GiD-CCFD
Thermohydrodynamic Analysis Software

Exercise Book

February 2007

ITOCHU Techno-Solutions Corporation
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1. Introduction

1.1 GiD-CCFD

A GiD is an interactive graphic user interface for defining, preparing, and displaying all data related to numerical simulations. Shapes, materials, conditions, solution methods, and definitions of other parameters are included in the data. This interface generates Mesh used for finite elements, finite volumes, or finite difference analyses. The GiD can also write data in formats required by numerical simulation programs. Numerical simulations can be executed and analysis results displayed from within the GiD.

The GiD-CCFD is customized with more additional functions than the GiD for use with thermohydrodynamic analysis software CCFD. Therefore, it can create computational models of CCFD and plot analysis results (post processing).

The flow of an analysis using the GiD-CCFD is shown below.

1. Create geometry or input from CAD data
2. Specify analysis control data for CCFD
3. Create material data
4. Create boundary conditions for geometry
5. Set mesh size to geometry
6. Create mesh
7. Execute analysis using the CCFD (use separate CCFD)
8. Plot CCFD results

1.2 Using this Manual

This manual describes exercises included on the installation CD of the GiD-CCFD. Please refer to the GiD-CCFD Operating Manual for descriptions of GiD-CCFD operations not included in this manual.
2. Exercises

2.1 Back Step Flow

Calculation of basic flow in which fluid flows in from the left side, passes through a back step, and then flows out from the right side. Two-dimensional calculations are performed by forming the thickness direction into one Mesh.

File name: backstep.gid
Analysis type: Steady
Eddy flow model: k-ε
Dimension: Two-dimension
Fluid: air
Mesh: Hexahedra (six-sided body)
Number of Mesh: 568
Units: SI
2.2 Natural Convection

This is an example of a calculation of natural convection using heat generation sources regularly arranged inside a building. Conditions are simulated by providing an inflow unit and an outflow unit in the building, and heat causes natural ventilation using rising air currents.

File name: natural_convec.gid
Analysis type: Unsteady
Calculation time: 1000 seconds
Eddy flow model: None
Dimension: Three-dimension
Fluid: Air
Mesh: Tetrahedra (four-sided body)
Number of Mesh: 17708
Units: SI
2.3 Heat Fluctuation

This is a calculation of heat fluctuations when fluids from three nozzles are discharged at different temperatures. Among these three nozzles, a high-temperature fluid discharges from both sides and low-temperature fluid discharges from the center.

File name: THERM_STRIP.gid
Analysis type: Unsteady
Calculation time: 400 seconds
Eddy flow model: None
Dimension: Two-dimension
Fluid: Water
Mesh: Hexahedra (six-sided body)
Number of Mesh: 9940
Units: SI
Temperature distribution [K]

Velocity vector [m/s]
2.4 Flow with Temperature Distribution inside Pipes

This is a calculation of the state of an elbow when fluids flow at different temperatures. High-temperature fluid flows inside the elbow and high-temperature fluid flows on the outside. Heat conduction inside a solid body is also calculated by cutting the Mesh of the thick wall portion of a pipe as a solid body element. Only one side is calculated with the center plane of the pipe the plane of symmetry to conserve memory and calculation time.

File name: elbox.gid
Analysis type: Unsteady
Calculation time: 10 seconds
Eddy flow model: None
Dimension: Three-dimension
Fluid: Water
Mesh: Hexahedra (six-sided body)
Number of Mesh: 16800
Units: SI
Mesh

Velocity contour [m/s]
2.5 Merging Y-pipe with Different Inflow Temperatures

This is a calculation of the portion where two pipes merge through which fluids flow at different temperatures. Shapes difficult to represent using six-sided elements are made conform to shapes with four-sided elements.

File name: y-ju.gid
Analysis type: Steady
Eddy flow model: None
Dimension: Three-dimension
Fluid: Air
Mesh: Tetrahedra (four-sided body)
Number of Mesh: 8886
Units: SI
Mesh

Velocity vector [m/s]
Temperature distribution [°C]
2.6 Flow inside a Micro Channel

This is a calculation of the state of fluids flowing in extremely small pipes at different temperatures. In this calculation example the length is in mm and units of physical property values related to this are converted as well. Because the CFD does not internally have dimensions, if each type of physical property value is brought into conformity, users can set their own values.

File name: micro.gid
Analysis type: Steady
Eddy flow model: None
Dimension: Two-dimension
Fluid: Air
Mesh: Hexahedra (six-sided body)
Number of Mesh: 8886
Units: Length = mm, thermal conductivity = mm²/s, kinematic viscosity coefficient = mm²/s
Mesh

Temperature distribution [°C]
Velocity vector [mm/s]
2.7 Example of Importing a Shape from CAD Data

This is a calculation of a dolphin shape of a CAD file imported into the GiD. The IGES file dolphin.igs located in DOLPHIN.gid is imported, the outer boundary of the calculation area created, and a Mesh cut.

File name: DOLPHIN.gid
Analysis type: Steady
Eddy flow model: None
Dimension: Three-dimension
Fluid: Water
Mesh: Tetrahedra (four-sided body)
Number of Mesh: 284807
Units: SI
Pressure distribution [Pa]

Velocity vector [m/s]