Parallel Algorithm of Spritting Method suitable for Incompressible Viscousf Flows Analysis

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Flow analysis has benn used in a phenomenon of the sea or lake tide, an atmosphere circulation and aerodynamics and architecture,etc. In order to investigate the realistic flow model,a large-scale numerical flow analysis is needed. Up to now,calculus of difference have been using for large-scale flow analysis. However,in generally case,this method is not available because a boundary form of them are complicated. On the other side,flow analysis by finite element method have an advantage of matching to the form approximation and structure analysis by any finite elements(triangle,quadrilateral,tetrahedron,hexahedron,etc). But,any improvements of this method are needed for stability,accuracy and velocity,etc. In recent years,large-scale and complicated of flow analysis have increasingly be possible by development of parallel computer. Then a parallel process of finite element method must be investigated for large-scale flow analysis. Once,a parallel process of finite element method by stream function and vorticity method was proposed by KAMAGATA(1994),then a model of them were realized on super parallel computer CM-5 by SIMD type algorithm. However,this method was not able to expand for 3-dimension model. Moreover,in this method, treatment of the unknown variable those are the velocity of a flowing fluid and pressure in the boundary condition was indirect. Then,as compared with velocity processed method which treats the unknown variable directly,this method was complicated form. In response to the facts,in this research,spritting method which has comparatively high accuracy in the velocity processed method is used. In this method,3 step calculation process is used for put a time step Δt forward 1 step. This method have an advantage of stability for the calculation results because advection,which is non-linear term,and continuity function of incompressible viscous flow are separated. In the calculation step,load of calculation is large because large-scale simultaneous linear equation

must be solved at three times. Then, parallel proceess of finite element method based on spritting method is investigated. In the fundamental design of this, KAMAGATA's SIMD type algorithm is used.

In recent years, liner solver on Parallel computer have been discussed iterative solution and blocked Gaussian eliminaion. CMSSL(Connection Machine Scientific Software Library) on CM-5 have lot of liner solver. However large-scale matrix by making Finite Element Method is non-symmetrical sparse matrix. In addition, a lot of array element values is 0. Then,Index array have been used because of memory. Therefor many liner solver of CMSSL do not use. Iterative solution with preconditioner and direct solution of liner solver by SIMD type programming is inefficient. In response to the facts,this thesis present Global/Local programming for the parallelization of Finite Element Method. Global/Local programming is one of programming model for Super Parallel computer CM-5 system. Global/Local application begins with a global main program executing in SIMD type program. The application is able to take explicit control of the nodes by calling a sub program executing in MIMD type program.: Therefore it is hybred parallel programming model. In this research,We compare Global/Local programming with SIMD type programming, as to the Successive Over-Relaxation method of Liner solver and calculation of global coefficient matrix inside Finite Element Method. As a result,case of calculation of global coefficient matrix, SIMD application is finished in short times as compared with Global/Local application. On the other side ,case of Successive Over-Relaxation method, Global/Local application is is finished in short times as compared with SIMD application. Therefore we know that Global/Local programming is avilable becoming process changed by MIMD type Local program.