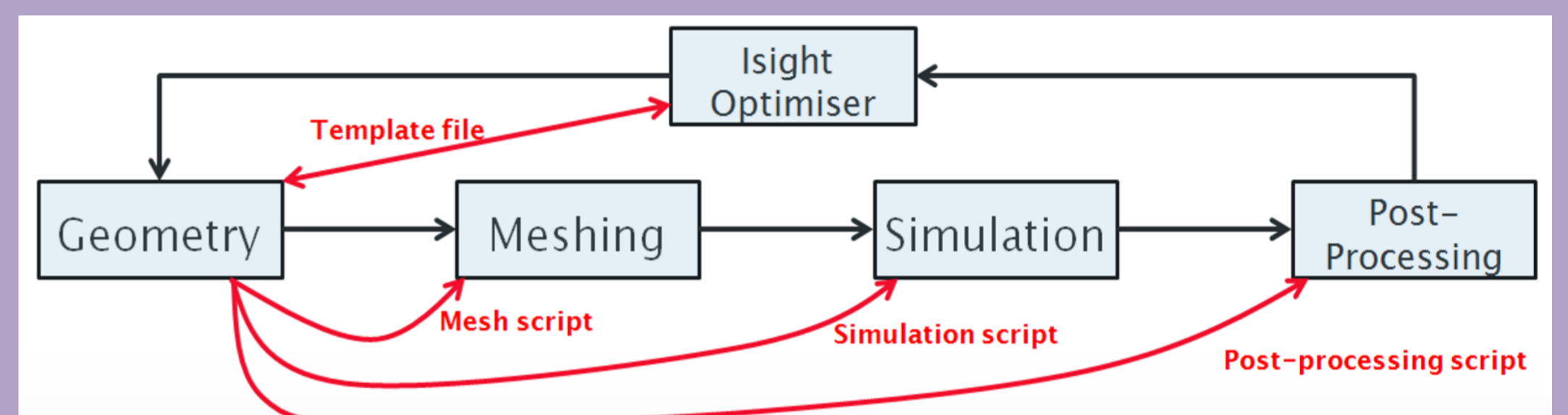
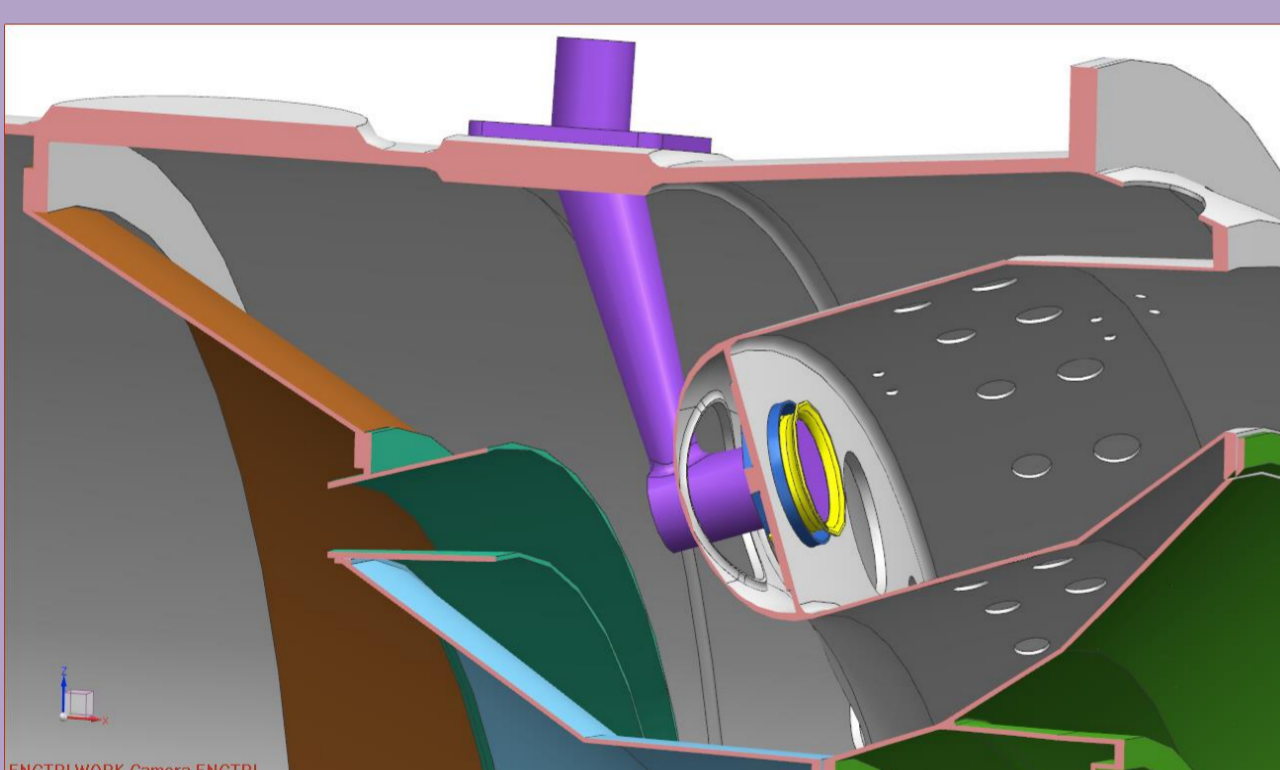


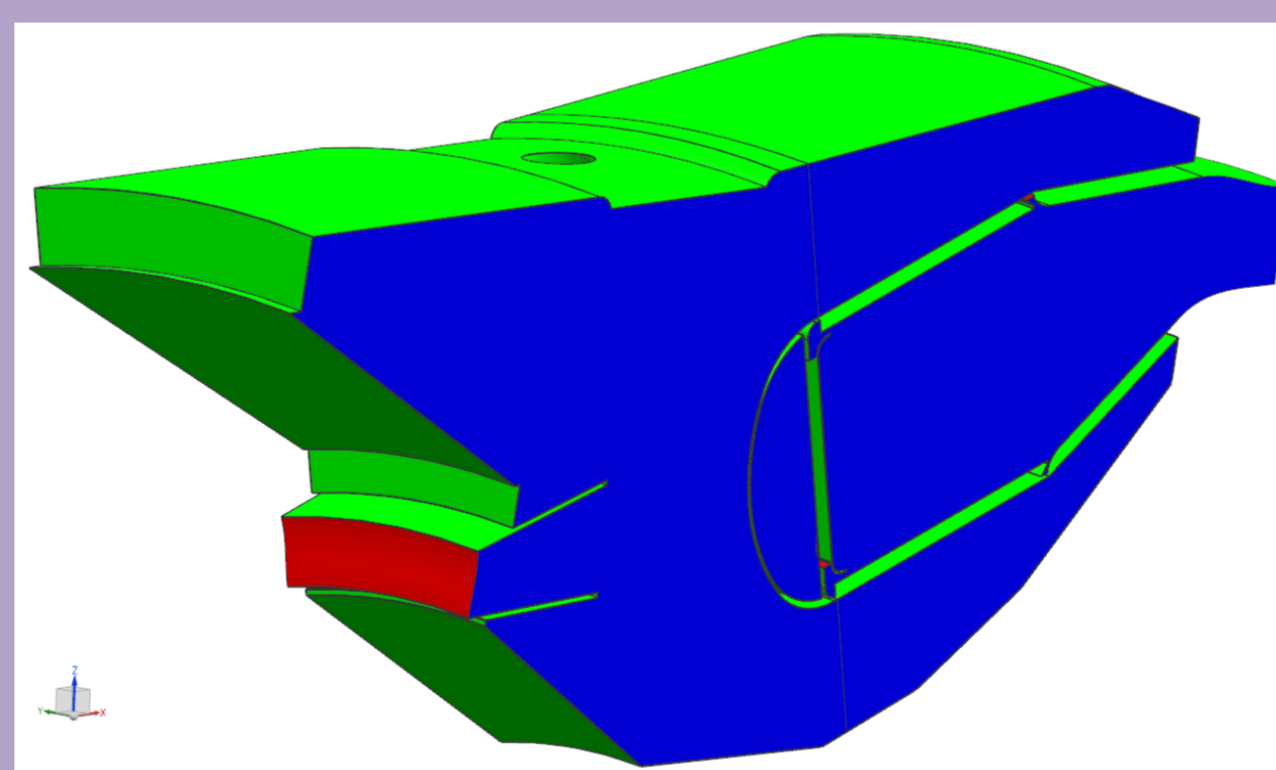
Figure 2: Prometheus “geometry centric” optimisation workflow

Current capabilities of Prometheus

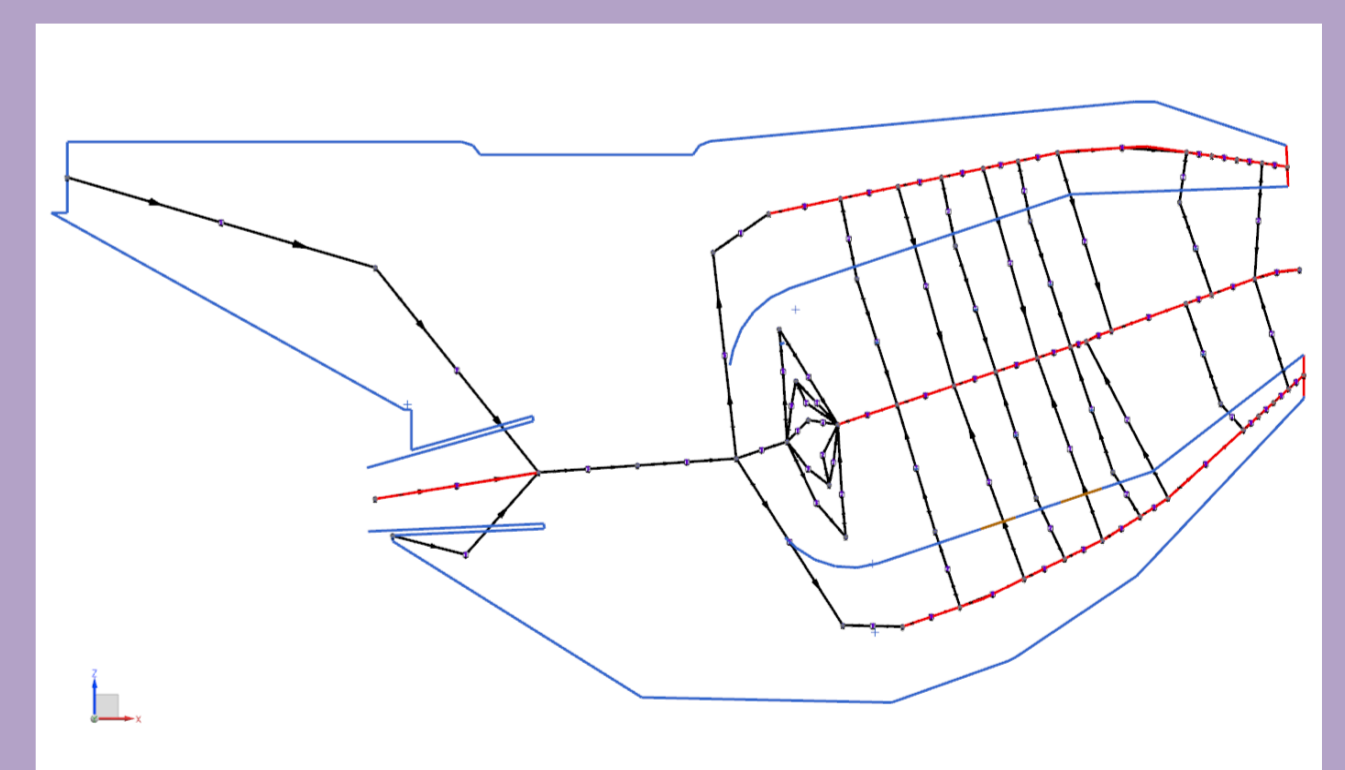
Figure 3 demonstrates the current capabilities of Prometheus within a combustor design optimisation workflow. Data from EPDS will be read in by Prometheus and used to manipulate the combustor geometry (Figure 3.a). Prometheus then automatically extracts an appropriate fluid volume for the particular combustor class (Figure 3.b), creates and solves an aerothermal network analysis (Figure 3.c), simultaneously creates scripts for meshing (Figure 3.d), combustion simulation and post-processing operations (Figure 3.e).



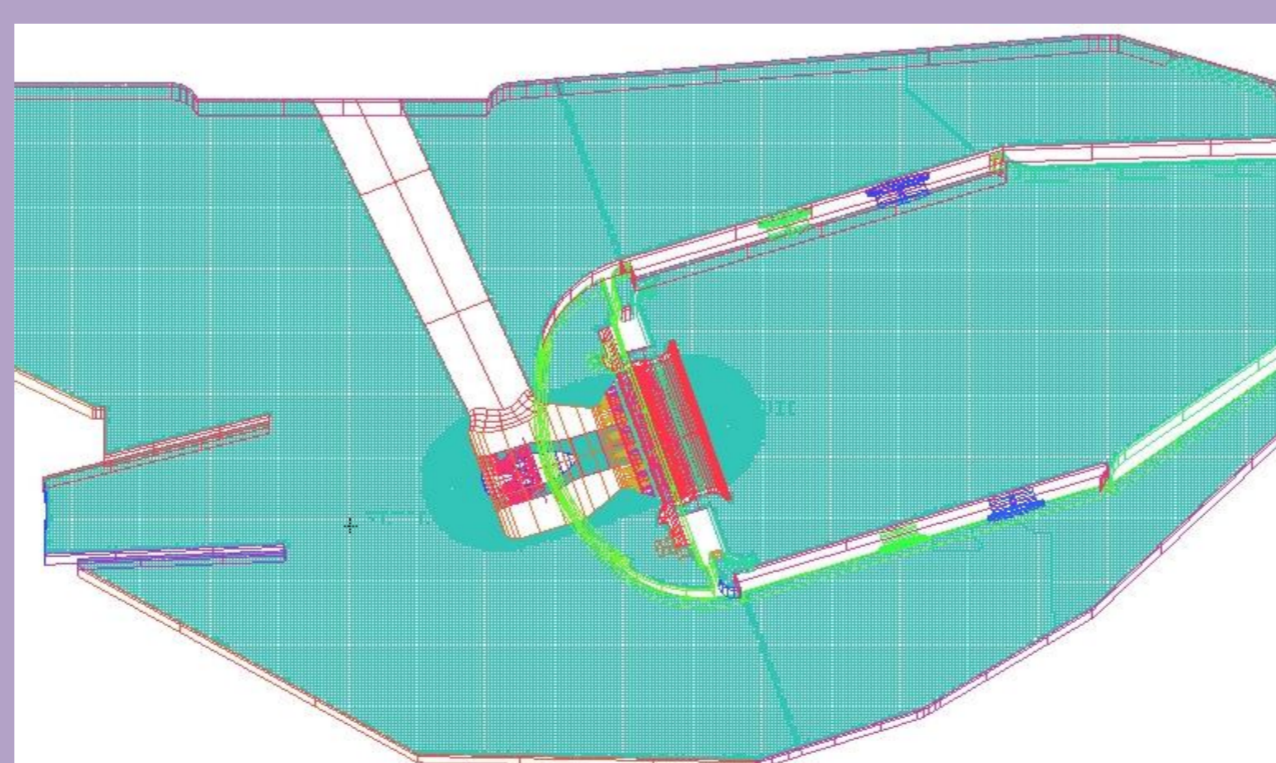
3.a



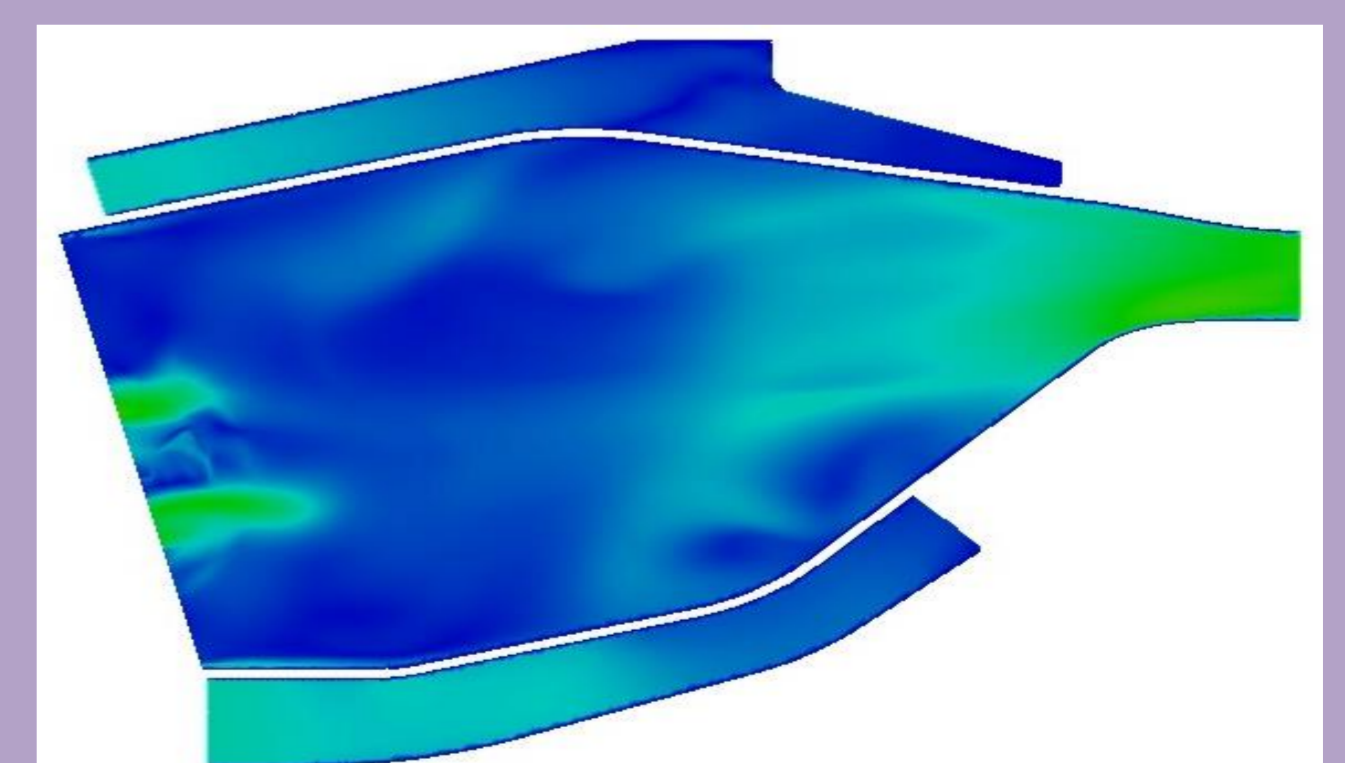
3.b



3.c



3.d



3.e

Figure 3: An example of combustor design optimisation workflow using Prometheus

- (3.a) Original sketchbook geometry
- (3.b) Generated fluid volume
- (3.c) Flownet network for aerothermal analysis
- (3.d) 3D mesh of the generated fluid volume
- (3.e) Combustor simulation

Future work

Currently, Prometheus can perform fluid and aerothermal analyses but work is ongoing to extend its capabilities to a multidisciplinary combustor design optimisation system by including, for example, cost modelling, structural and aeroacoustic analysis.

Acknowledgements

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