Discrete-Event Simulation Research Team

1. Team members

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2. Research Activities

Development of a management tool for simulations and analyses was started and a prototype is made in this fiscal year of 2013. It is named OACIS (**O**rganizing **A**ssistant for **C**omprehensive and **I**nteractive **S**imulations). It is developed using Ruby, Ruby-on-rail framework and MongoDB. After installation, users register their applications for simulations and analyses, and their computers from PC to supercomputers like K to the OACIS. Then they can design and order executions of simulations and analyses on its web-browser front end. The ssh connection is used to operate the registered remote computers and Job states are supervised by the OACIS. Current prototype transfers output files of simulations and analysis to the local computer operating the OACIS from remote computers. The results and historical data are preserved in local computer using MongoDB.

Algorithm and coding technology of graph and network simulations and analyses are studied. K-oriented program for a benchmark problem, GRAPH500, is designed and developed, although the current version requires further tuning to reach the current world record. An application of agent-based automobile traffic simulation, named MATES developed in the University of Tokyo, is ported to K computer. The MATES is one of few applications of traffic simulation parallelized and coded with C++, and these features are favorable to K computer.

Using the OACIS and the MATES, and an optimization for signal control for a city traffic was performed. A simple GA method coding signal timing is used and traffic simulation using the MATES was executed for each genotype. Signal timing showing shorter averaged travel time was found.

3. Research Results and Achievements

Computers, especially supercomputers nowadays, have been extending the human abilities and possibilities. The frontiers are both in quantity and in quality, which correspond to accuracy and complexity, respectively. DESRT is challenging the latter with the K computer. With the K-class computer, the social activities, which comprise the ultimate of complex phenomena, are in scope of computer applications, and as a matter of course, social modeling and simulations are an objective of DESRT activity.

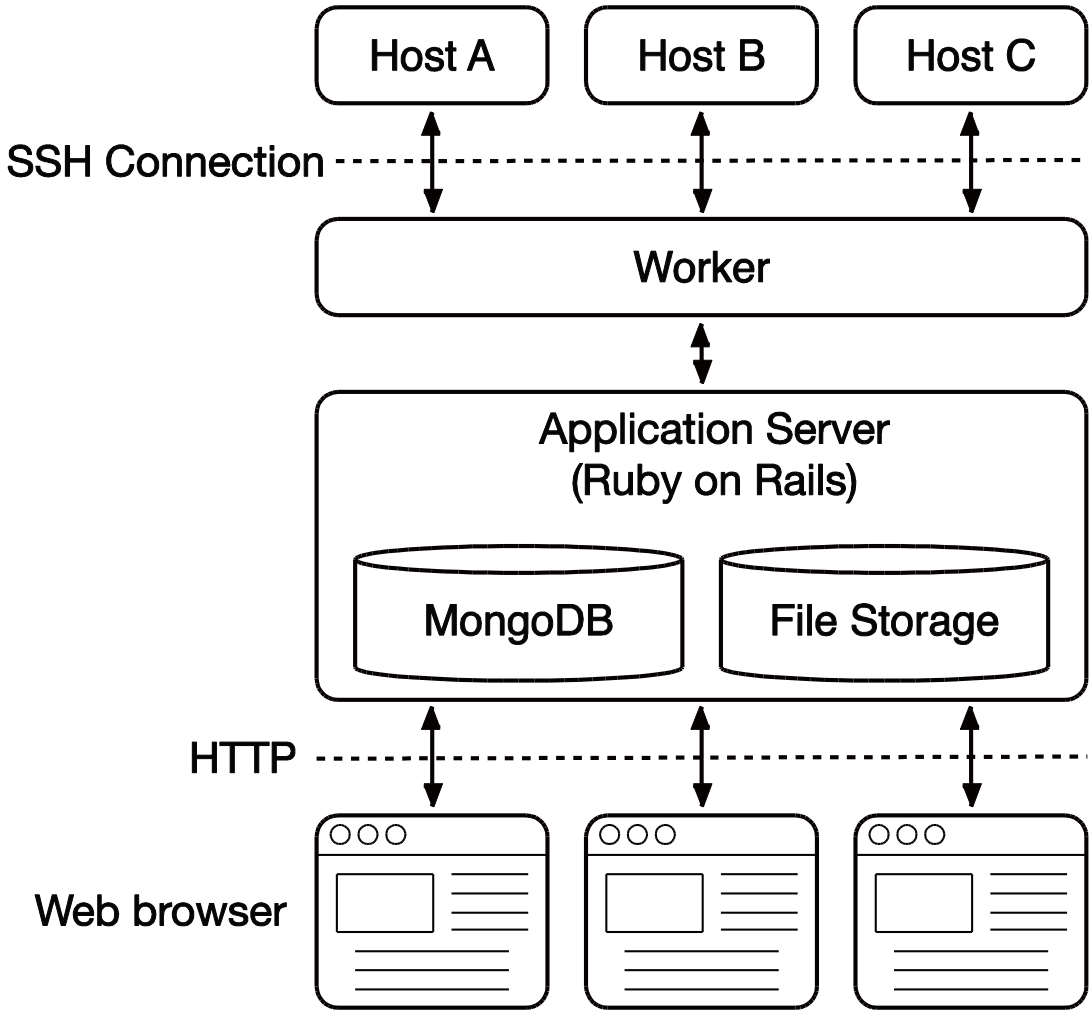
Social modeling has been pursued for long times and the history will be regarded as long as one of human communities. Actually, idea and system of scientific laws of natural phenomena stems from social one like the Roman law. Communities and societies are based on individual people or agents. Small communities and societies with tens people, perhaps, will be managed and controlled based on person-wise or agent-based optimizations, but agent modeling for cities and countries with millions of people and global society with billions of people is not well established yet. In addition to a reliable model, design and optimization with computer simulations requires search for the better parameters, and social parameters usually have discrete option, not analytic nor continuous: a traffic signal is blue or red or some other, and a decision is to adopt an idea or to dismiss it. Therefore a combinatorial complexity is abundant in social application.

A working hypothesis of social application of K-class computer will be to test many kinds of social models, and to challenge their combinatorial possibilities, using huge number of processors. With this hypothesis, the DESRT has been challenging development of a management tool for simulations and analyses, and algorithm and coding technology of graph and network simulations and analyses.

3.1. A management tool for simulations and analyses: OACIS

K-class compuers allow us to execute millions of difference simulations simultaneously, and such big parameter paralellization is an advantage of top-end supercomputers nowaday. But job management by human hands are quite behind the current number of parallelism. We need an efficient intelligent tool to manage such parameter paralellism. If paralellized parameters are quite simple like seed numers for random number generation, such paralellism will be rather easy, although the big nmber itself usually cause sometimes unfeasible operations of comoputers. To overcome the difficulty, the DESRT has been proposing an intelligent application to help to manage the situation. A prototype software tool named OACIS (**O**rganizing **A**ssistant for **C**omprehensive and **I**nteractive **S**imulations) has developed in this year. It is developed using Ruby, Ruby-on-rail framework and MongoDB. After installation, users

register their applications for simulations and analyses, and their computers from PC to supercomputers like K to the OACIS. Then they can design and order executions of simulations and analyses on its web-browser front end. The ssh connection is used to operate the registered remote computers and Job states are supervised by the OACIS. Current prototype transfers output files of simulations and analysis to the local computer operating the OACIS from remote computers. The results and historical data are preserved in local computer using MongoDB.



Structure of OACIS is shown schematically.

3.2. Algorithm and coding technology of graph and network simulations and analyses

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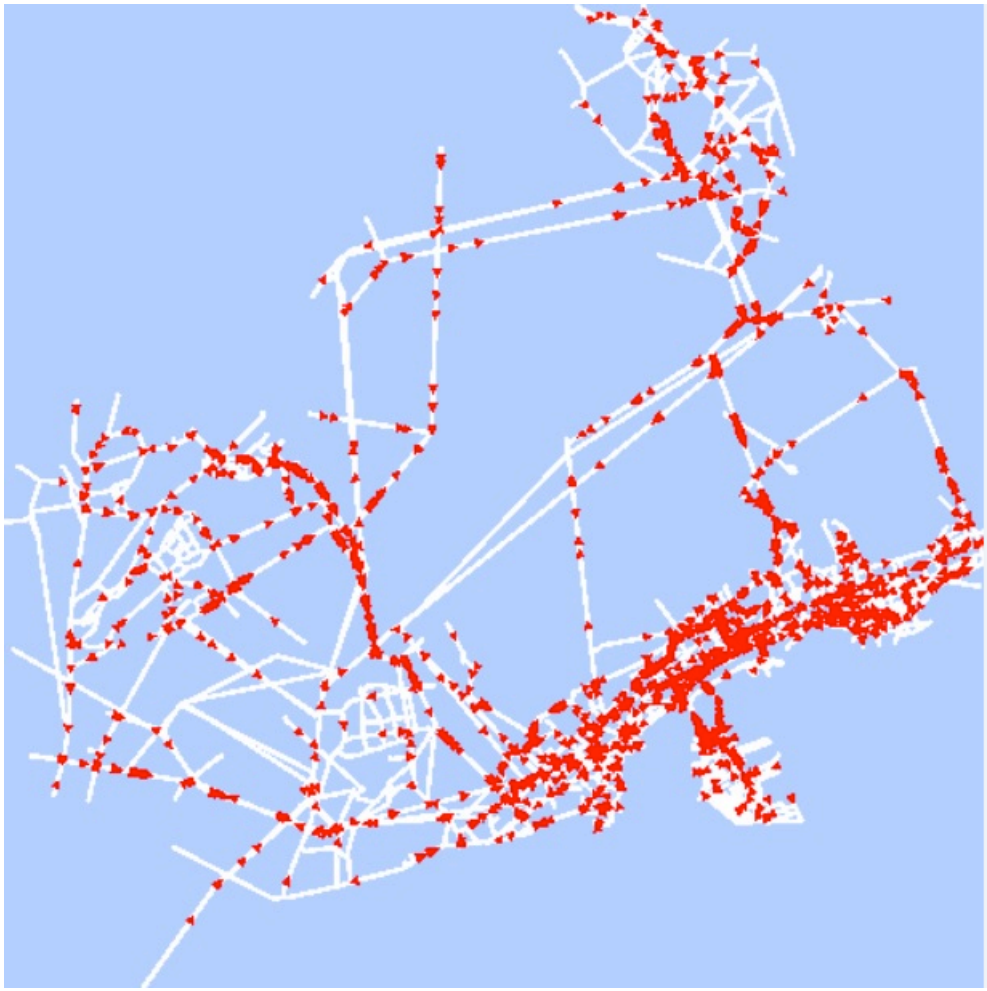

An example of automobile traffic simulation of the Kobe city.

4. Schedule and Future Plan

In the following years, a beta version of the OACIS is released to the public, and tools of visualization and simulation design will be developed. And a graph simulation and analysis tool working on K-computer up to its full node will be developed.