Project Summary

This work studies a parallel machine architecture called the Virtual Time Machine (VTM) that uses rollback to synchronize parallel computations. A simulator for the machine architecture was developed, and performance of benchmark applications was examined. A software-based implementation on general purpose multiprocessor hardware (a Kendall Square Research KSR-1 machine) was developed, and used extensively to evaluate performance of this approach. Hardware designs for key components of the machine were developed, and an implementation of certain mechanisms used in the memory system was developed (in collaboration with Integrated Parallel Technologies) and formally verified. Extensive analytic and experimental performance studies using a testbed system running on a BBN Butterfly the KSR-1 architecture were completed. A parallelizing compiler for SIMSCRIPT II.5 was developed and demonstrated on both the simulated machine and the KSR-1 implementation.

The project successfully demonstrated the effectiveness of rollback-based synchronization for a variety of discrete event simulation applications. Rollback-based synchronization mechanisms appear to have good promise for providing orders of magnitude speedup for large-scale simulation computations that are too time consuming to perform today in applications such as computer system design, telecommunication networks, design of transportation systems, manufacturing, and others.

Software

A significant amount of parallel simulation software was developed for this project. This software is made available to anyone requesting it, free of charge. To our knowledge, at least two groups (at the University of Calgary and University of Waikato in New Zealand) are actively using this software in their research.

Publications

The following publications report results supported in whole or in part by research performed under this grant:


