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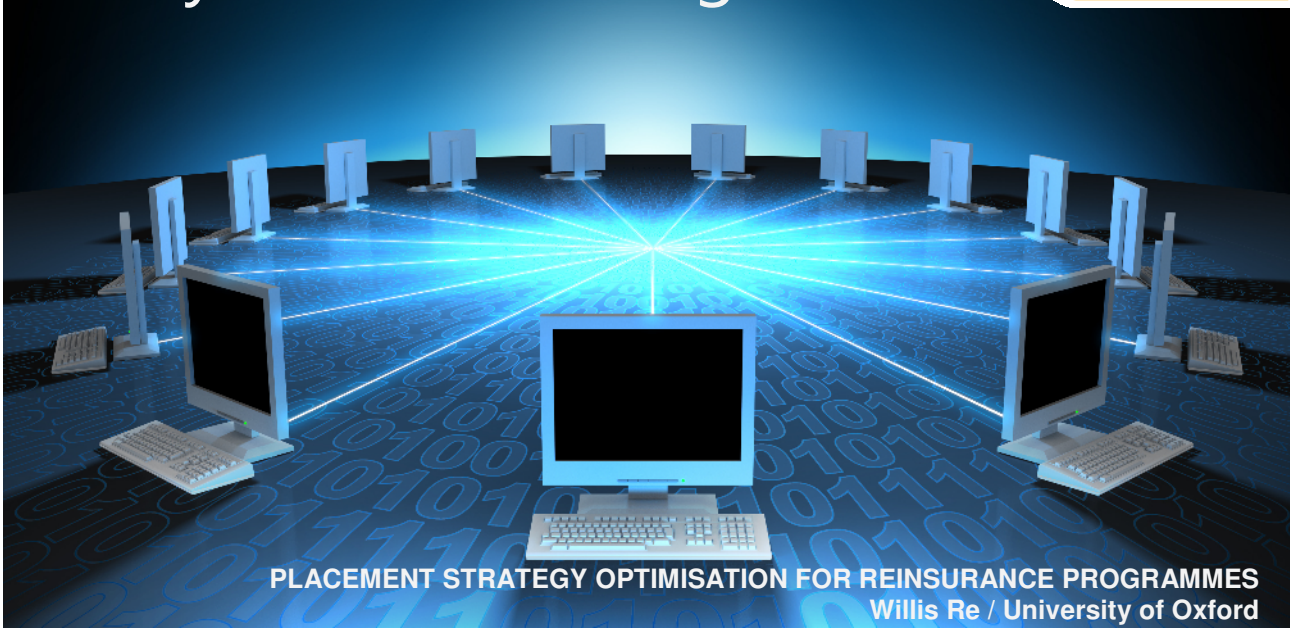
Industrial Mathematics

Many hands make light work



PLACEMENT STRATEGY OPTIMISATION FOR REINSURANCE PROGRAMMES

Willis Re / University of Oxford

The need

Reinsurance provides protection for insurance companies against the risk of losses including catastrophic events such as earthquakes and floods. Quantification of the associated risk relies on intensive simulations and the optimisation of complex contracts. The challenge of carrying out these calculations could benefit greatly from recent developments in parallel computing.

Willis have a new experimental prototype tool for optimising the placement strategy of client reinsurance programmes. However, to provide this service to their clients, the runtime of the software needs to be significantly reduced.

The aim of the project was to adapt the prototype tool so that the software could be run on many computers in parallel.

The outcomes

The reinsurance placement tool requires tens of thousands of different strategies to be run. Considerable improvement in speed is possible by writing a parallelised version of the software, sharing the calculations between many computers.

The parallelised software was tested in the optimisation of a reinsurance placement contract, with the calculations being shared between the number of desktop computers that might be typically available to the company. The optimisation ran up to 25 times faster than in the nonparallel approach. The behaviour with multiple users was explored and the runtime scaled as expected.

With an appropriate number of client computers, a robust system with reasonable waiting times for job completion was achievable.

By using Nereus grid computing technology, Willis was able to harness available, idle computer power and so the cost of implementing this solution was negligible. Much scientific computing at Willis is done in Java which is ideal for Nereus and highly parallel problems such as Monte-Carlo simulations can be trivially mapped to the Nereus system. Should more computing power be required, the Nereus network can be expanded by simply connecting more computers.

"[The intern] has provided us with a possible solution which speeds up the runtime by several factors. We are now analysing Shilan's findings and hope to make a decision soon how to implement his solution."

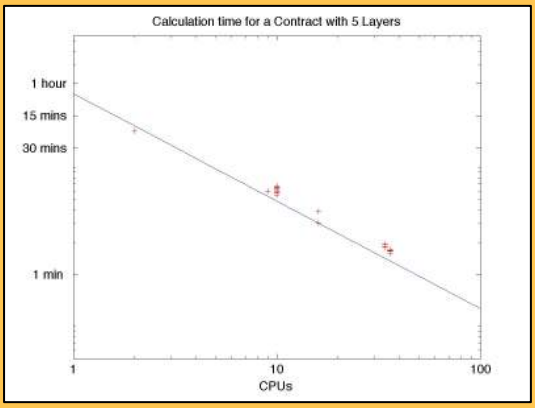
Jürgen Gaiser-Porter
Willis Re

Technical summary

A parallel version of the optimisation code was written in Java and implemented in the Nereus grid computing technology developed at Oxford University by Dr. Rhys Newman. Written entirely in Java, Nereus aims to provide a simple platform in which a cluster can be built over a network, allowing users to donate their computers' idle time to perform calculations. Since the Nereus cluster can be built using the existing Willis network of standard desktop computers, very few additional resources are required.

Two issues need to be taken into account when choosing the number of computers in the Nereus cluster that will carry out the parallel calculations. Too small a size fails to realise the benefits of the parallelisation. Too large a size increases the risk of individual computers in the network switching off during a calculation.

The performance of the parallelised code was tested in the case of a reinsurance placement contract that comprised five segments of the liability insured. This places an upper limit on the number of computers that can be used in the Nereus cluster of [11^5/100] = 1611. The code was run for varying numbers of computers in the cluster, and the resulting computation times were found to be in good agreement with the dependence predicted by theory, as illustrated in the graph.



The results demonstrate that a significant increase in the speed of the optimisation is achieved by increasing the number of computers in the cluster. For the test contract with five segments of liability insured, 10000 simulations were optimised in two minutes using 36 standard desktop computers in the cluster, compared with a nonparallel approach that could take up to 50 minutes.

"This project demonstrated how easy this process was to implement and deploy, delivering dramatic speed improvements to a key business problem. NereusV turns the background latent processing power in a typical modern office into a supercomputer for 100 times lower cost than conventional alternatives."

Rhys Newman, University of Oxford

"We were able to combine techniques from mathematics and computational science to substantially improve the efficiency of risk analysis modelling in the reinsurance sector. We look forward to further collaboration through the Willis Research Network."

Patrick McSharry
University of Oxford

This project was part of the programme of industrial mathematics internships managed by the Knowledge Transfer Network (KTN) for Industrial Mathematics. The KTN works to exploit mathematics as an engine for innovation. It is supported by the Technology Strategy Board, in its role as the UK's national innovation agency, and the Engineering and Physical Sciences Research Council, in its role as the main UK government agency for funding research and training in engineering and the physical sciences.

EPSRC
Engineering and Physical Sciences Research Council

Project Details

Partners
Willis Re
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Project investment
£9,000

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