

Conifer Cast 2.5

New Features:

- Numerical Options
- GMRES Iteration Option for Pressure-Velocity Coupling
- Tilt Pour Casting
- Custom Flow-3D Parameters
- Three Heat Transfer Void Types
- Baffle Setup
- Moving Obstacle Setup
- The Thermoelastic Stress Model
- Implicit Surface Tension
- Air Entrainment Model

Numeric Options

Numerical options

Pressure iteration method

- Point-by-point succ. overrelaxation (SOR)
- Line implicit method (ADI) [iadjx, iadiy, iadjz]
- GMRES method [igmres]

Heat transfer and conduction [imphtc]

- Explicit
- Implicit

Elastic stress evaluation [impels]

- Explicit
- Implicit

Surface tension evaluation [impsft]

- Explicit
- Implicit

Multi-block boundary conditions

Mixture coefficient [alphamb]

Viscous stress evaluation [impvis]

- Explicit evaluation [0]
- Implicit evaluation with SOR [1]
- Implicit evaluation with ADI [2]
- Implicit evaluation with GMRES [3]

Time-step size control

Control method [autot]

- Constant time-step size [0]
- Stability [2]
- Stability and nr of pressure iterations [1]

Initial time-step size [delt] s

Minimum timestep size [dtmin] s

Maximum timestep size [dtmax] s

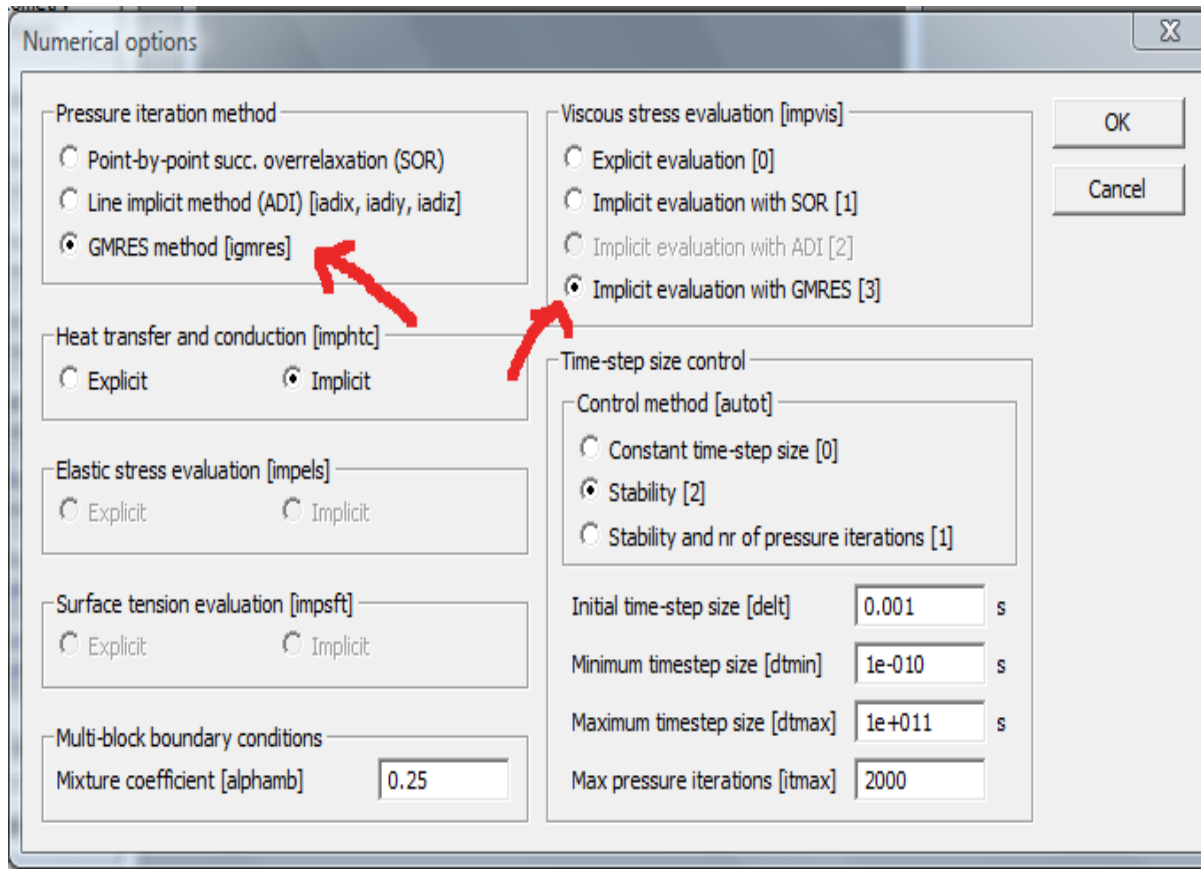
Max pressure iterations [itmax]

OK

Cancel

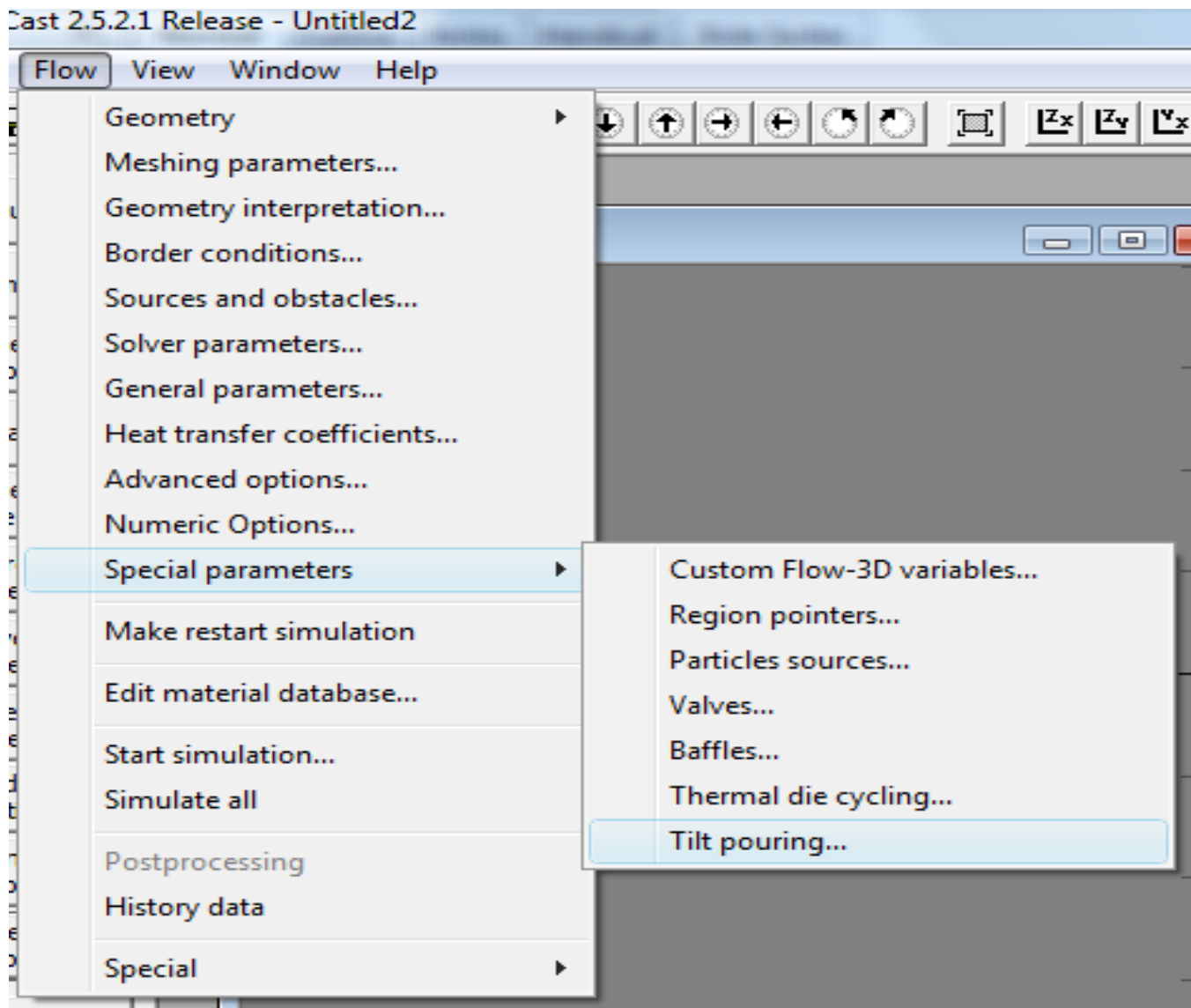
- A new dialog 'Numerical options' have been introduced.
- Numerical options contains options that control the technical details of the solver behavior.

GMRES Iteration Option



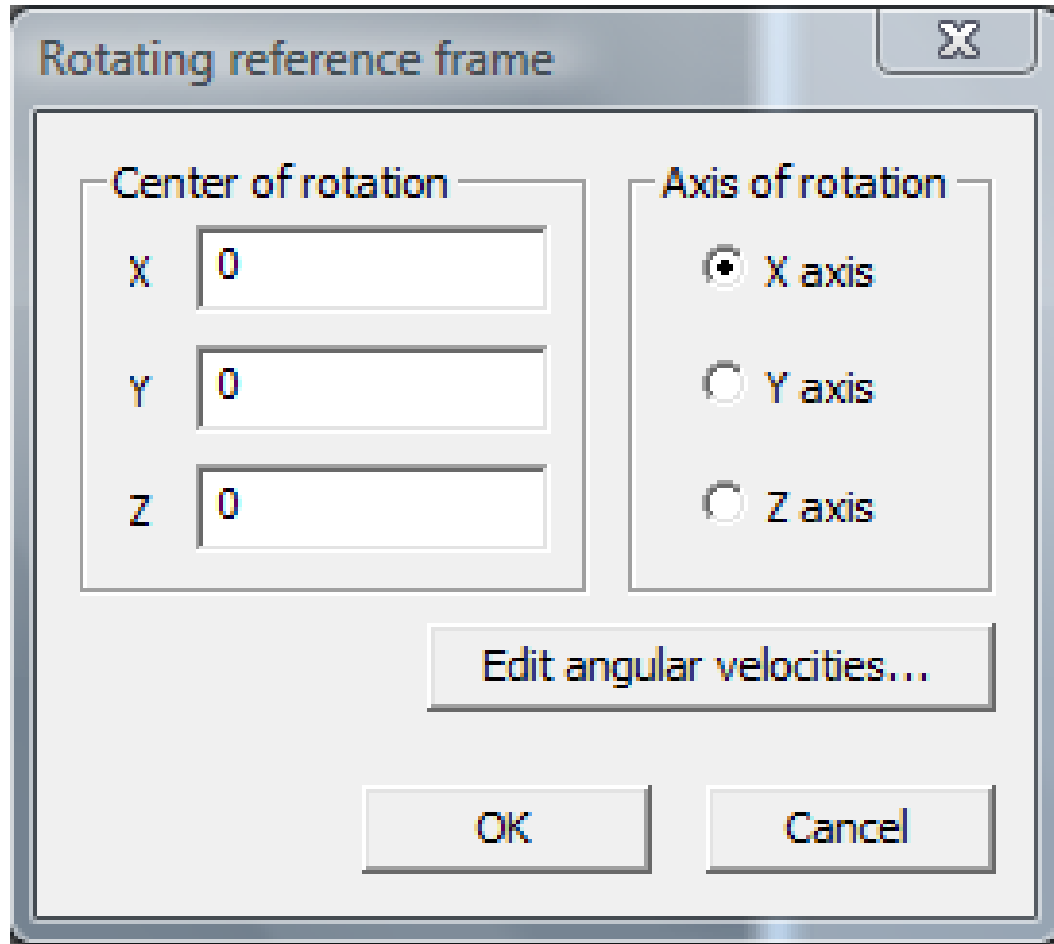
- New solver iteration method GMRES has been introduced.
- This method is the generic minimum residual method (GMRES), which is a generalization of the conjugate gradient method for non-symmetric problems. '
- The GMRES method can also be used for viscous stress evaluation, but only if it is used for pressure-velocity coupling.

Tilt Pour Casting 1/2



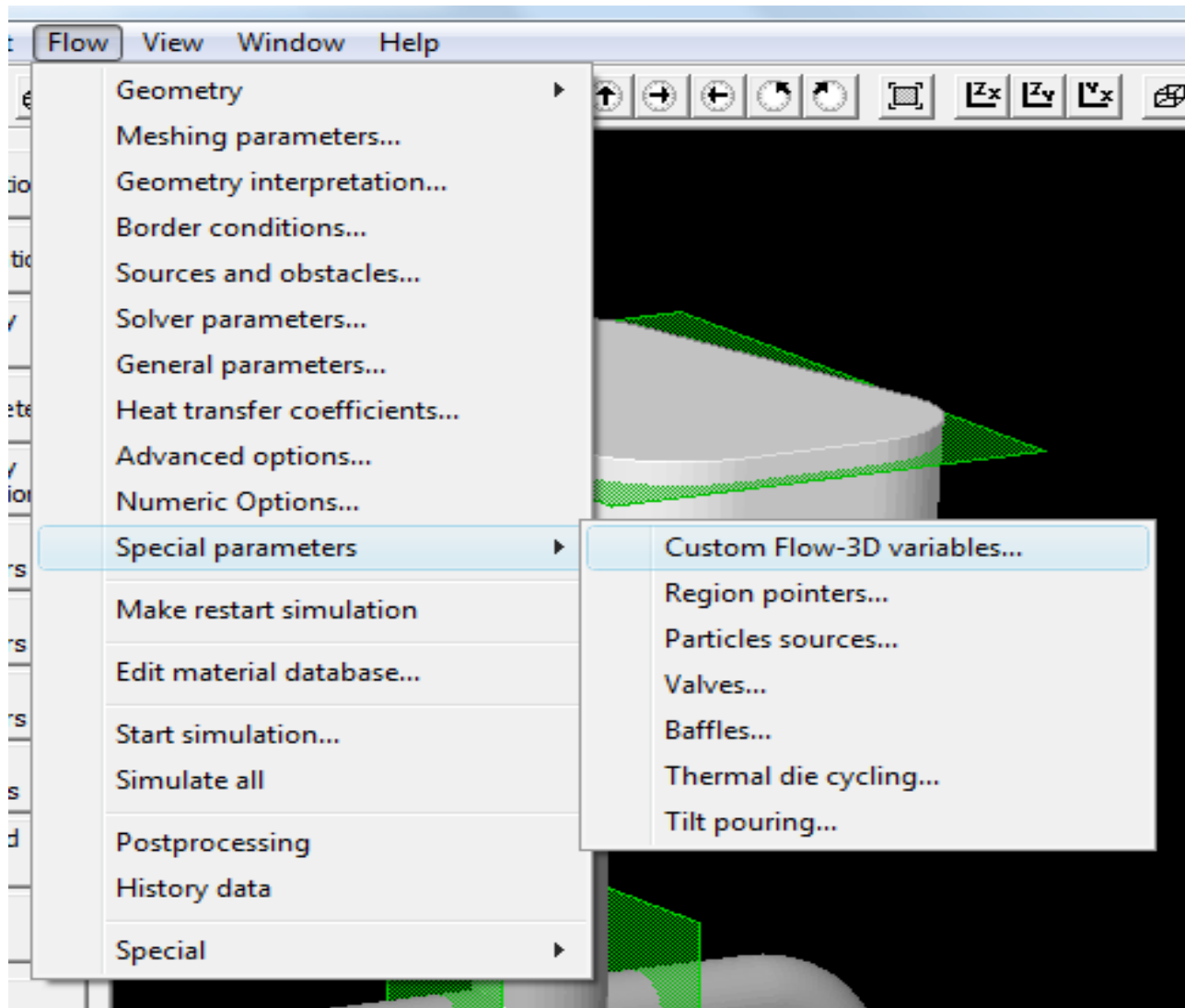
- A new feature for specifying non-inertial reference frames.
- This is used for simulating tilting casting system. The whole simulation domain is rotated according to given timetable
- Effects on
 - fluid inertia
 - gravity direction

Tilt Pour Casting 2/2



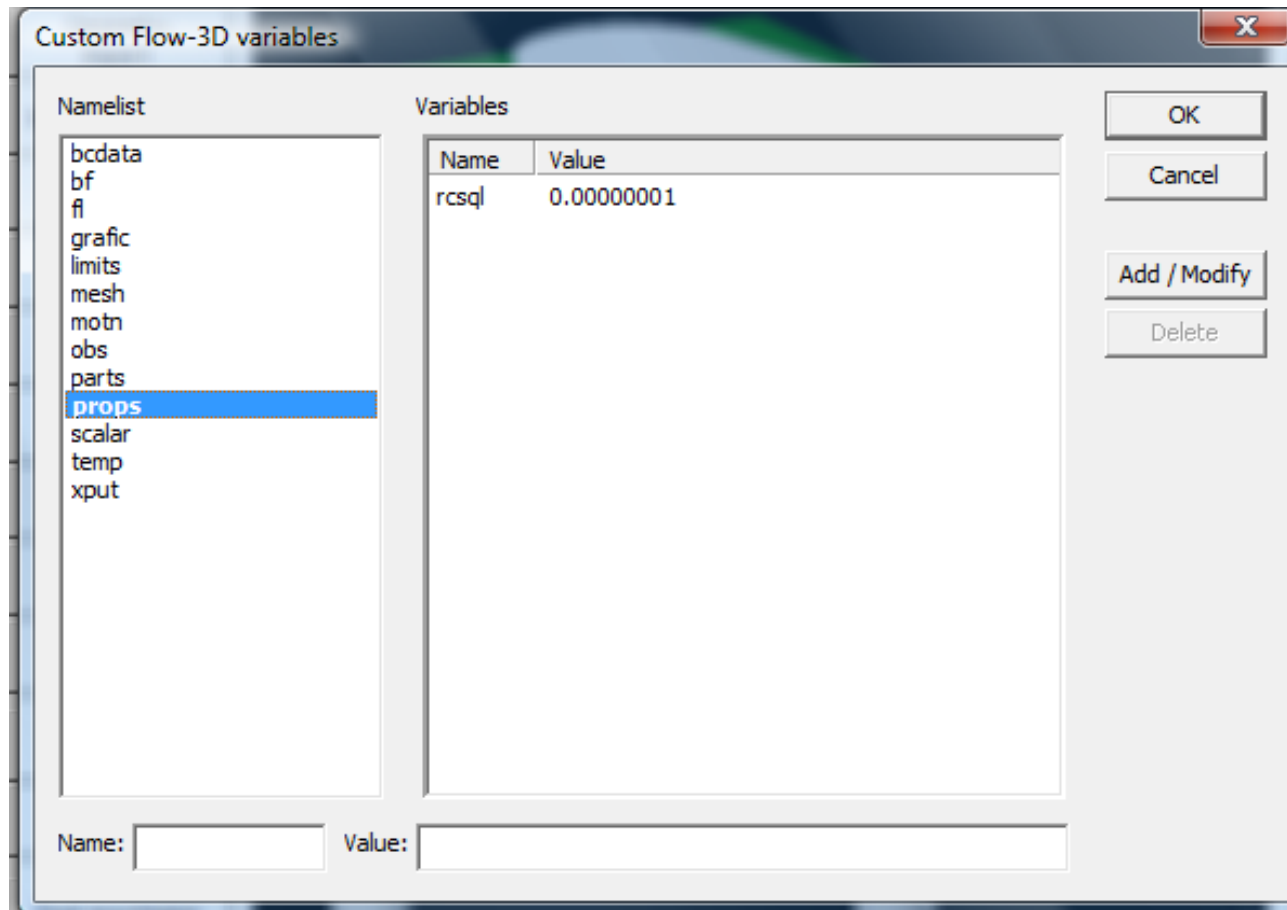
- Definition
 - The user interface allows the user to enter the following values:
 - Center of rotation (x, y and z)
 - Axis of rotation (x, y or z)
 - A table of angular velocities indexed by time (velocities in degrees / second)
- In postprocessing the view is rotated according to given angle values

Custom Flow-3D Parameters 1/2



- A new feature for declaring Flow-3D input variables that are otherwise unsupported by Conifer Cast has been implemented.

Custom Flow-3D Parameters 2/2

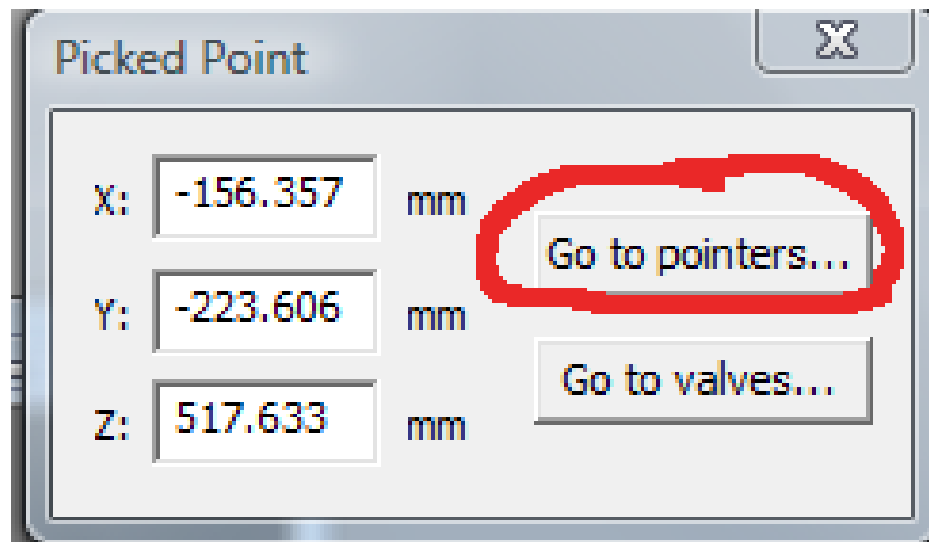


- Left hand side contains a list of namelists as defined in the FLOW-3D prepin.inp specification
- Right hand side contains a list of defined variables and their current values.
- The bottom of the dialog has fields for entering the variable name and its value.
- The values defined here are appended as they are to the prepin.inp file from where the solver reads the simulation problem definition
- Values given here have precedence over any values written by the Conifer Cast user interface

Three Heat Transfer Void Types 1/3



- There is a possibility in Flow-3D to declare three different types of heat transfer voids.
- Void regions are typically used for modeling gas regions
- Void region type is defined with pointers
 - Select 'Pick point' feature from the toolbar
 - Click on a location on screen
 - 'Picked Point' dialog will appear with the coordinates of the picked point
 - Click 'Go to pointers...'



Three Heat Transfer Void Types 2/3

Region pointers

Location	Pressure	Temp.	Fluid	HT
0.00, -700.00, 0.00	100000	20	no	type 1
250.00, -300.00, -300.00	100000	20	no	type 2

Location [x-,y-,zvr]

X


Y

Z

Pressure [pvrd] Pa

Temperature [tvrd] °C

Fluid fraction [fvrd]

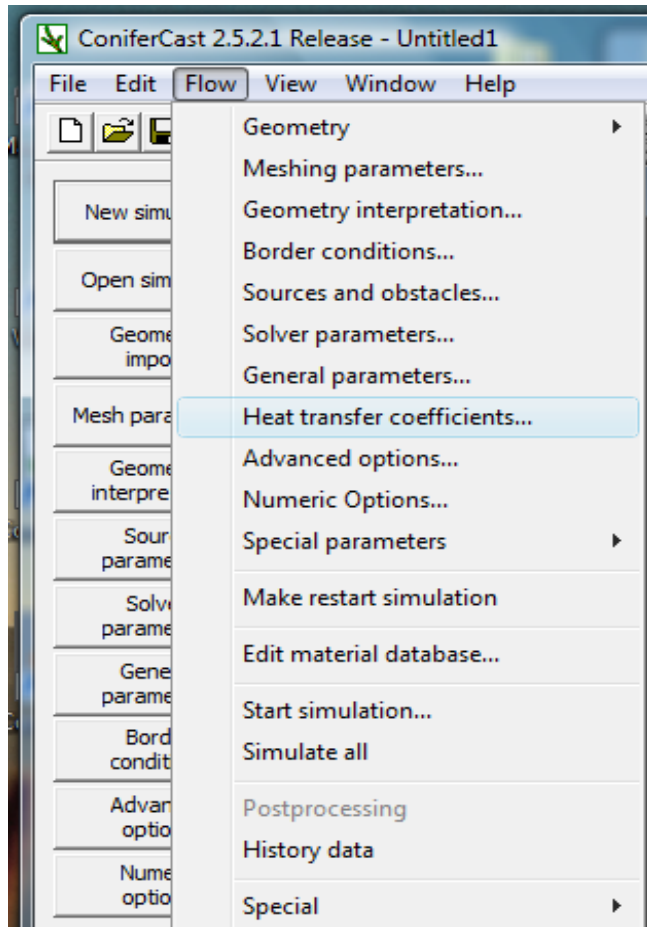
Heat transfer [ivht] Type 1 

Add Change Remove

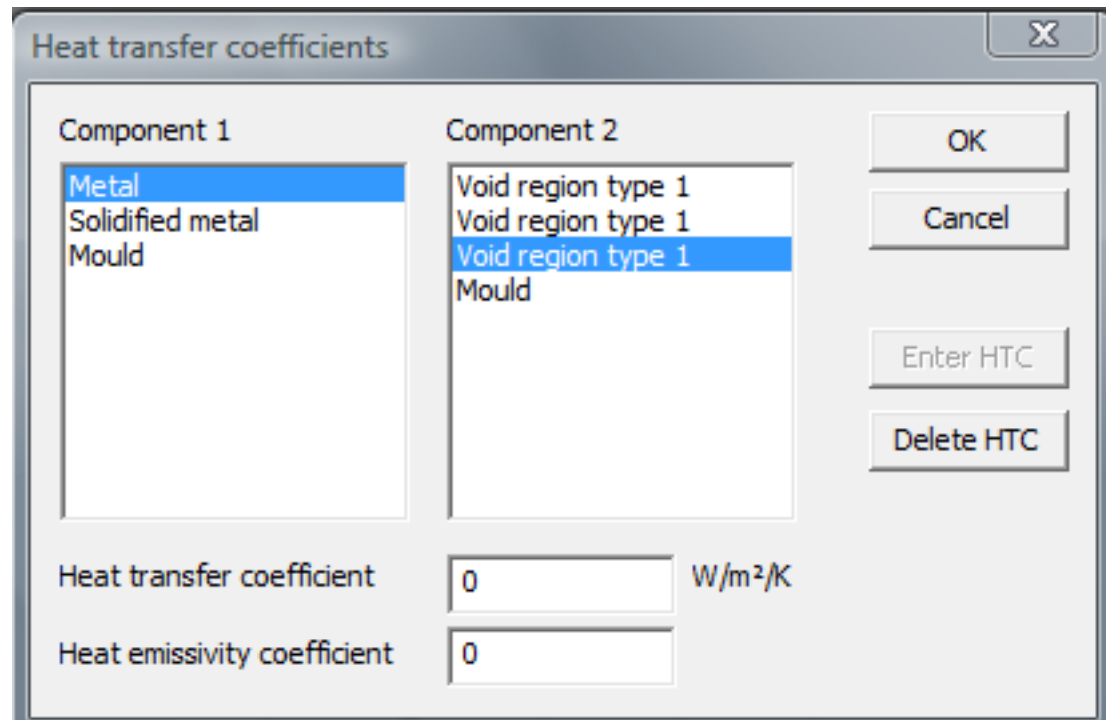
OK Cancel

- For each of these three void types a separate temperature and pressure s can be given.

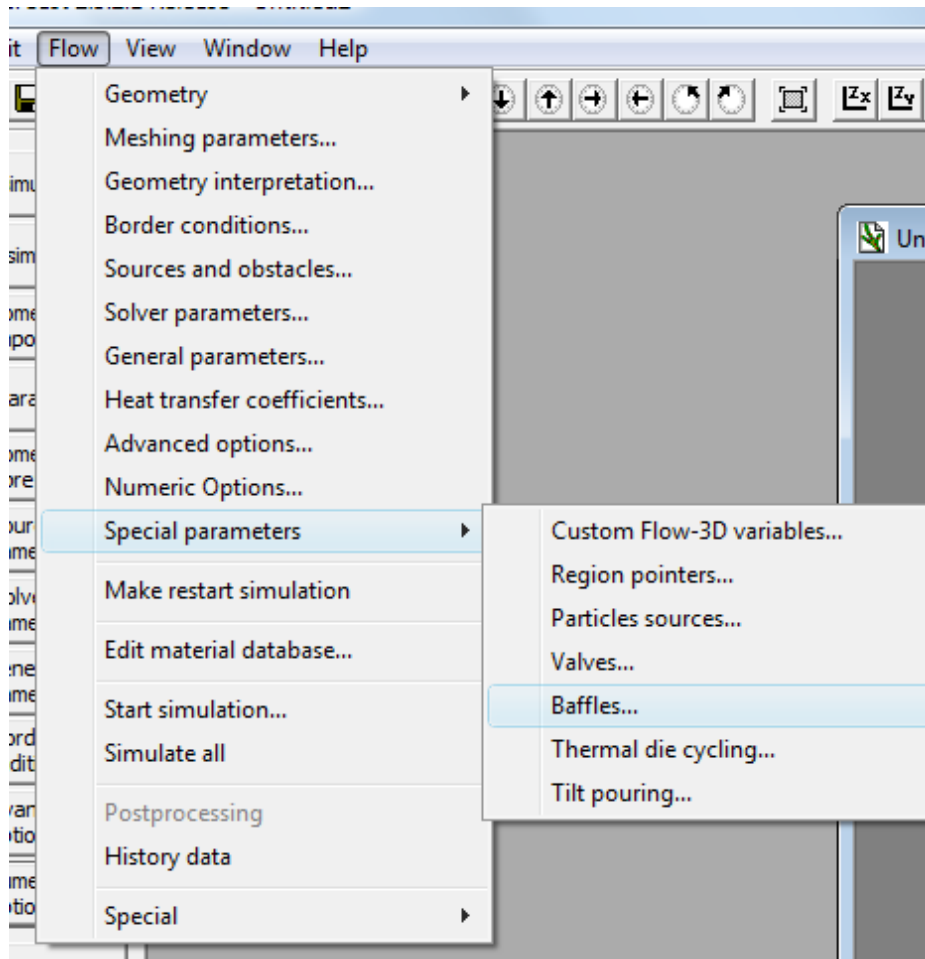
Three Heat Transfer Void Types 3/3



- Heat conductivities and heat emissivity coefficients can be given for all obstacles and the metal.

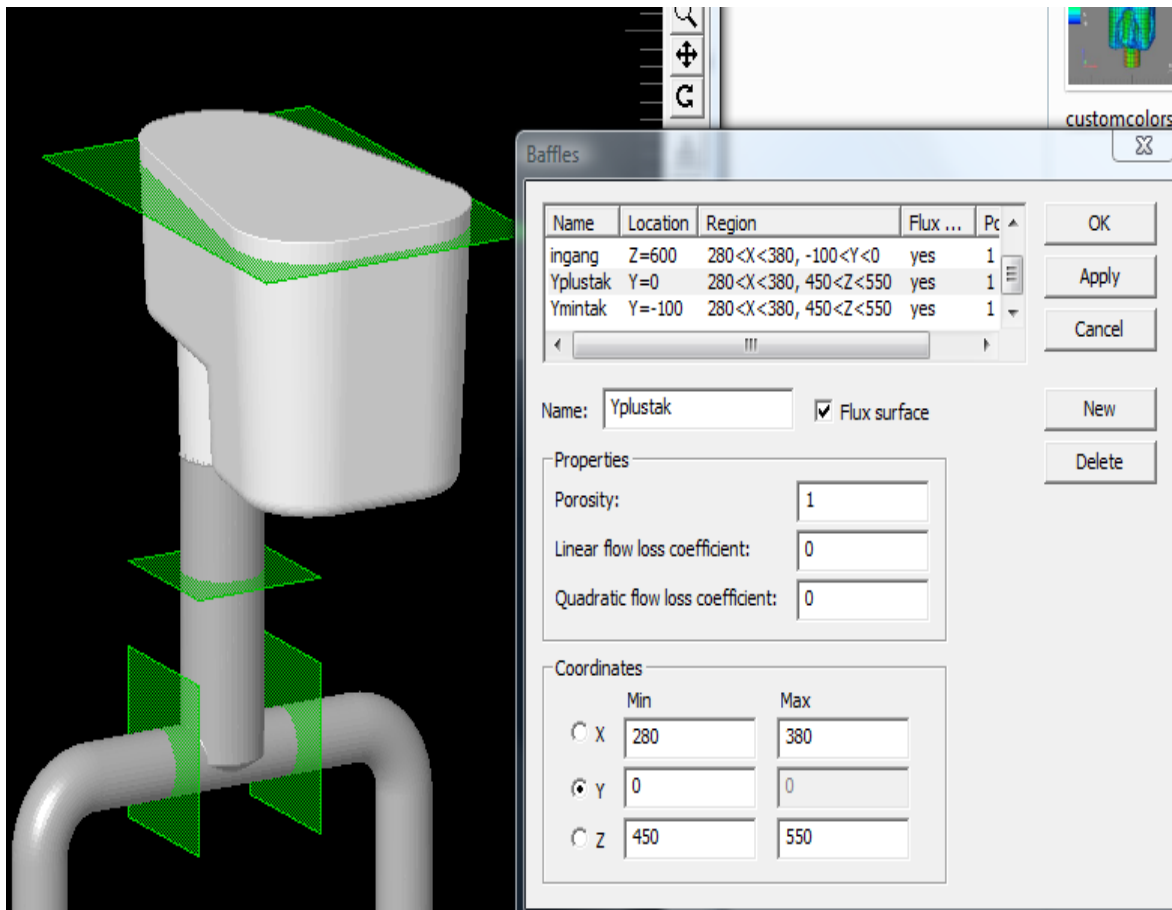


Baffles 1/2



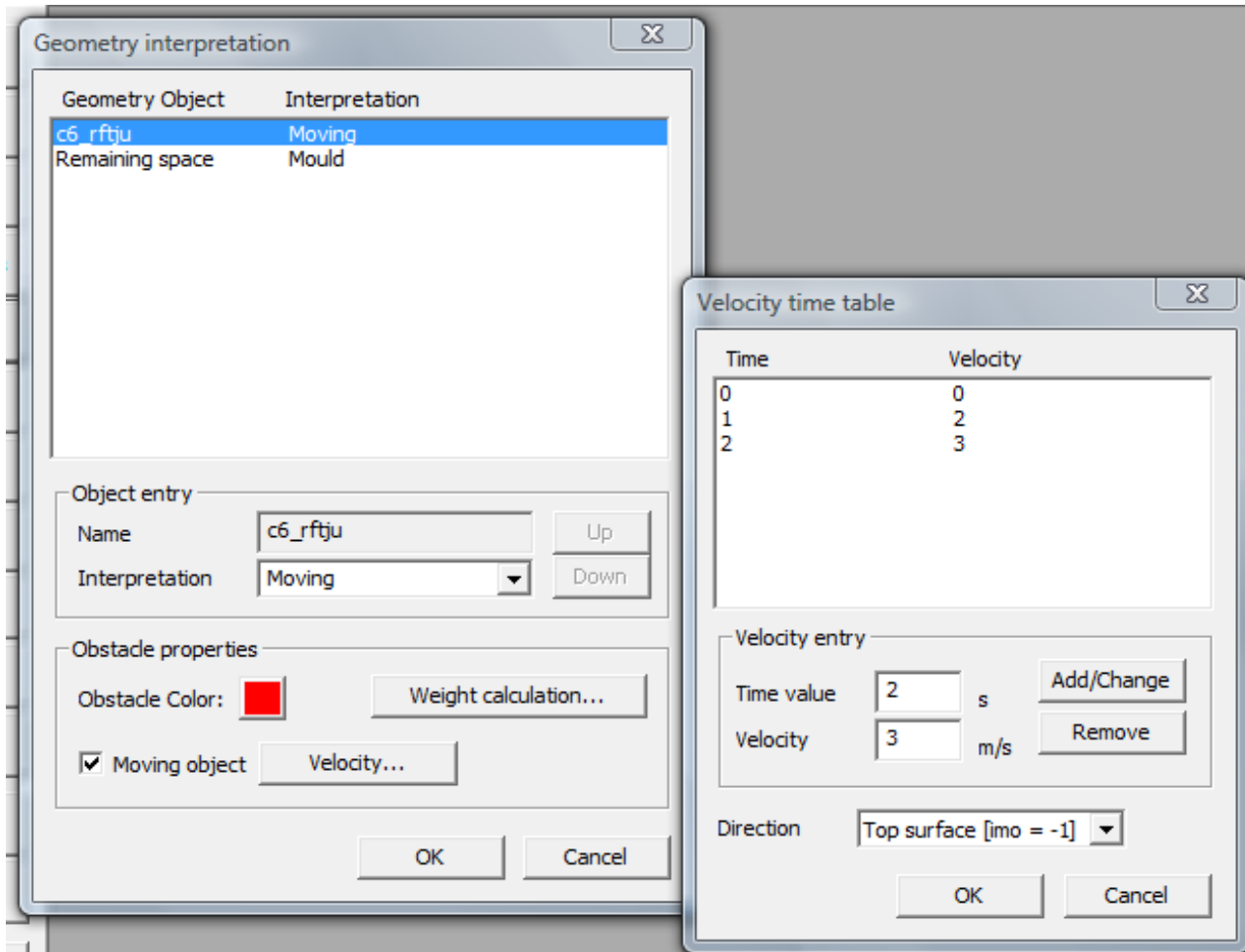
- Baffles are two dimensional elements that reside between calculation cells

Baffles 2/2



- Baffles can be used for
 - Measuring fluid flow through given location. When 'Flux surface' is enabled a history plot will be generated about the metal flow through the baffle.
 - Modeling drag effect of filters

Moving Obstacles



- Geometries can be defined as moving in the geometry interpretation dialog
- Object velocity is given as a function of time
- Useful for modeling pistons etc

Thermoelastic Stress Model 1/3

Solver Parameters

Flow calculation [ihonly]

No flow evaluation [2]

Calculate flow [0]

Heat transfer model [ihtc]

No heat transfer [0]

Evaluate heat transfer in fluid [1]

Evaluate heat transfer and conduction in fluid and obstacles [2]

Thermoelastic stress model [ielast]

No stress evaluation [0]

Activate elastic stress model [1]

Shrinkage calculation model [ishrnk]

No shrinkage [0]

Rapid Shrinkage model [2]

Dynamic Shrinkage model [1]

Calculation end criteria [ifin]

End when filled or time limit exceeded [2]

End when solidified or time limit exceeded [3]

Calculation end criteria limits

End when filled/solidified up to % [frcfm] 100 %

Force simulation end at time [twfin] 10000 s

Number of spatial data timesteps

Specified number [pltfrc] 20

Time interval [pltdt] 1 s

Animation data

Time interval [apltdt] 0.1 s Select data...

Progress messages / history plots

Time interval [sprtdt, hpltdt] 0.1 s

OK

Cancel

- Calculating Thermoelastic Stresses have been added
- Flow evaluation must be enabled for the elastic stress module
- Thermoelastic Stress model is enabled in Solver Parameter dialog

Thermoelastic Stress Model 2/3

Material

Material type: Metal Solid/Input Foam

Solid parameters

Density [rhofs]	0.001	kg/m ³
Specific heat [cvs1]	800	J/kg/K
Thermal conductivity [thcs1]	0	W/m/K
Thermal expansion coeff. [thexs1]	0	1/K

Liquid parameters

Density [rhof]	0	kg/m ³
Specific heat [cv1]	800	J/kg/K
Thermal conductivity [thc1]	0	W/m/K
Dynamic viscosity [mu1]	0	kg/m/s
Dynamic visc. at solidification [mus]	0	kg/m/s
Thermal expans. coeff. [thexf1]	0	1/K
Cavitation pressure [pcav]	0	Pa
Heat transfer coeff. to void [hflv1]	0	W/m ² /K
Emissivity coefficient to void [hfle1]	0	
Cont. ang. for wall adhesion [cangle]	-90	deg

Surface tension parameters

Surface tension coefficient [sigma]	0	J/m ²
Coeff. temp. sensitivity [csigma]	0	J/m ² /K

Elastic parameters

Elastic shear modulus	0	N/m ²
Shear modulus temp. sens.	0	N/m ² /K
Yield stress limit	-1	N/m ²
Yield stress limit temp. sens.	0	N/m ² /K

Solidification parameters

Solidus temperature [ts1]	999999	C
Liquidus temperature [tl1]	1000000	C
Solidification drag coeff. [tsdrg]	1	1/s
Latent heat of fusion [dht1]	0	J/kg
Fr. of solid at coherency point [fsco]	0	
Critical fraction of solid [fscr]	1	
Squared speed of sound [asqr]	0	m ² /s ²
Cr. pr. of porosity formation [pgasmp]	0	Pa

Viscosity parameters

Temperature dependent viscosity model

Coefficient 1 [mutmp1]	0	
Coefficient 2 [mutmp2]	0	K
Coefficient 3 [mutmp3]	1	

Shear stress dependent viscosity model

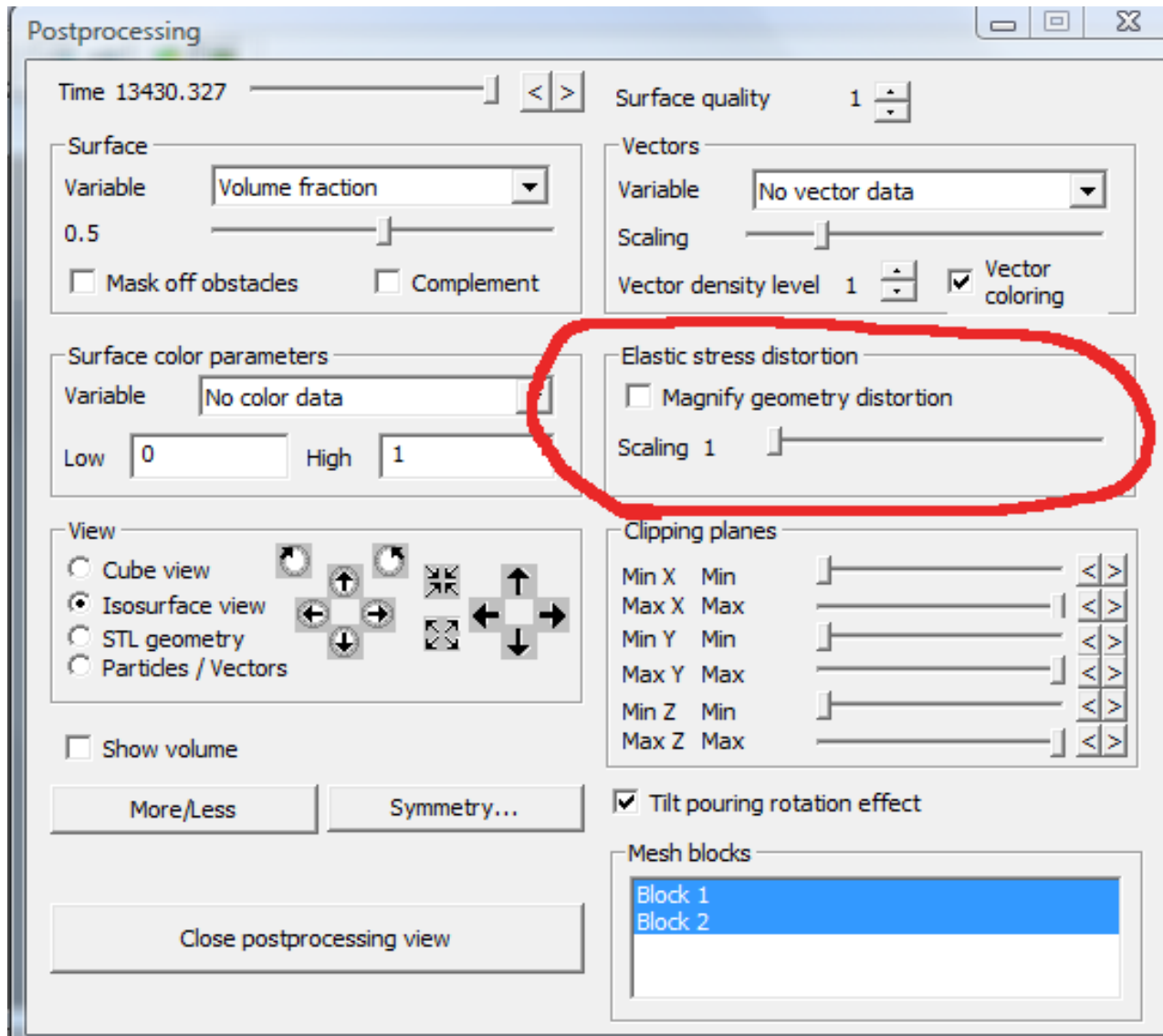
Coefficient 1 [muc0]	1	
Coefficient 2 [muc1]	0	1/s
Coefficient 3 [muc2]	0	
Coefficient 4 [muc3]	0	kg/m/s
Min. fluid strain (0 = N/A) [muctst]	0.001	1/s

OK Cancel

The material parameters are as follows:

- EMOD1 / EMODT1: Shear elastic modulus. $E = EMOD1 + EMOD1T * (T - TSTAR)$
- YIELD1 / YIELDT1: Yield stress. $Y = YIELD1 + YIELD1 * (T - TSTAR)$
- THEXS1: Thermal expansion coefficient of the solid phase (alpha)

Thermoelastic Stress Model 3/3



- Once thermoelastic stress is calculated the geometry distortion can be visualized in the postprocessing
- Casting piece geometry is distorted in the view according to simulation results
- In order to make the distortion more visible it can be magnified using the slider in postprocessing dialog

Implicit Surface Tension

Numerical options

Pressure iteration method

- Point-by-point succ. overrelaxation (SOR)
- Line implicit method (ADI) [iadx, iady, iadz]
- GMRES method [igmres]

Viscous stress evaluation [impvis]

- Explicit evaluation [0]
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Heat transfer and conduction [imphtc]

- Explicit
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Elastic stress evaluation [impels]

- Explicit
- Implicit

Surface tension evaluation [impsft]

- Explicit
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Multi-block boundary conditions

Mixture coefficient [alphamb]

Time-step size control

Control method [autot]

- Constant time-step size [0]
- Stability [2]
- Stability and nr of pressure iterations [1]

Initial time-step size [delt] s

Minimum timestep size [dtmin] s

Maximum timestep size [dtmax] s

Max pressure iterations [itmax]

OK

Cancel

- New implicit solution method for surface tension calculation has been added

Air Entrainment Model

Advanced options

Viscosity [ifvis]

Local viscosity evaluation (no turbulence model) [0]
 Two-equation turbulence model [3]
 Renormalized Group Theory model [4]

Density [ifrho]

Constant uniform density [0]
 Function of local temperature [1]
 Solve transport equation for density [2]
 Solve with 2nd order method [3]

Gas model [gamma]

Fixed pressure gas regions
 Adiabatic gas regions

Adiabatic constant

Drag function [idrg]

No drag [0]
 Volume fraction dependent drag [1]
 Fluid fraction dependent drag [2]
 Unsaturated flow in porous media [5]
 Reynolds number dependent drag [4]

Other models

Disable wall shear stress calculation [iwsh]
 Enable cavitation mode [icav]
 Enable viscous heating [ivish]
 Enable surface tension [ifsft]
 Enable wall adhesion [cangle]
 Enable surface defect tracking [idfct]
 Enable micro-porosity evaluation [impor]
 Enable air entrainment evaluation [idfair]
 Shear dependent viscosity model [mde1]
 Temperature dependent viscosity model [mutmp1]

Gravity [gx, gy, gz]

X Y Z m/s²

Restart

Restart time [trest]

Temperature options [ihtst]

Use all data from previous run [0]
 All data except temperatures [1]
 Solid temperatures only [2]

OK
Cancel

- New feature of air entrainment tracking has been added