# Parallel Computation of Instability Flow in Pipe using CIP

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Eulerian method and the Lagrangian method are used as a solver of the motion equation of the fluid. The mesh is fixed to grid point in the space as for Eulerian method, the other hand side, the mesh moves in Lagrangian method according to the movement of grid point. Therefore Lagrangian method is used generally in the movement boundary problem. Eulerian method have the advantage to treat easily because of the fixed mesh to grid point. But It is difficult to express the curved surface boundary and boundary of soil and liquid.

The Cubic Interpolation Propagation (CIP) proposed by T. Yabe is the technique that can treat each compress fluid, compress fluid, or the gas, the liquid, and the solid united by using the Eulerian method and can catch the boundary of the solid and the fluid in accuracy. So a lot of researches which have used the CIP method up to now are done, and therefore it is confirmed stability in many times that it is a good scheme. The flow when solid moves and the effect which liquid gives solid can be analyzed by Eulerian method using CIP. Moreover, it is easy to expand in multi-dimension.

Furuta analyzed the flow of pipe with moving valve using the CIP. The CIP was used to calculate the advection of the NS equation. However, it is instability flow, so Large time is required to the computation of the Poisson equation of pressure. Therefore, it is difficult to treat at large calculation area and use a detailed grid.

In this paper I propose the parallel numerical algorithm of analysis of fluid by CIP on parallel computer SGI Cray T3E using Message Passing Interface (MPI) which was the communication library. The flow in pipe with the concave part was analyzed. It is a purpose that the pattern of flow and the time in parallel computation are compared with in sequential. Moreover, I analyze two problem of instability flow that is basic experiments on the analysis of the flow in the elasticity pipe. The first is an analysis of the flow in

pipe with three concave parts where the vibrating noise full flow was assumed to be an inflow condition. Another is an analysis of the flow in pipe with vibrating wall. There are instability like a cause of addition changing boundary condition and large-scale computations.

The following results were achieved in this research.

1. The problem of instability flow using CIP was analysed with parallel computer at short time.

2. To use detailed calculation grid with Eulerian method the curved line of boundary and the line of movement boundary were caught accuracy and physical phenomenon of the flow was showing good accuracy