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# Parallelization Flow Simulation on Sheard Memory System

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## 1 Introduction

Recently, the shared memory parallel system, especially the spread of the small and middle scale SMP (Symmetric Multi-Processor) system is remarkable. However, the efficient programming method at user level is not necessarily established though the spread of hardware is remarkable. You need not communicate in the shared memory system such as SMP system though the parallel computation program of using the communication library such as MPI (Message Passing Interface) is being established in the parallel computation system usually. Therefore, a variety of program model is being proposed by the shared memory system. The one is Thread.

There are a lot of advantages which use the shared memory program model (Thread etc.) in the shared memory system. In the communication library, it is very annoying when it is necessary to think about the communication and the data index, and Programming is difficult.

The shared memory system only consids about the synchronization of the access to the common data. In the distributed memory system, it is synonymous to take synchronization in the communication. The communication is compared at the case to use the communication when the synchronization of the memory access is compared with the taken cost and it does not cost. It is easier to think about synchronization than the programming thinks about the communication.

As mentioned above, the advantage used in which the computer of an efficient shared memory system with a remarkable spread is used to compute the science and technology like a numerical computation, especially CFD (Computational Fluid Dynamics) is

abundant. However, computation efficiency low, it is easy to use like the current state, parallel computer is a situation which cannot be said. The dependence relation between many often exists in data in the place where the actual problem and the problem of these techniques of the fluid analysis when thinking about the numerical analysis, especially CFD.

Therefore, when the program is made with the distributed memory system, it will very cost the communication. It is thought that the program can be executed when these points are considered by smaller synchronization cost than the communication cost by the use of a shared memory system and a synchronization facility. Therefore, it is thought that a high-speed computing is possible.

## 2 Thread Programming

Thread Programming is a program which does the parallel processing by using the sheard memory program model. In the sheard memory system, it is more efficient to generate Thread about the advantage which uses Thread than to generate two or more processes because the resources can be saved more than a lot of processes are used.

## 3 Synchronization Facility

The programming method has not been maintained yet, and there is a program which should be mounted before a real problem is analyzed on a shared memory type parallel computer though it is easy to parallel data and the pipeline parallel processing, etc. by using Message Passing on a distributed memory type parallel computer.

When a parallel programming is done in the computer system with the shared memory mechanism, important to control exclusively and to control synchronize is played. However, the synchronization of the data access of couple 1 which corresponds to the transmission by global synchronization to barrier synchronize and the MPI Library and the receptions is not offered though primitive exclusive control is offered in the Pthread library. These implementation is indispensable, and when the algorithm is mounted, can reduce the cost of the programming to use a shared memory type parallel computer.

The barrier synchronization by which synchronization is globally taken is used for the synchronization of Thread program usually. Barrier synchronization of the shared memory system, many paper already exist. There is merit that needless confusion of a network and other resource can be arranged the calculation phase by barrier synchronization. However, the cost because of global synchronization it is large. The local synchronization facility on the shared memory computer is used. Global synchronization of the barrier synchronization need not be used the pipeline parallel processing are done when such a synchronization method is used, and there is a possibility that more high-performance computation can be done.

## 4 Experience and Discussion

The method of the performance improvement in SMP system and the entire shared memory system is examined. The CG methods demonstrates the vector operation and the ability is demonstrated in the computer system to which the main vicinity and the memory access are reinforced. In short, it is effective in the system to which the vector computer and the high-speed memory access system are reinforced. In the SMP system, the locality of the data reference is drawn out, the re-reference to cache is raised, the memory reference ability is pseudoraised, and the programming by which the ability of RISC processor is drawn out is necessary. The SMP system is not effective to the repetition method like the CG method by which a huge vector operation should be done for that. Then, the method of solving the Poisson equation of pressure at high speed was examined by devising the method of solving the SOR method by pipeline processing. As a result, a very highly effective algorithm was obtained.

It has been understood that efficiency of making to the parallel is good as a result of the experiment. when the division grain degree to which efficiency worsened when the message communication was used was detailed, a good result was obtained from MPI Library. It is possible to be able to decrease the parallel addition time by the local synchronization facility. And, it is a cause that the execution result in 1Thread(1PE) is considerably slow.

## 5 Problem in the Future

New, some result has come out as efficiency of making to the parallel. and, this level is obtained also on the shared memory PVP system. The following is necessary in the future when thinking about the speed-up of a further fluid analysis.

- Obtains at the stage where the Poisson equation of pressure is solved, and the precondition is given to the procession of the coefficient of a large-scale n former simultaneous equations, and the analysis which requires the computation time is speed up.
- The preconditioning is made parallel at the same time, and compute at high speed in addition.
- Application to general problem and application of three dimensions to large-scale problem according to it.

It is necessary to think about the above absolutely when thinking about the feedback of the result to the reality society.