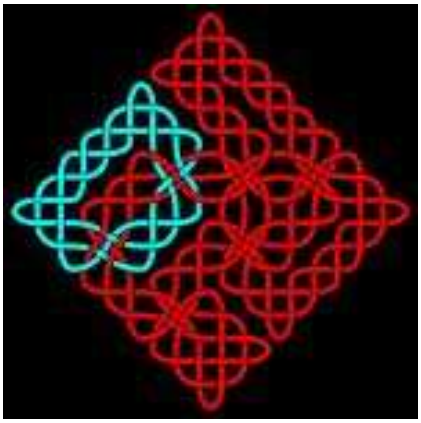
IT Services

Case Study

BlueBEAR provides a substantial computing resource that properly supports the research work of research staff and students at Birmingham. It provides a cost effective facility that optimises the effectiveness of research and ensures the University continues to be a world-class academic learning and research environment.

Parallel Computation of Braid Orbits with GAP and SCSCP



Challenges

In algebra, the Inverse Galois Problem concerns whether or not every finite group G can be realized as a Galois group over the rational numbers. The case where G is soluble was resolved by Shafarevich in the 1950s, but the general case remains open. One approach to the realization of a group as Galois group is via classification of Hurwitz loci of complex curves admitting G. These loci are indexed by the orbits of a suitable surface braid group acting on the generating tuples of G. When the genus of the curve is low, the braid orbits can be enumerated explicitly using GAP (Groups, Algorithm, Programming) computer algebra system and the BRAID package by Magaard, Shpectorov and Völklein. The length of the orbits dramatically increases with the size of G and genus of the curve. In order to handle larger orbits, we propose to use parallel computing in GAP via the package SCSCP (Konovalov and Linton).

Results

Using parallel computation, we have successfully computed an orbit of size approximately 1.2 million using 15 processors in the server babbage2 in school of mathematics, where we set one master worker, eight applicator workers and six storage workers to do the parallel computation. And we also repeated this computation in BlueBEAR.

Problems and Future Work

The communication in SCSCP package and queuing takes a lot of time. It turns out that almost two third of the duration time are for waiting, encoding, decoding and so on. This needs to be improved.

We want to use 100s processors at the same time for the cases of orbit length up to 10 million or more, and we want to use them for several hours. While we consider using more resources to handle the large orbits, we are also thinking about reducing the size of each computing task. This requires more work about the algorithm.

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Product Used
Algebra System GAP (Groups, Algorithms, Programming)
The BRAID package by Magaard, Shpectorov and Volklein
The SCSCP package by Konovalov and Linton

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