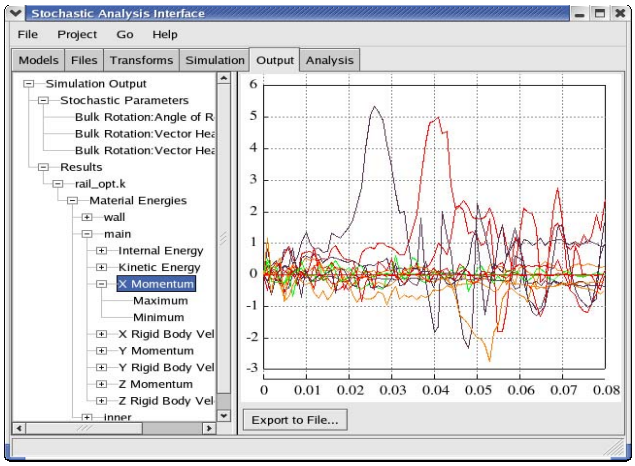
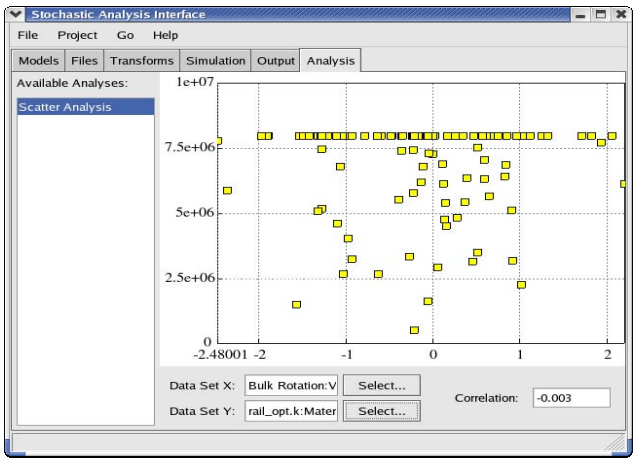
Stochastic Analysis Interface





Research Objective

This project aimed to produce a software system for the stochastic analysis of engineering models, consisting of a Graphical User Interface through which the Engineer could to attach to the parameters of a model a probability distribution for their value. Engineers would then be able to run a large number of tests on different instances of the model, collating and analysing the results from each. Engineers would gain a better understanding of the behaviour of their mode than they previously would using traditional single analysis methods.

The research aims to provide a convenient interface for stochastic analysis using existing computational prototyping tools, rather than duplicating functionality already existing commercial packages.

Motivation / Significance

The traditional process of computer simulation of engineering models is deterministic - running the same model through the same simulation process will always produce the same results. In contrast, systems in the real world rarely exhibit this kind of repeatability and their properties are often idealised.

Consequently, traditional computational modelling techniques suffer from the shortcoming that the results obtained are limited to an over-specified product whose equivalent may never exist in the real world.

It is well established that small changes to a system can result in large changes in behaviour, so the results of any such modelling process must be regarded with a degree of caution.

The process of stochastic analysis replaces exact values within the model with a probability distribution for the value. In order to perform a simulation, random samples are taken from these distributions to produce a fully specified model that can be run through a standard simulation process. By performing a large number of such simulations, a set of differing but related results is obtained.

These results can be analysed in two ways. First, they may highlight aspects of the system where small changes in the properties produce large (potentially undesirable or dangerous) changes in behaviour. These aspects indicate a lack of robustness in the design and should be remedied if possible. Second, it becomes possible to apply statistical techniques to determine the relationships between various system parameters and behaviours. This may help highlight areas for design improvement.

Conclusion

The initial Stochastic Analysis Interface passed all compliance criteria. Further improvements to the software would be required before it could be used in a production environment. These improvements could easily be implemented within the existing architecture. The flexibility and generality of the system mean that it could be extended to deal with a wide variety of engineering applications. Thus, the main research objectives of this project have been achieved.