Grid Services in action: Grid Enabled Optimisation and Design Search

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Abstract

We are developing a Grid Enabled Optimisation and Design Search system (GEODISE). It offers grid-based access to a state-of-the-art collection of optimisation and design search tools, industrial strength analysis codes, and distributed computing and data resources.

1 Introduction

Engineering design search and optimisation is the *process* whereby engineering modelling and analysis are exploited to yield improved designs. In the next 2-4 years intelligent search tools will become a vital component of all engineering design systems and will steer the user through the process of setting up, executing and post-processing design search and optimisation activities. Such systems typically require large-scale distributed simulations to be coupled with tools to describe and modify designs using information from a knowledge base. The GEODISE project utilises a distributed, modular architecture to facilitate engineering design search and optimisation (EDSO). This structure is comprised of a series of Grid services [1,2] offering access to resources for computation, visualisation, and data management coupled to optimisation and Computational Fluid Dynamics (CFD) application services. The web-based system portal offers intelligent guidance to the user via a design optimisation wizard and a knowledge management system.

2 GEODISE Architecture

In the current version of GEODISE (v2.0) an engineer presents credentials to the portal through a web browser and provides a geometry file in parametric form and associated data which defines a CFD problem. An exemplar problem is the optimisation of the aerodynamics of a nacelle (the housing for the engine on an aeroplane wing.)

A form-based design wizard gathers the appropriate setup information and guides the engineer through the initial design space mapping phase. GEODISE (v2.0) includes a Latin Hypercube sampling scheme to map the design space and a Kriging regression tool to develop a response surface model of the objective function. The significant computational requirements to analyse each design using computational fluid dynamics are met by a Condor pool that is exposed as a web service [2] to which the executables are submitted along with the parameters for a given design. Once the response surface model has been created, the system provides a number of traditional optimisation methods to improve the objective function.

Throughout the EDSO process extensive data is logged using database services. The engineer may investigate the design space data via the portal's query interface and visualise individual nacelle designs explored as part of the optimisation process by calling an SVG visualisation service. An engineer can also retrieve and post-process past results and visualise the progress of long running optimisations through the portal's query interface.

3 References

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