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Parallel Computing Techniques for Investigating Three Dimensional Collapse of a Masonry Arch

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Summary

Although parallel computing aims to offer an unlimited source of computing power to satisfy ever growing processing demands, this potential source is not always easy to harness for any given problem. A solution is considered on a class of parallel computer known as the distributed memory MIMD computers, consisting of a number of processing elements each capable of functioning on their own (i.e. a complete CPU with its own memory) and which communicate with each other using a network of message passing communication channels. A successful implementation of an algorithm depends on its parallelisation, the granularity of a problem, and the effective utilisation of available communication resources.

In this thesis a parallel solution for the 3-dimensional collapse of a masonry arch is investigated. In the UK alone there are in excess of 40 000 bridges which require regular maintenance and renovation to accommodate the increasing loading demands. Each bridge is built to a different specification and is subjected to different types of loadings and hence must be individually assessed. Current analysis methods are based on the 2-dimensional behaviour of the arch and hence are inherently limited.

The parallel algorithm for this problem requires global communication of data between the processing elements which may originate at any processing element. Hence a network topology which minimises the distance between a source processing element and each destination processing element is desired. The limiting criteria in designing a suitable topology are the number of available communication channels (constructed from corresponding links of two processing elements) and their transmission bandwidth. A configuration is constructed in this thesis which takes advantage of all the available resources and presents better results than existing topologies.

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