CADMAS-3D program calculation tutorial

Topic： Reproduction of solitary wave wall collision experiments

中央大学　海岸・港湾研究室

1. Tutorial content and process

Creation of input data

- Creation of obstacle data
- Creation of lattice data
- Creating ‘data.in’.

Execution of calculations

- Preparing the executable file, ‘data.env’, ’data.mtb’
- Execution of calculations

Checking calculation results

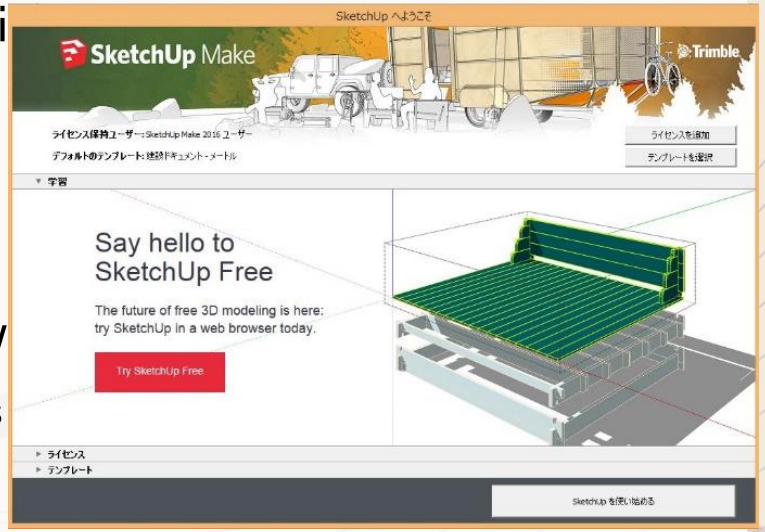
- Check the ‘data.list’
- Check the ‘data.tran’
- Check the ‘data.grp’

2. Creation of obstacle data

This section describes how to create obstacle data.To carry out numerical calculations, it is first necessary to create data on the obstacles to be placed in the analysis area.

1-1. Software used.

SketchUp is used to create obstacle data.This software can be used to create STL files (three-dimensional shape data storage format).The three-dimensional obstacle data stored in this STL file is used in the next task 'Create CADMAS gri



1-2. Process

The procedure for creating obstacle data is described below

The explanation assumes the case of numerical calculations of cross-sectional experiments.

SketchUp usage is omitted; once the obstacle data has been created in SketchUp, export the obstacle data in STL format.

3. Preparation of input data by CADMAS-MESH.

1. Preparation of ST files

When STL files are loaded into CADMAS-MESH, an ST file is required that defines the position of obstacles in the area, etc. In the ST file, information such as the void ratio for each STL file and the position of the obstacles in the area is entered.

ST file format.

File name　Porosity　Expansion rate　Inertia force coefficient　Resistance coefficient　4*4 matrix of moving rotation

An example input for this calculation is shown below.

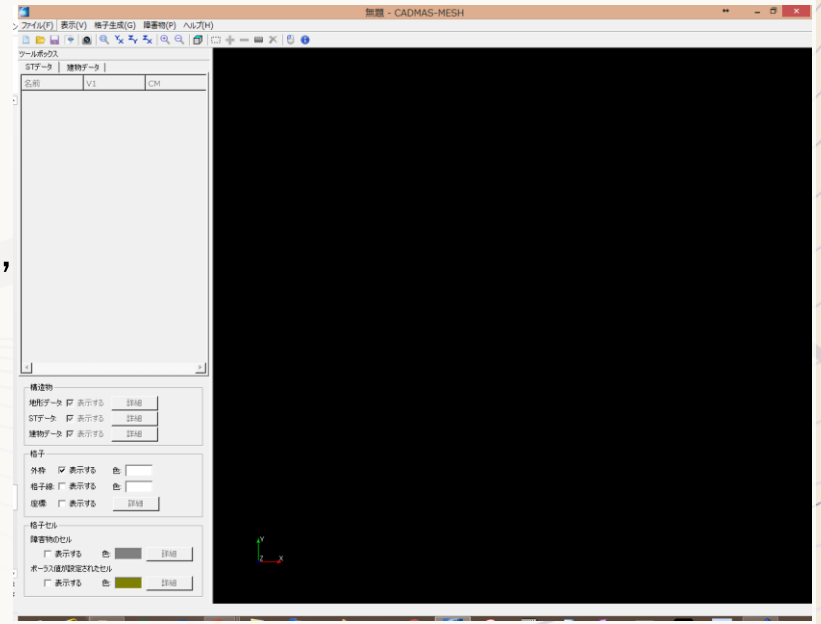
```
1 wall.stl    0.0   1.0   0.0   0.0   1000  0100  0010  0001 ↓
2 [EOF]
```

Enter the STL file name created in section 2.

2. Launching the software

Start CADMAS-MESH.

For detailed instructions on how to use CADMAS-MESH, please refer to the manual.



4. Creating the ‘data.in’ file

1. Setting up the grid data

Copy and paste the entire contents of the grid file created in 3 into the data.in file.

Grid file

```
GRID  X
0.00000000000000e+00
1.00000000000000e-01
2.00000000000000e-01
3.00000000000000e-01
4.00000000000000e-01
:
1316 POROUS Y    194     3     5   194     3     5     0.0000000000e+00     3.2500030000e-01
1317 POROUS Y    195     3     5   195     4     5     0.0000000000e+00     2.7500020500e-01
1318 POROUS Y    194     4     5   194     4     5     0.0000000000e+00     3.2500030000e-01
1319 POROUS Y    194     5     5   194     5     5     0.0000000000e+00     3.2500030000e-01
1320 POROUS Y    195     5     5   195     5     5     0.0000000000e+00     2.7500020000e-01
```

Copy all

‘data.in’ file

```
58 ##################################################################
59 #===格子座標等□データ〇
60 GRID  X
61 0.00000000000000e+00
62 1.00000000000000e-01
63 2.00000000000000e-01
64 3.00000000000000e-01
65 4.00000000000000e-01
:
1375 POROUS Y    194     3     5   194     3     5     0.0000000000e+00     3.2500030000e-01
1376 POROUS Y    195     3     5   195     4     5     0.0000000000e+00     2.7500020500e-01
1377 POROUS Y    194     4     5   194     4     5     0.0000000000e+00     3.2500030000e-01
1378 POROUS Y    194     5     5   194     5     5     0.0000000000e+00     3.2500030000e-01
1379 POROUS Y    195     5     5   195     5     5     0.0000000000e+00     2.7500020000e-01
```

Overwrites the same header section.

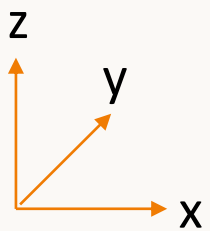
4. Creating the ‘data.in’ file

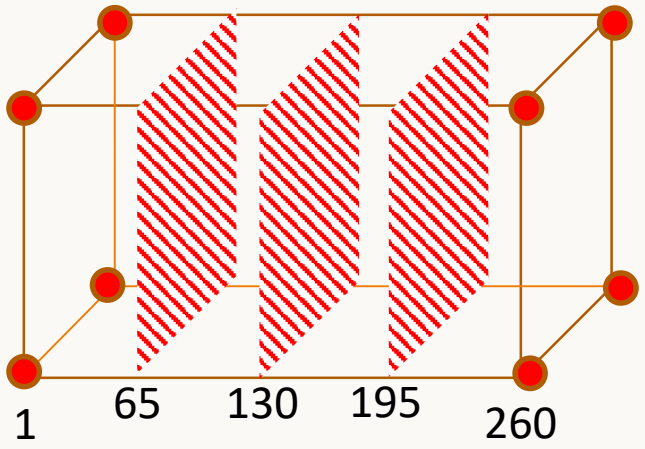
2. Parallel control data settings

Set how the area is divided. An example for dividing a region into four is shown below.

```
 7 #====並列制御□データ===●↵
 8 ↵
 9 PARALLEL X   65↵
10 PARALLEL X   130↵
11 PARALLEL X   195↵
```

Enter the cell number at the position separating the lattice.





3. Time control data settings

Set the calculation time increments and analysis time. For the calculation time increments, set (1) the initial value, (2) the safety factor, (3) the minimum value, (4) the maximum value and (5) the maximum number of steps and (6) the analysis end time, respectively.

```
14 #===時間制御□データ===●↵
15 ↵
16 TIME   AUTO    1.0D-5    1.0D-1↵
17 TIME   LIMIT   1.0D-5    1.0D0↵
18 TIME   END     999999    15↵
19 ↵
```

TIME␣AUTO␣Initial value␣Safety
TIME␣LIMIT␣Minimum␣Maximum value
TIME␣END␣Maximum number of steps␣End time of analysis
Enter the following information.

4. Creating the ‘data.in’ file

4. Setting of physical property values and other data

Set the physical properties of the fluid and gravity. For fluid, set (1) the initial water level, (2) the density of water, (3) the kinematic viscosity coefficient of water and (4) the acceleration of gravity for gravity.

```
20 #===物性値等□データ===●↵
21 ↵
22 MATE  W-LEVEL          1.0↵
23 MATE  DENSITY          1000.0↵
24 MATE  K-VISC           1.0D-6↵
25 MATE  GRAVITY          9.8↵
```

MATE␣W-LEVEL␣Initial water level
MATE␣DENSITY␣Density of water
MATE␣K-VISC␣Kinematic viscosity of water
MATE␣GRAVITY␣Gravitational acceleration
MATE␣GRAVITY␣Gravitational acceleration.

4. Setting the wave-making model data

Set the wave-making conditions. Set

(1)the wave making function, (2) the water depth,

(3) the wave height, (4) the period and

(5) the number of wave amplification cycles.

```
28 #===造波モデル□データ===●↵
29 ↵
30 MODEL WAVE-BC X- FUNC MATRIX↵
31 MODEL WAVE-BC X- DEPTH 1.0↵
32 MODEL WAVE-BC X- HEIGHT 1.0↵
33 MODEL WAVE-BC X- PERIOD 15.0↵
34 MODEL WAVE-BC X- AMPL 0.0↵
```

Wave making function FUNC MATRIX

:

Matrix data (.mtb) is used Direction

X-: From the minimum x-coordinate position to the normal direction

MODEL␣WAVE-BC␣direction␣wave-making function
MODEL␣WAVE-BC␣Direction␣DEPTH␣Depth
MODEL␣WAVE-BC␣direction␣HEIGHT␣wave height
MODEL␣WAVE-BC␣direction␣PERIOD␣period
MODEL␣WAVE-BC␣DIR␣AMPL␣How many periods to amplify

4. Creating the ‘data.in’ file

6. Set up the numerical solution related data

① Parameters for MILU ② Maximum number of iterations ③ Convergence error (absolute error) ④ Convergence error (relative error) ⑤ Differential scheme parameters for the advection term, respectively.

```
#===数値解法関連□データ○
COMP  MTRX M-ILUBCGSTAB  0.95
COMP  MTRX MAX-ITR       500
COMP  MTRX A-ERROR       1.0D-12
COMP  MTRX R-ERROR       1.0D-10
COMP  SCHM VP-DONOR      1.0
COMP  SCHM FF-SLOPE
```

COMP␣MTRX␣M-ILUBCGSTAB␣Parameters for MILU
COMP␣MTRX␣MAX-ITR␣Maximum number of iterations
COMP␣MTRX␣A-ERROR␣Convergence error (absolute error)
COMP␣MTRX␣R-ERROR␣Convergence error (relative error)
COMP␣SCHM␣VP-DONOR␣Difference scheme parameters for advection terms
COMP␣SCHM␣FF-SLOPE

7. Boundary condition data setting

Set the boundary conditions for flow velocity, pressure and VOF function. Set the boundary conditions for (1) flow velocity and pressure and (2) VOF function F, respectively, for the overall boundary of the numerical tank.

```
#===境界条件データ===●
B.C.  D                  VP  SLIP
B.C.  D                  F   FREE
```

B.C.␣D ␣Boundary conditions for flow velocity and pressure
B.C.␣D ␣Boundary conditions for VOF function F

4. Creating the ‘data.in’ file

8. Output file control settings

(i) Configuration of graphical file output contr

(1) Output start time

(2) Output end time

(3) Output time interval

```
1400 #===図化ファイル出力制御□データ===●↵
1401 ↵
1402 #FILE GRP STEP          0  100   1↵
1403 FILE GRP TIME          0  15  0.1↵
```

FILE␣GRP␣TIME␣Output start time␣Output end time␣Output time interval

(ii) Configuration of time series file output control.

(1) Output start time (2)Output end time

(3) Output time interval

(4)Physical quantity to be output

(5)x-direction cell number (6)y-direction cell number

(7)z-direction cell number

set respectively.

```
1412 #===時系列ファイル出力制御データ===●↵
1413 ↵
1414 #FILE TRN STEP  1  999999  1↵
1415 FILE TRN TIME     0  15  0.1↵
1416 ↵
1417 ##########################################
1418 ↵
1419 FILE   TRN   POINT   P   250   3   8↵
1420 FILE   TRN   POINT   P   250   3   9↵
1421 FILE   TRN   POINT   P   250   3   10↵
1422 FILE   TRN   POINT   P   250   3   11↵
1423 FILE   TRN   POINT   P   250   3   12↵
1424 FILE   TRN   POINT   P   250   3   13↵
1425 FILE   TRN   POINT   P   250   3   14↵
1426 FILE   TRN   POINT   P   250   3   15↵
1427 FILE   TRN   POINT   P   250   3   16↵
1428 FILE   TRN   POINT   P   250   3   17↵
1429 FILE   TRN   POINT   P   250   3   18↵
1430 FILE   TRN   POINT   P   250   3   19↵
1431 FILE   TRN   POINT   P   250   3   20↵
1432 FILE   TRN   POINT   P   250   3   21↵
1433 FILE   TRN   POINT   P   250   3   22↵
1434 FILE   TRN   POINT   P   250   3   23↵
1435 FILE   TRN   POINT   P   250   3   24↵
1436 FILE   TRN   POINT   P   250   3   25↵
1437 FILE   TRN   POINT   P   250   3   26↵
1438 FILE   TRN   POINT   P   250   3   27↵
1439 FILE   TRN   POINT   P   250   3   28↵
1440 FILE   TRN   POINT   P   250   3   29↵
1441 FILE   TRN   POINT   P   250   3   30↵
```

FILE␣TRN␣TIME␣Output start time␣Output end time␣Output time interval
FILE␣TRN␣POINT␣ Physical quantity to output␣ x-direction cell number␣ y-direction cell number␣ z-direction cell number

5. Execution of calculations

1. Prepare the files needed for the calculation

(1) ‘data.in’ 4 to create (2) ‘data.env’ command file (3) ‘data.mtb’ file with any wavemaking model (4) executable file

2. Computation run

6. Checking calculation results

1. Checking the list file

2. (1) The number of steps, analysis time, time increments, number of iterations, etc. in the analysis can be checked respectively.

```
7702 STEP=  2787 : TIME=  1.26733E+01 : DT   =  3.32689E-03 : FSUM=  2.13870E+01 : FCUT= -1.62350E-16 : !VD!=  3.40766E-02
7703             : !B! =  3.81295E-02 : !R! =  7.04230E-13 : ITR =     30
7704 STEP=  2788 : TIME=  1.26766E+01 : DT   =  3.33747E-03 : FSUM=  2.13870E+01 : FCUT=  2.65340E-16 : !VD!=  3.34169E-02
7705             : !B! =  1.06107E-02 : !R! =  9.30020E-14 : ITR =     30
7706 STEP=  2789 : TIME=  1.26800E+01 : DT   =  3.33105E-03 : FSUM=  2.13870E+01 : FCUT=  2.71456E-15 : !VD!=  3.33063E-02
7707             : !B! =  7.37033E-03 : !R! =  1.13477E-12 : ITR =     28
7708 STEP=  2790 : TIME=  1.26833E+01 : DT   =  3.30667E-03 : FSUM=  2.13870E+01 : FCUT=  7.67666E-16 : !VD!=  3.97081E-02
7709             : !B! =  2.88531E-03 : !R! =  2.03514E-13 : ITR =     28
```

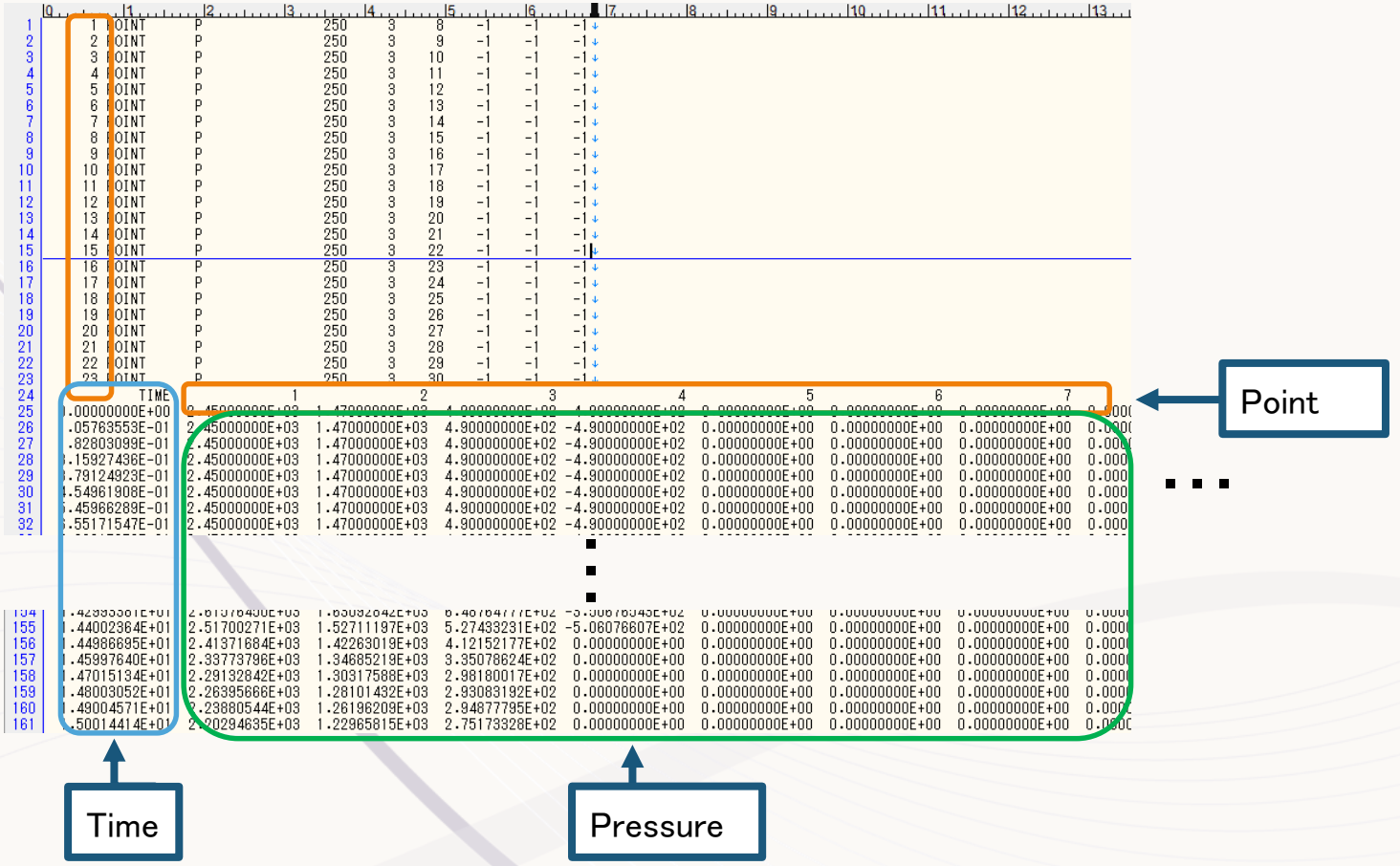
(2) At the bottom you can check whether the calculation has been successfully completed.

```
9121 ##### CPU TIME [S] ############################
9122
9123 ##  <<FLOW>>
9124 ##  TOTAL                          118.45
9125 ##  +-- PRE PROCESS                  0.17
9126 ##  +-- CALCULATION                118.28
9127 ##  |    +-- FILE I/O                1.51
9128 ##  |    +-- VELO & PRES            83.28
9129 ##  |    |    +-- CONV & VISC        2.88
9130 ##  |    |    +-- GENERATION         1.05
9131 ##  |    |    +-- INTEGRATION        3.96
9132 ##  |    |    +-- POISSON COEF       3.03
9133 ##  |    |    +-- POISSON SOLV      66.38
9134 ##  |    |    +-- V & P MODIF        1.21
9135 ##  |    |    +-- E.T.C.             4.78
9136 ##  |    +-- TEMPERATURE             0.00
9137 ##  |    +-- CONCENTRATION           0.00
9138 ##  |    +-- K-EPSIRON               0.00
9139 ##  |    +-- VOF FUNCTION           29.29
9140 ##  |    |    +-- CONVECTION         4.58
9141 ##  |    |    +-- INTEGRATION        1.49
9142 ##  |    |    +-- MODIF & CUT        0.91
9143 ##  |    |    +-- NF & T-DOOR       17.51
9144 ##  |    |    +-- E.T.C.             4.80
9145 ##  |    +-- E.T.C.                  4.19
9146 ##  +-- E.T.C.                       0.00
9147
9148 ##  <<ROUTINE>>
9149 ##  +-- VF_P*****                  42.06
9150 ##  +-- VF_M1BCGS                  66.23
9151 ##  +-- VF_FDROPF                  13.65
9152
9153 ##### NORMAL END. ##############################
```

6. Checking calculation results

2. Checking the tran file

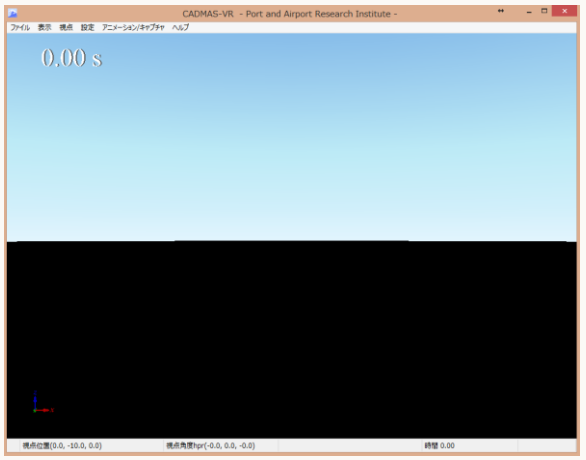
The time-series pressure values in the cell (in front of the wall) set in 5-8-(1) are output.



6. Checking calculation results

3. Checking the grp file Visualise the calculation results.

(1) Starting the software Start CADMAS-VR.



(2) Loading files

For detailed instructions on how to use CADMAS-VR, please refer to the manual.