Distributed computing on HORB environment and simulation study of epidemic spreading

Seiji Tanno

School of Knowledge Science
Japan Advanced Institute of Science and Technology
March 2005

Keywords: HORB, Distributed computing, Dynamic loader, Scale-free network, Coupled duplication divergence model, Spreading of virus.

Recently, the performance of processing speed and memory capacity in computer systems has been improved exponentially with several technical innovations. Therefore, it has been able to solve further more valuable problems only with a single computer. However it is necessary to use super computer to costly problems.

In the research field of high-performance computing, one of the attracted technologies is distributed computing. Distributed computing is a method to achieve high computing performance on a network environment, in which high load problem is subdivided into small tasks, and many computers process the subdivided tasks at a high speed with facility. In addition, for processing the tasks, distributed objects have been provided to treat remote computers transparently.

However, distributed computing has some problems. One of the problems is consistent maintenance of the programs to process the tasks. When the programs are updated, they must be allocated to all computers on a distributed environment.

For the problems, I construct Master-Slave distributed computing system, which has Dynamic Loading function by using HORB. HORB is a famous distributed object software for Java. To evaluate the system, I investigate the following example of high load problem: the random generation of large network models and the simulation of the epidemic spreading on the models.

To analyze the spreading, we consider Coupled duplication divergence (CDD) model to generate scale-free networks, whose structures appear on human relation, E-mails and so on. CDD model can parametrically control degree correlation (the average degree of the nearest neighbors of a node to the degree of that), which is the topological structure. We get the following result by spreading simulation of virus on the network.

When infectious capacity becomes comparatively high, spreading scale on the networks of positive degree correlation (connections between the nodes with high-degree exist at high rates) is large in comparison with that on those of negative degree correlation (connections between the nodes with high-degree and the nodes with low-degree exist high rates) without recourse to network size and source of infection. However, if and only if infectious capacity becomes extremely low, spreading scale to degree correlation is reversed.

On the other hand, from the viewpoint of distributed computing, to evaluate the performance, I compare the processing time in the case of using one computer and this system. As a result, this system can process a problem more efficiently than one computer when the total load of the problem increases.