Gospel

"computational engineering research can be used to make significant improvements in an industrial design process"

Grid Optimisation Software for Problems of Elastohydrodynamic Lubrication

This project demonstrates how a Grid-based tool for undertaking co-operative, multidisciplinary, computational engineering research can be used to make significant improvements in an industrial design process related to computational models of lubricants. The design process uses core lubrication software developed at the **University of Leeds** over a decade's collaboration with **Shell Global Solutions** (Shell) as part of an optimisation procedure. The software models **Elastohydrodynamic Lubrication** (EHL) in which applied loads are so great that metal components deform and that the lubricant may have glass-like properties.

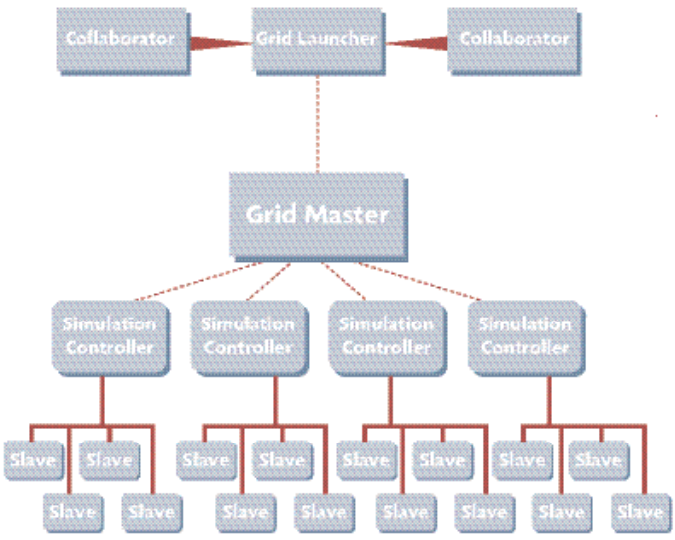

Figure 1: Example of the GOSPEL structure

The goal of the **optimisation** work is to find a set of physical parameters that match numerical simulations to reference experiments obtained from a variety of physical conditions. Since EHL modelling is both a computationally intensive and algorithmically challenging problem to solve numerically, successful optimisation work typically requires very long timescales – on a single processor for ten lubricant parameters it can take many days to find a local optimum in the parameter space for example. This is because for each set of parameters to be evaluated, a sequence of EHL simulations must be undertaken and the numerical results compared against the experimental results.

The GOSPEL **e-Science** project combines the numerical solver and the optimisation work into one Grid-enabled application run in parallel. This parallelism may be anything from running groups of similar

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experiments in parallel up to actually running each simulation in parallel on **White Rose Grid** machines using the **gViz** libraries for communication.

Furthermore GOSPEL is built inside a **Problem Solving Environment** (PSE) in **IRIS Explorer**. This PSE facilitates visualisation of the results as the simulation proceeds. Moreover, with high dimensional spaces to visualise, the simulation on the Grid must allow computational steering both to allow the optimiser to be shifted away from local minima or to increase the size and complexity of the parameter space being studied.

Further Information

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The project's web pages are at:
http://www.comp.leeds.ac.uk/ceg/ehlgospel.html

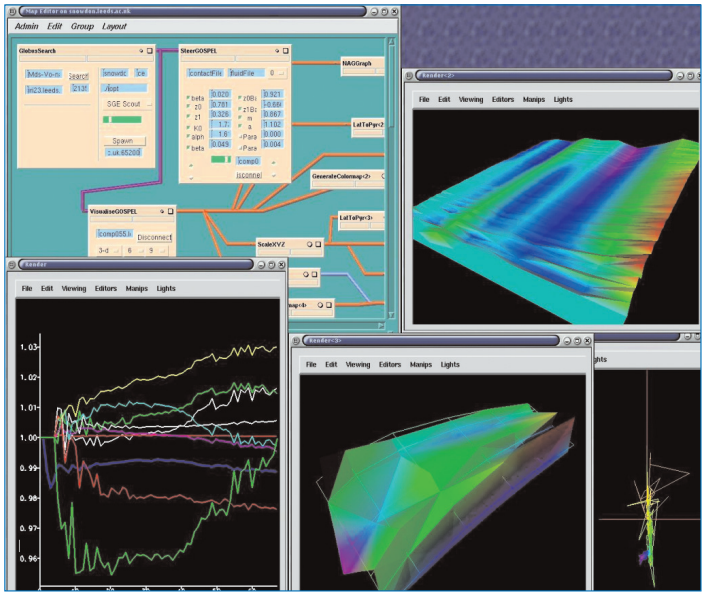

Figure 2: A user's view of the execution of an optimisation run across the Grid