Analysis of interaction between fluid and elastic wall in pipe flow using CIP method

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Many of phenomena of the flow which exist near ourselves are the flow which have the moving boundary. There are exmple that flow seen in river and sea area, two layers flow between oil and water,and flow of the air of transformed the structure surroundings. Today numerical fluid analysis is being done to this movement boundary ploblem by various technique.

Eulerrian method and Lagrangian method are used as a solver of the motion equation of fluid. The grid system is fixed to grid point in the sapce as for Eulerrian method, the other hand side, the grid system moves in Lagrangian method according to the moving grid points. In general, Lagrangian method is used for moving boundary problem. Because Lagrangian method can set the girid which fits the boundary of fluid and solid, the definition of a free surface is easy. However, re-griding of each time step is needed when the grid system is defined by Lagrangian method, and there are ploblem of the extream transformation of the mesh etc. Eulerrian method have the advantage to treating easy because of the fix mesh to grid point. But it is defficult to express the boundary of fluid and solid accuracy good, and the device is necessary to express the boundary. The advection term is calculated in equation of motion When the boundary of fluid and solid is pursued, the decrease in accuracy because of numerical diffusion is caused.

The CIP method proposed by Yabe is technique. The CIP technique is a method of sloving the advection equation by using a fixed grid in accuracy good. Furuta analyzed the flow of pipe with moving wall using the CIP. Araki developed parallel implementation base domain decomposition for pipe flow with movig wall using the CIP method on the parallel computer.

This research aims to analyze the interaction between fluid and elastic wall by using CIP. The calculation modele assumed the axis symmetry model. The calculation is

transformed from two dimension cartesian coordinates into a cylinder axis coordinates, and has been enhanced from 2 dimension to semi-2 dimension. A preliminary experiment analyzed the flow with concave part in pipe flow. The calculation result of the axis symmetry model is verified. The second experiment analyzed the wall vibrating model pipe flow. The influence of the flow by the moving wall was examined. The main experiment analyzed the interaction of fluid and elasticity wall. The calculation model is a shell model. The amount of transformation is calculated from the pressure difference. The transformation speed is divied the amount of the transformation by delta t. The calculation result was obtained in the case with very small amount of the transfomation. However, a steady calculation result was not obtained with the case with very large amount of the transformation.

The following results were achived in this reserch.

1. When the amount of the transformation was very small, the interaction of the fluid and the elasticity wall was able to be analyzed.

2. The device which can be analyzed for large amount of the transformation is necessary.