

XML GUIDE FOR DUALSPHYSICS

Create your own case using the XML file

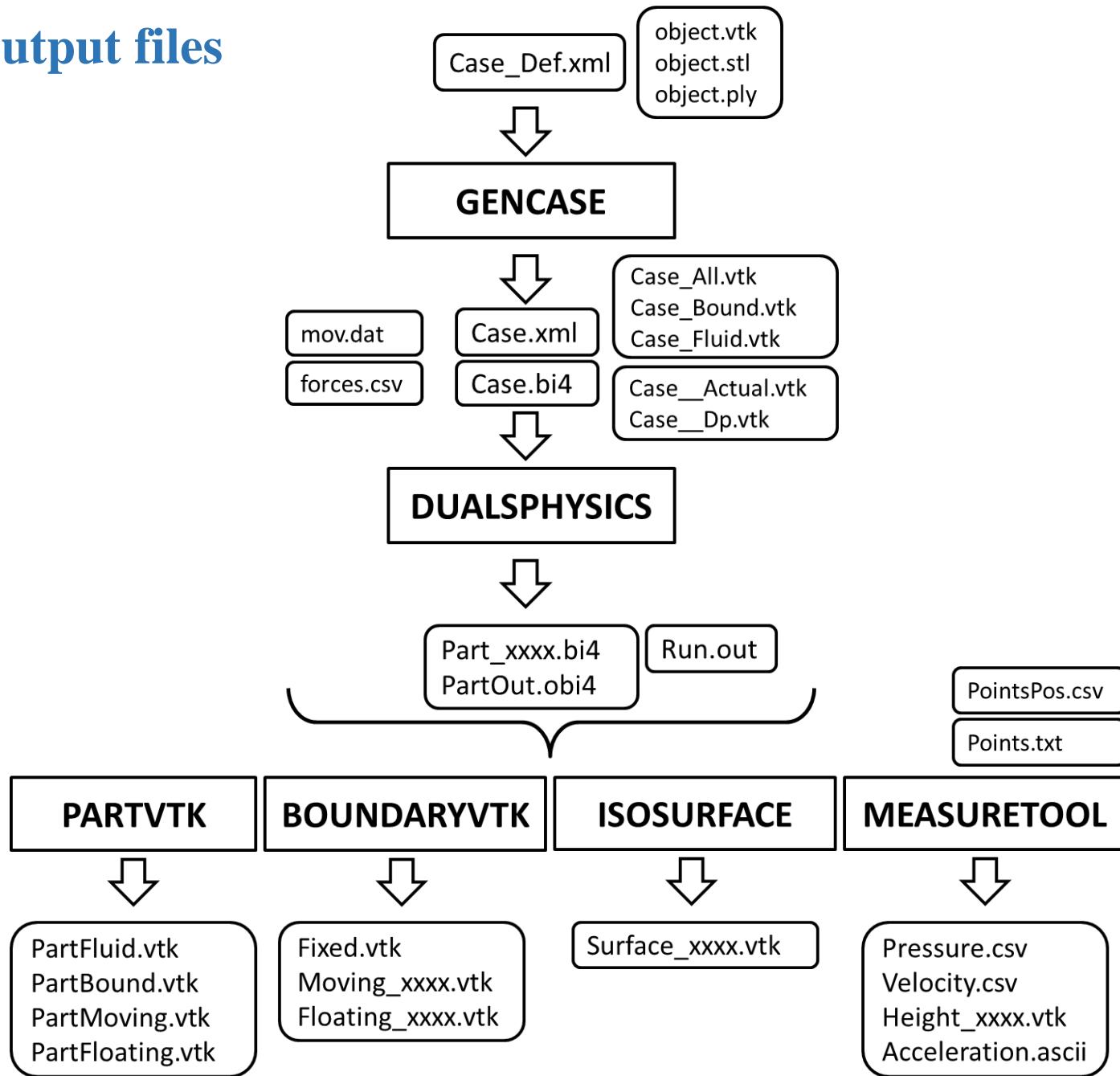


April 2016

DualSPHysics team

Input & output files

Pre-Processing



Input & output files: Format files

Case_Def.xml

Case.xml

XML File

- The eXtensible Markup Language is textual data format compatible with any hardware and software.
- Information is structured and organised by using labels.
- They can be easily edited using any text editor.

Case.bi4

Part_xxxx.bi4
PartOut.obi4

BINARY File

- Binary format consumes six times less memory than text format.
- Reading or writing is several times faster using a binary format.
- A special code is required to read the data (JPartDataBi4.cpp/.h).
- “.bi4” is the new binary format that also includes double precision.
- The user can also define new arrays that post-processing tools can automatically manage.

Input & output files

Constants and configuration parameters for simulation

Case_Def.xml

object.vtk
object.stl
object.ply

GENCASE

Created by the user

Created by GenCase BUT it can also be created by the user

Data for moving boundaries

Data of forces exerted on fluid

mov.dat

forces.csv

Case_All.vtk
Case_Bound.vtk
Case_Fluid.vtk

Case_Actual.vtk
Case_Dp.vtk

DUALSPHYSICS

Binary file with particle data at output time

Binary file with excluded particles during simulation

Part_xxxx.bi4
PartOut.obi4

Run.out

Text file with execution log

Binary file with particle data at initial instant

XML file

Case_Def.xml



GENCASE



Case.xml

```

<case>
<casedef>
    <lattice bound="1" fluid="1" />
    <gravity x="0" y="0" z="-9.81" comment="Gravitational acceleration" units_comment="m/s^2" />
    <cfnumber value="0.2" comment="Coefficient to multiply Dt" />
    <chwl value="0" auto="true" comment="Maximum still water level to calculate speedofsound using coefsound" units_comment="metres (m)" />
    <speedsystems value="0" auto="true" comment="Maximum system speed (by default the dam-break propagation is used)" />
    <coefsound value="20" comment="Coefficient to multiply speedsystems" />
    <speedsound value="0" auto="true" comment="Speed of sound to use in the simulation (by default speedofsound=coefsound*speedsystems)" />
    <coef value="1.0" comment="Coefficient to calculate the smoothing length (H=coefficient*sqrt(3*dp^2) in 3D)" />
    <gamma value="7" comment="Politropic constant for water used in the state equation" />
    <rhop0 value="1000" comment="Reference density of the fluid" units_comment="kg/m3" />
</casedef>
<mkmconfig bounount="240" fluidcount="10" />
<geometry>
    <definition dp="0.01" units_comment="metres (m)">
        <pointmin x="-1" y="0" z="-1" />
        <pointmax x="4.5" y="0" z="3.5" />
    </definition>
    <commands>
        <mainlist>
            <seedrandom mode="full" />
            <setmkfluid mk="0" />
            <drawbox>
                <boxfill>solid</boxfill>
                <point x="0" y="-1" z="0" />
                <size x="3" y="2" z="3" />
            </drawbox>
            <setmkbound mk="0" />
            <drawbox>
                <boxfill>bottom | left | right | front | back</boxfill>
                <point x="0" y="1" z="0" />
                <size x="4" y="2" z="3" />
            </drawbox>
        </mainlist>
    </commands>
</geometry>
<parameters>
    <parameter key="StepAlgorithm" value="1" comment="Step Algorithm 1:Verlet, 2:Symplectic (default=1)" />
    <parameter key="VerletSteps" value="40" comment="Verlet only: Number of steps to apply Euler timestepping (default=40)" />
    <parameter key="VerletTimestep" value="0.001" comment="Interaction Kernel 1:Cubic Spline, 2:Wendland, 3:Laplacian (default=2)" />
    <parameter key="ViscoTreatment" value="1" comment="Viscosity formulation 1:Artificial, 2:Laminar+SFS (default=1)" />
    <parameter key="Visco" value="0.02" comment="Viscosity value" />
    <parameter key="ViscoBoundaryFactor" value="1" comment="Multiply viscosity value with boundary (default=1)" />
    <parameter key="DeltaSPH" value="0.1" comment="DeltaSPH value, 0.1 is the typical value, with 0 disabled (default=0)" />
    <parameter key="Shift" value="0" comment="Shifting mode 0:None, 1:Ignore bound, 2:Ignore fixed, 3:Full (default=0)" />
    <parameter key="#ShiftCoef" value="2" comment="Coefficient for shifting computation (default=2)" />
    <parameter key="#ShiftTTS" value="1.5" comment="Threshold to detect free surface. Typically 1.5 for 2D and 2.75 for 3D (default=0)" />
    <parameter key="RigidAlgorithm" value="1" comment="Rigid Algorithm 1:SFM, 2:DEM (default=1)" />
    <parameter key="FtPause" value="0.0" comment="Time to freeze the floatings at simulation start (warmup) (default=0)" units_comment="seconds" />
    <parameter key="CoedDMIn" value="0.05" comment="Coefficient to calculate minimum time step dtmin=coedtmin/h/speedsound (default=0.05)" />
    <parameter key="#DtInit" value="0.0001" comment="Initial time step (default=h/speedsound" units_comment="seconds" />
    <parameter key="#DDMin" value="0.00001" comment="Minimum time step (default=coedtmin/h/speedsound" units_comment="seconds" />
    <parameter key="#DDFixed" value="0" comment="Dt values are loaded from file (default=disabled)" />
    <parameter key="DtAllParticles" value="0" comment="Velocity of particles used to calculate DT. 1:AII, 0:Only fluid/floating (default=0)" />
    <parameter key="TimeMax" value="0.72" comment="Time of simulation" units_comment="seconds" />
    <parameter key="TimeOut" value="0.01" comment="Time out data" units_comment="seconds" />
    <parameter key="Ind2" value="1" comment="Increase of Z+" units_comment="decimal" />
    <parameter key="PartsOutMax" value="1" comment="Allowed /100 of fluid particles out the domain (default=1)" units_comment="decimal" />
    <parameter key="Rhop0Min" value="700" comment="Minimum rhop valid (default=700)" units_comment="kg/m3" />
    <parameter key="Rhop0Max" value="1300" comment="Maximum rhop valid (default=1300)" units_comment="kg/m3" />
</parameters>
</case>

```

```

<case>
<casedef>
    <constantdef>
        <gravity x="0" y="0" z="-9.81" comment="Gravitational acceleration" units_comment="m/s^2" />
        <cfnumber value="0.2" comment="Coefficient to multiply Dt" />
        <chwl value="0" auto="true" comment="Maximum still water level to calculate speedofsound using coefsound" units_comment="metres (m)" />
        <speedsystems value="0" auto="true" comment="Maximum system speed (by default the dam-break propagation is used)" />
        <coefsound value="20" comment="Coefficient to multiply speedsystems" />
        <speedsound value="0" auto="true" comment="Speed of sound to use in the simulation (by default speedofsound=coefsound*speedsystems)" />
        <coef value="1.0" comment="Coefficient to calculate the smoothing length (H=coefficient*sqrt(3*dp^2) in 3D)" />
        <rhop0 value="1000" comment="Reference density of the fluid" units_comment="kg/m3" />
    </constantdef>
    <mkmconfig bounount="240" fluidcount="10" />
    <geometry>
        <definition dp="0.01" units_comment="metres (m)">
            <pointmin x="-1" y="0" z="-1" />
            <pointmax x="4.5" y="0" z="3.5" />
        </definition>
    </geometry>
    <commands>
        <mainlist>
            <setdrawmode mode="full" />
            <setmkfluid mk="0" />
            <drawbox>
                <boxfill>solid</boxfill>
                <point x="0" y="-1" z="0" />
                <size x="3" y="2" z="3" />
            </drawbox>
            <setmkbound mk="0" />
            <drawbox>
                <boxfill>bottom | left | right | front | back</boxfill>
                <point x="0" y="1" z="0" />
                <size x="4" y="2" z="3" />
            </drawbox>
        </mainlist>
    </commands>
</geometry>
<casedef>
<parameters>
    <parameter key="StepAlgorithm" value="1" comment="Step Algorithm 1:Verlet, 2:Symplectic (default=1)" />
    <parameter key="VerletSteps" value="40" comment="Verlet only: Number of steps to apply Euler timestepping (default=40)" />
    <parameter key="Kernel" value="2" comment="Interaction Kernel 1:Cubic Spline, 2:Wendland (default=2)" />
    <parameter key="Visco" value="1" comment="Viscosity formulation 1:Artificial, 2:Laminar+SFS (default=1)" />
    <parameter key="Visco" value="0.02" comment="Viscosity value" />
    <parameter key="ViscoBoundaryFactor" value="1" comment="Multiply viscosity value with boundary (default=1)" />
    <parameter key="DeltaSPH" value="0.1" comment="DeltaSPH value, 0.1 is the typical value, with 0 disabled (default=0)" />
    <parameter key="Shift" value="0" comment="Shifting mode 0:None, 1:Ignore bound, 2:Ignore fixed, 3:Full (default=0)" />
    <parameter key="#ShiftCoef" value="2" comment="Coefficient for shifting computation (default=-2)" />
    <parameter key="ShiftTTS" value="1.5" comment="Threshold to detect free surface. Typically 1.5 for 2D and 2.75 for 3D (default=0)" />
    <parameter key="RigidAlgorithm" value="1" comment="Rigid Algorithm 1:SFM, 2:DEM (default=1)" />
    <parameter key="FtPause" value="0.0" comment="Time to freeze the floatings at simulation start (warmup) (default=0)" units_comment="seconds" />
    <parameter key="CoedDMIn" value="0.05" comment="Coefficient to calculate minimum time step dtmin=coedtmin/h/speedsound (default=0.05)" />
    <parameter key="#DtInit" value="0.0001" comment="Initial time step (default=h/speedsound" units_comment="seconds" />
    <parameter key="#DDMin" value="0.00001" comment="Minimum time step (default=coedtmin/h/speedsound" units_comment="seconds" />
    <parameter key="#DDFixed" value="0" comment="Dt values are loaded from file (default=disabled)" />
    <parameter key="DtAllParticles" value="0" comment="Velocity of particles used to calculate DT. 1:AII, 0:Only fluid/floating (default=0)" />
    <parameter key="TimeMax" value="0.72" comment="Time of simulation" units_comment="seconds" />
    <parameter key="TimeOut" value="0.01" comment="Time out data" units_comment="seconds" />
    <parameter key="Ind2" value="1" comment="Increase of Z+" units_comment="decimal" />
    <parameter key="PartsOutMax" value="1" comment="Allowed /100 of fluid particles out the domain (default=1)" units_comment="decimal" />
    <parameter key="Rhop0Min" value="700" comment="Minimum rhop valid (default=700)" units_comment="kg/m3" />
    <parameter key="Rhop0Max" value="1300" comment="Maximum rhop valid (default=1300)" units_comment="kg/m3" />
</parameters>
<particles np="21001" nh="1001" nbf="1001" mkboundfirst="11" mkfluidfirst="1">
    <fixed mkbound="0" mk="11" begin="0" count="1001" />
    <fluid mkfluid="0" mk="1" begin="1001" count="20000" />
</particles>
<constants>
    <gravity x="0" y="0" z="-9.81" units_comment="m/s^2" />
    <cfnumber value="0.2" />
    <gamma value="7" />
    <rhop0 value="1000" units_comment="kg/m3" />
    <dp value="0.01" units_comment="metres (m)" />
    <ch value="1.41421356248-002" units_comment="metres (m)" />
    <db value="1.115371429e+006" units_comment="metres (m)" />
    <massbound value="1.000000000-001" units_comment="kg" />
    <massfluid value="1.000000000-001" units_comment="kg" />
</constants>
<emotion />
</case>

```

STRUCTURE OF THE XML FILE

Divided in two sections:

“casedef”

Definition of the case with initial geometry and configuration.

Created by the user and used by GenCase

“execution”

Information required to execute the case.

Created by the user, modified by GenCase and only used by DualSPHysics

```
- <case>
  - <casedef>
    + <constantsdef>
      <mkconfig/>
    - <geometry>
      + <definition>
        - <commands>
          + <mainlist>
        </commands>
      </geometry>
    + <initials>
    + <floatings>
    + <motion>
  </casedef>
  <execution>
    - <special>
      - <wavepaddles>
        + <piston>
        + <piston_spectrum>
      </wavepaddles>
      + <accinputs>
    </special>
    + <parameters>
  </execution>
</case>
```

STRUCTURE OF THE XML FILE

- “casedef” :
 - **constantsdef** constants needed in SPH
 - **mkconfig** label configuration
 - **geometry** system geometry (boundaries and fluid)
 - **definition**
 - **commands (list & mainlist)**
 - **initials** special features for fluid particles
 - **floatings** description of floating objects
 - **motion** description of boundary movement
- “execution”
 - **special** automatic wave generation and external forces
 - **wavepaddles (piston & piston_spectrum)**
 - **accinputs**
 - **parameters** execution parameters in DualSPHysics

```
<constantsdef>
    <lattice bound="1" fluid="1" />
    <gravity x="0" y="0" z="-9.81" comment="Gravitational acceleration"
              units_comment="m/s^2" />
    <rhop0 value="1000" comment="Reference density of the fluid"
              units_comment="kg/m^3" />
    <hswl value="0" auto="true" comment="Maximum still water level to calculate speedofsound"
              units_comment="metres (m)" />
    <gamma value="7" comment="Polytropic constant for water used in the state equation" />
    <speedsystem value="0" auto="true" comment="Maximum system speed
              (by default the dam-break propagation is used)" />
    <coefsound value="20" comment="Coefficient to multiply speedsystem" />
    <speedsound value="0" auto="true" comment="Speed of sound to use in the simulation
              (by default speedofsound=coefsound*speedsystem)" />
    <coeffh value="0.866025" comment="Coefficient to calculate the smoothing length
              (h=coeffh*sqrt(3*dp^2) in 3D)" />
    <cflnumber value="0.2" comment="Coefficient to multiply dt" />
</constantsdef>
```

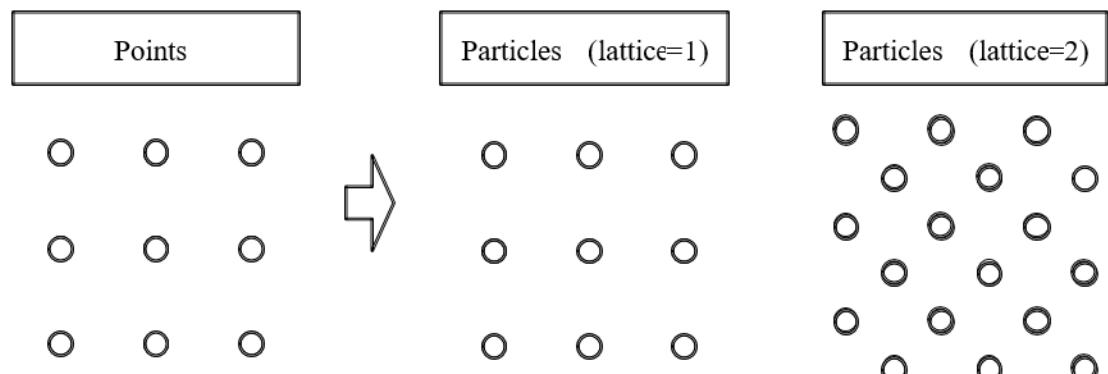
```

<constantsdef>
    <lattice bound="1" fluid="1" />
    <gravity x="0" y="0" z="-9.81" comment="Gravitational acceleration"
              units_comment="m/s^2" />
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    <cflnumber value="0.2" comment="Coefficient to multiply dt" />
</constantsdef>

```

lattice: indicates the type of mesh
to create particles:

- 1: one particle per point
- 2: two particles per point



```

<constantsdef>
    <lattice bound="1" fluid="1" />
    <gravity x="0" y="0" z="-9.81" comment="Gravitational acceleration"
              units_comment="m/s^2" />
    <rhop0 value="1000" comment="Reference density of the fluid"
           units_comment="kg/m^3" />
    <hswl value="0" auto="true" comment="Maximum still water level to calculate speedofsound"
          units_comment="metres (m)" />
    <gamma value="7" comment="Polytropic constant for water used in the state equation" />
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                  (by default the dam-break propagation is used)" />
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    <cflnumber value="0.2" comment="Coefficient to multiply dt" />
</constantsdef>

```

$$\frac{d\boldsymbol{v}_a}{dt} = - \sum_b m_b \left(\frac{\boldsymbol{P}_b + \boldsymbol{P}_a}{\rho_b \cdot \rho_a} + \boldsymbol{\Pi}_{ab} \right) \nabla_a W_{ab} + \boxed{\boldsymbol{g}}$$

```

<constantsdef>
    <lattice bound="1" fluid="1" />
    <gravity x="0" y="0" z="-9.81" comment="Gravitational acceleration"
              units comment="m/s^2" />
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    <hswl value="0" auto="true" comment="Maximum still water level to calculate speedofsound"
          units comment="metres (m)" />
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                  (by default the dam-break propagation is used)" />
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    <speedsound value="0" auto="true" comment="Speed of sound to use in the simulation
                  (by default speedofsound=coefsound*speedsystem)" />
    <coeffh value="0.866025" comment="Coefficient to calculate the smoothing length
                  (h=coeffh*sqrt(3*dp^2) in 3D)" />
    <cflnumber value="0.2" comment="Coefficient to multiply dt" />
</constantsdef>

```

$$speedsystem = \sqrt{g \cdot h_{swl}}$$

$$P = \frac{c_s^2 \rho_0}{\gamma} \left(\left(\frac{\rho}{\rho_0} \right)^{\gamma} - 1 \right)$$

$$c_s = coef_{sound} \cdot \sqrt{g \cdot h_{swl}}$$

$$B = \frac{c_s^2 \cdot \rho_0}{\gamma} = \frac{coef_{sound}^2 \cdot g \cdot h_{swl} \cdot \rho_0}{\gamma}$$

Speed of sound

```

<constantsdef>
    <lattice bound="1" fluid="1" />
    <gravity x="0" y="0" z="-9.81" comment="Gravitational acceleration"
              units_comment="m/s^2" />
    <rhop0 value="1000" comment="Reference density of the fluid"
              units_comment="kg/m^3" />
    <hswl value="0" auto="true" comment="Maximum still water level to calculate speedofsound"
              units_comment="metres (m)" />
    <gamma value="7" comment="Polytropic constant for water used in the state equation" />
    <speedsystem value="0" auto="true" comment="Maximum system speed
              (by default the dam-break propagation is used)" />
    <coefsound value="20" comment="Coefficient to multiply speedsystem" />
    <speedsound value="0" auto="true" comment="Speed of sound to use in the simulation
              (by default speedofsound=coefsound*speedsystem)" />
    <coeffh value="0.866025" comment="Coefficient to calculate the smoothing length
              (h=coeffh*sqrt(3*dp^2) in 3D)" />
    <cflnumber value="0.2" comment="Coefficient to multiply dt" />
</constantsdef>

```

$$speedsystem = \sqrt{g \cdot h_{swl}}$$

$$P = \frac{c_s^2 \rho_0}{\gamma} \left(\left(\frac{\rho}{\rho_0} \right)^\gamma - 1 \right)$$

$$c_s = coef_{sound} \cdot \sqrt{g \cdot h_{swl}}$$

$$B = \frac{c_s^2 \cdot \rho_0}{\gamma} = \frac{coef_{sound}^2 \cdot g \cdot h_{swl} \cdot \rho_0}{\gamma}$$

Speed of sound

```

<constantsdef>
    <lattice bound="1" fluid="1" />
    <gravity x="0" y="0" z="-9.81" comment="Gravitational acceleration"
              units_comment="m/s^2" />
    <rhop0 value="1000" comment="Reference density of the fluid"
              units_comment="kg/m^3" />
    <hswl value="0" auto="true" comment="Maximum still water level to calculate speedofsound"
              units_comment="metres (m)" />
    <gamma value="7" comment="Polytropic constant for water used in the state equation" />
    <speedsystem value="0" auto="true" comment="Maximum system speed
              (by default the dam-break propagation is used)" />
    <coefsound value="20" comment="Coefficient to multiply speedsystem" />
    <speedsound value="0" auto="true" comment="Speed of sound to use in the simulation
              (by default speedofsound=coefsound*speedsystem)" />
    <coeffh value="0.866025" comment="Coefficient to calculate the smoothing length
              (h=coeffh*sqrt(3*dp^2) in 3D)" />
    <cflnumber value="0.2" comment="Coefficient to multiply dt" />
</constantsdef>

```

$$\text{speedsystem} = \sqrt{g \cdot h_{\text{swl}}}$$

$$P = \frac{c_s^2 \rho_0}{\gamma} \left(\left(\frac{\rho}{\rho_0} \right)^\gamma - 1 \right)$$

$$c_s = \text{coefsound} \cdot \sqrt{g \cdot h_{\text{swl}}}$$

$$B = \frac{c_s^2 \cdot \rho_0}{\gamma} = \frac{\text{coefsound}^2 \cdot g \cdot h_{\text{swl}} \cdot \rho_0}{\gamma}$$

```

<constantsdef>
    <lattice bound="1" fluid="1" />
    <gravity x="0" y="0" z="-9.81" comment="Gravitational acceleration"
              units_comment="m/s^2" />
    <rhop0 value="1000" comment="Reference density of the fluid"
              units_comment="kg/m^3" />
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              units_comment="metres (m)" />
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              (by default the dam-break propagation is used)" />
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              (by default speedofsound=coefsound*speedsystem)" />
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              (h=coeffh*sqrt(3*dp^2) in 3D)" />
    <cflnumber value="0.2" comment="Coefficient to multiply dt" />
</constantsdef>

```

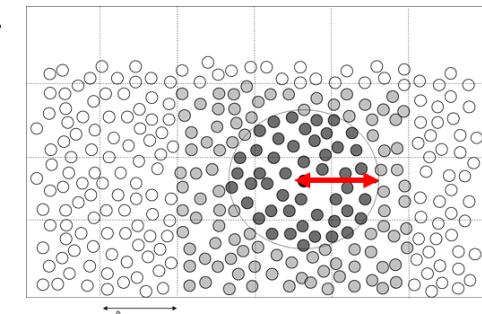
coeffh=1 typical value

coeffh=1.2, 1.5 better for wave propagation

$$h = \boxed{coeffh} \cdot \sqrt{dx^2 + dy^2 + dz^2}$$

$$h = \boxed{coeffh} \cdot \sqrt{3 \cdot dp^2}$$

$$h = \boxed{coeffh} \cdot \sqrt{3} \cdot dp$$



Other option is to define:

```
<hdp value="1.5" comment="Coefficient to calculate the smoothing length (hdp=h/dp)" />
```

$$\boxed{hdp} = h/dp$$

```

<constantsdef>
    <lattice bound="1" fluid="1" />
    <gravity x="0" y="0" z="-9.81" comment="Gravitational acceleration"
              units_comment="m/s^2" />
    <rhop0 value="1000" comment="Reference density of the fluid"
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    <coeffh value="0.866025" comment="Coefficient to calculate the smoothing length
              (h=coeffh*sqrt(3*dp^2) in 3D)" />
    <cflnumber value="0.2" comment="Coefficient to multiply dt" />
</constantsdef>

```

$$\Delta t = \boxed{\text{CFL}} \cdot \min(\Delta t_f, \Delta t_{cv})$$

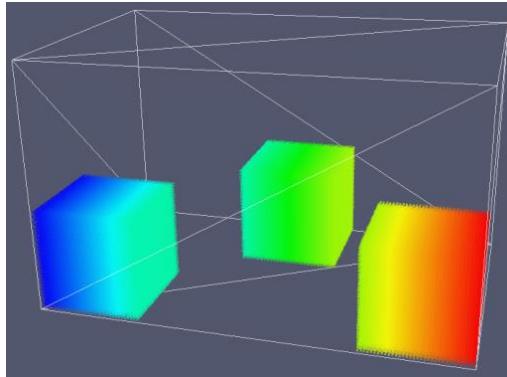
$$\Delta t_f = \min\left(\sqrt{h/|f_a|}\right)$$

$$\Delta t_{cv} = \min_a \frac{h}{c_s + \max_b \left| \frac{h \mathbf{v}_{ab} \cdot \mathbf{r}_{ab}}{\mathbf{r}_{ab}^2} \right|}$$

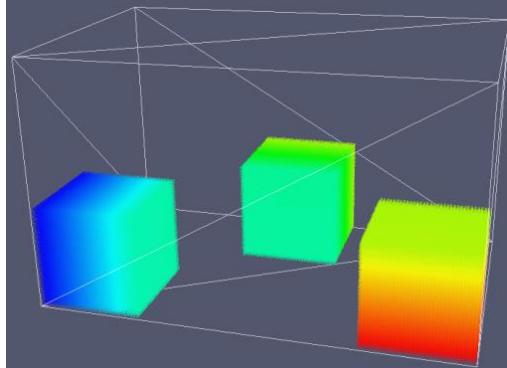
CASEDEF-MKCONFIG

```
- <mkconfig boundcount="240" fluidcount="10">
  <mkorientbound mk="0" orient="YxZ"/>
  <mkorientfluid mk="1" orient="yzX"/>
  <mkorientfluid mk="2" orient="ZYx"/>
</mkconfig>
```

mkorientfluid = "xyz"



mkorientfluid = "xyz"
mkorientfluid = "yzX"
mkorientfluid = "ZYx"



mk: label used to

- defines the order objects are created
- applies specific features to the different set of points such as movement, rigid motion...

240 labels for boundary particles and

10 labels for fluid particles

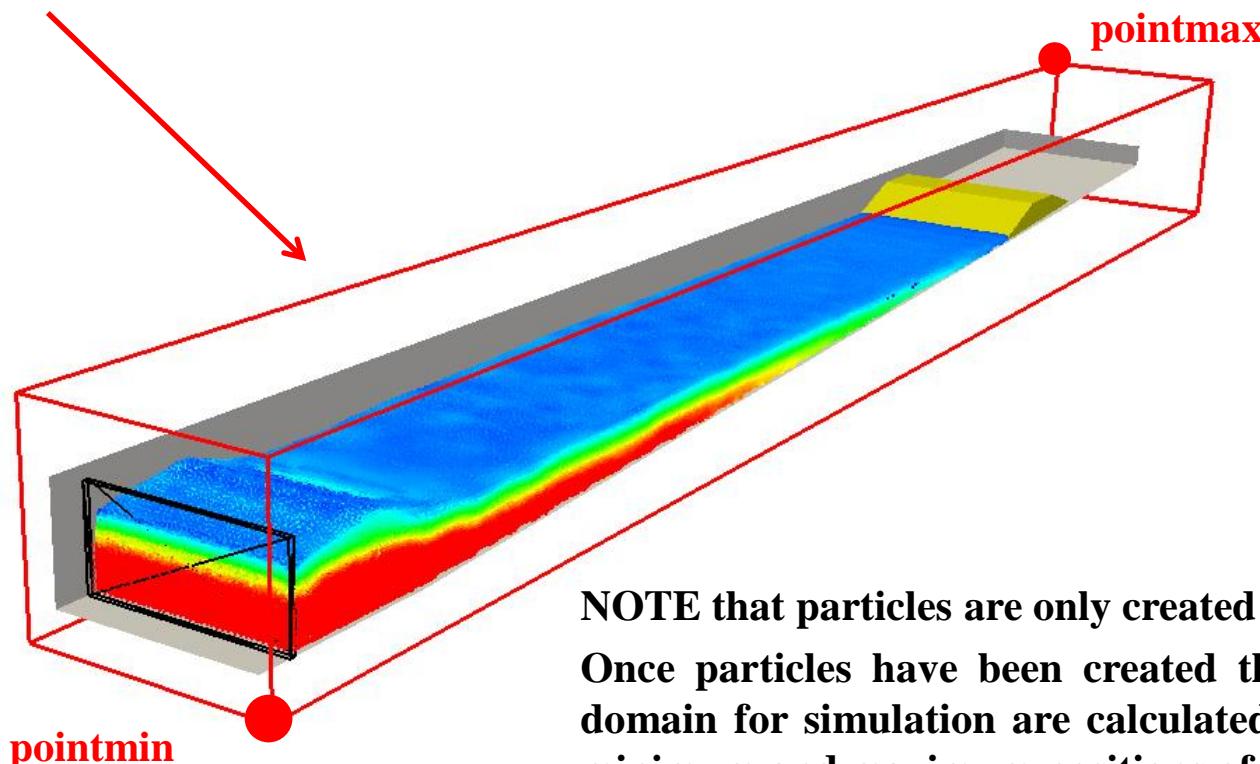
mkorientation: determines the order of particles when creating one object (useful for visualization with the variable *idp*)

```
<!--DEFINITION OF DOMAIN WHERE PARTICLES WILL BE CREATED -->
<definition dp="0.005">
    <pointmin x="-0.05" y="0.1" z="-0.05" />
    <pointmax x=" 2.00" y="0.1" z=" 1.00" />
</definition>
```

dp defines the distance between particles

WHEN CHANGING THIS PARAMETER, THE TOTAL NUMBER OF PARTICLES IS MODIFIED

pointmin & pointmax defines the dimensions of the domain where particles can be created

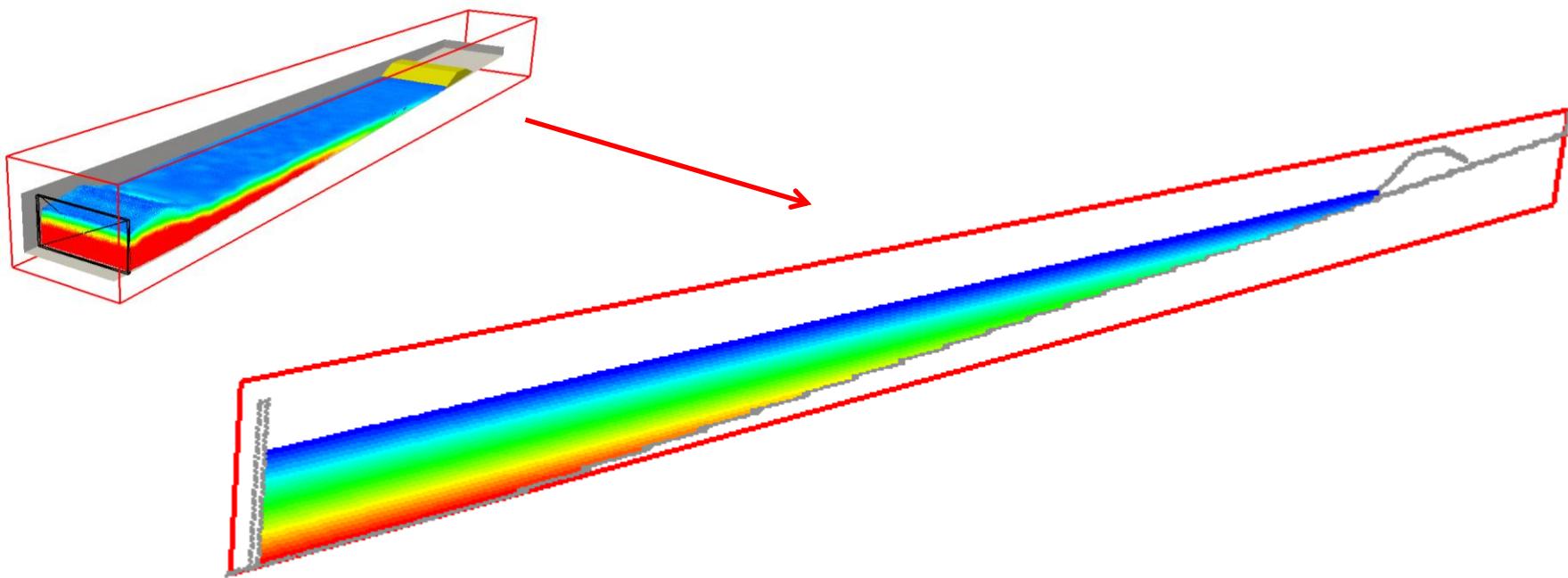


NOTE that particles are only created within this domain.
Once particles have been created the dimensions of the domain for simulation are calculated again starting from minimum and maximum positions of the created particles.

```
<!--DEFINITION OF DOMAIN WHERE PARTICLES WILL BE CREATED -->
<definition dp="0.005">
    <pointmin x="-0.05" y="0.1" z="-0.05" />
    <pointmax x=" 2.00" y="0.1" z=" 1.00" />
</definition>
```

A 2-D configuration can be generated by imposing the same values along Y-direction

$\langle\text{pointmin}\rangle = \langle\text{pointmax}\rangle$



```
<commands>
  <mainlist>
    <setshapemode>dp | bound</setshapemode>
    <setdrawmode mode="full" />
    <!--CREATION OF FLUID PARTICLES (BOX OF WATER)-->
    <setmkfluid mk="0" />
    <drawbox>
      <boxfill>solid</boxfill>
      <point x="0" y="0" z="0" />
      <size x="0.4" y="0.67" z="0.3" />
    </drawbox>
    <!--CREATION OF BOUNDARY PARTICLES (WALLS OF TANK) -->
    <setmkbound mk="0" />
    <drawbox>
      <boxfill>bottom | left | right | front | back</boxfill>
      <point x="0" y="0" z="0" />
      <size x="1.6" y="0.67" z="0.4" />
    </drawbox>
    <shapeout file="" />
  </mainlist>
</commands>
```

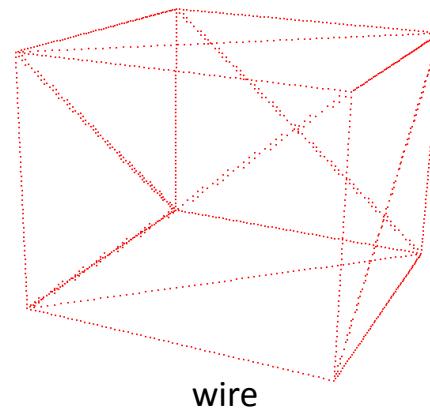
Volume of fluid: *setmkfluid mk=0*,
solid to create particles within the specified volume
drawbox to plot a rectangular box defining a corner and its size in the 3 directions

Boundary Tank: *setmkbound mk=0*,
specify box faces on which particles are created (top is not used in this example)

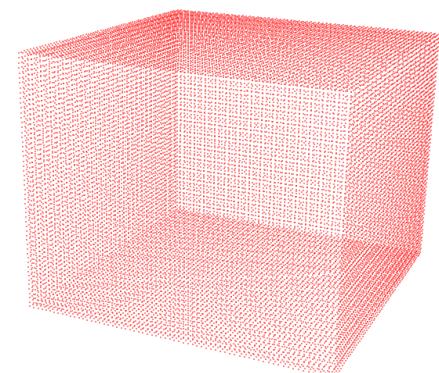
CASEDEF-GEOMETRY-COMMANDS-MAINLIST

This command indicates the mode to create points where particles will be generated

```
- <mainlist>
  <setdrawmode mode="wire"/>
  <setdrawmode mode="face"/>
  <setdrawmode mode="solid"/>
  <setdrawmode mode="full"/>
</mainlist>
```



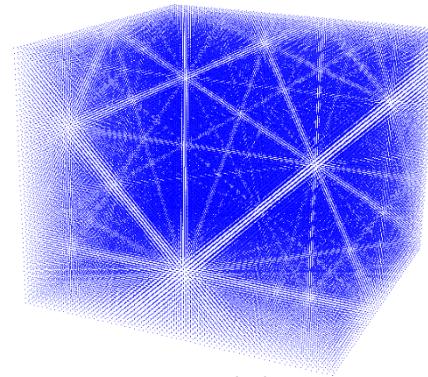
wire



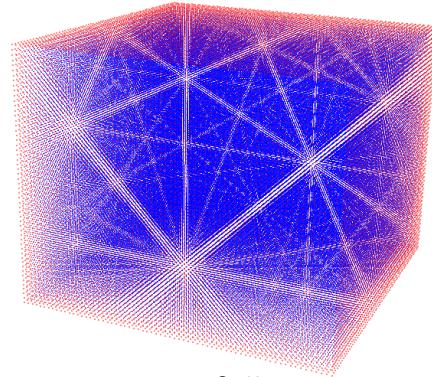
face

<setdrawmode>:

- “**wire**”: wire mode
- “**face**”: draw faces
- “**solid**”: draw inside
- “**full**”: combines *face* and *solid*



solid



full

CASEDEF-GEOMETRY-COMMANDS-MAINLIST

```
- <mainlist>
  <setshapemode>dp | bound</setshapemode>
  <setshapemode>dp | bound | fluid</setshapemode>
  <setshapemode>real | void</setshapemode>
</mainlist>
```

<setshapemode>: defines the draw operations to create VTK files (polygons)

- “**real**”: using the real coordinates
- “**dp**”: adjusting coordinates to *dp*
- “**fluid**”: operations with *mk-fluid*
- “**bound**”: operations with *mk-bound*
- “**void**”: operations with *mk-void*

CASEDEF-GEOMETRY-COMMANDS-MAINLIST

<setshapemode>: defines the draw operations to create a VTK files (polygons)

```
- <mainlist>
  <setshapemode>dp | bound</setshapemode>
  <setdrawmode mode="full"/>
  <setmkfluid mk="0"/>
  + <drawbox></drawbox>
    <setmkbound mk="0"/>
  + <drawbox></drawbox>
    <shapeout file="Box"/>
    <setmkvoid/>
  + <drawbox></drawbox>
    <setmkbound mk="1"/>
  + <drawbox></drawbox>
    <shapeout file="Building"/>
</mainlist>
```

```
- <mainlist>
  <setshapemode>real | dp | bound</setshapemode>
  <setdrawmode mode="full"/>
  <setmkfluid mk="0"/>
  + <drawprism mask="0"></drawprism>
    <setmkvoid/>
  + <drawbox></drawbox>
    <setdrawmode mode="face"/>
    <setmkbound mk="10"/>
  + <drawbox></drawbox>
    <setmkbound mk="0"/>
  + <drawprism mask="96"></drawprism>
    <shapeout file="" reset="true"/>
</mainlist>
```

shapeout: creates VTK files (polygons)
of only some *bound* objects
Case_Box_Dp.vtk
Case_Building_Dp.vtk

shapeout: creates VTK files (polygons)
of all the *bound* objects
Case__Real.vtk
Case__Dp.vtk

reset="true" objects created after this command will be saved on a different VTK file

CASEDEF-GEOMETRY-COMMANDS-MAINLIST

These commands indicate the type of particles to be generated

```
- <commands>
  - <mainlist>
    <setmkvoid/>
    <setmkfluid mk="0"/>
    <setmkbound mk="0"/>
    <setmknexfluid next="true"/>
    <setmknexbound next="false"/>
    <setmknexauto active="true"/>
  </mainlist>
</commands>
```

<setmkvoid>, <setmkfluid>, <setmkbound>: defines the label *mk* to draw points of type:
void (empty), fluid, bound

<setmknexfluid>, <setmknexbound>: increases (decreases) the value of *mk* with next=*true* (=*false*)
<setmknexauto>: after each draw command *mk* is increased automatically

CASEDEF-GEOMETRY-COMMANDS-MAINLIST

Transformation utilities

```
- <mainlist>
  <setshapemode>dp | bound</setshapemode>
  <setmkbound mk="0"/>
  <move x="0.5" y="0" z="0"/>
+ <drawbox></drawbox>
  <shapeout file="BoxMove" reset="true"/>
  <matrixreset/>
  <scale x="2" y="1.5" z="0.5"/>
+ <drawbox></drawbox>
  <shapeout file="BoxScale" reset="true"/>
  <matrixreset/>
  <rotate x="0" y="0" z="1" ang="45"/>
+ <drawbox></drawbox>
  <shapeout file="BoxRotate" reset="true"/>
</mainlist>
```

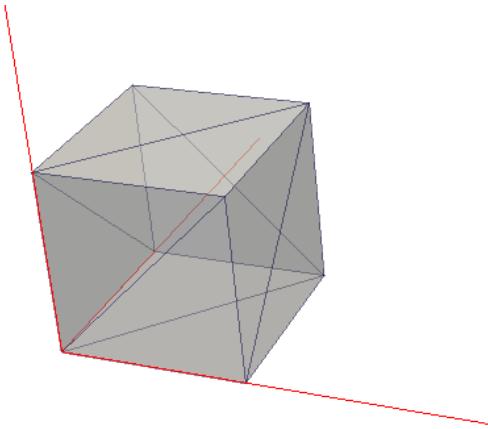
<move>: a displacement is applied to the transformation matrix

<scale>: scaling is applied to matrix

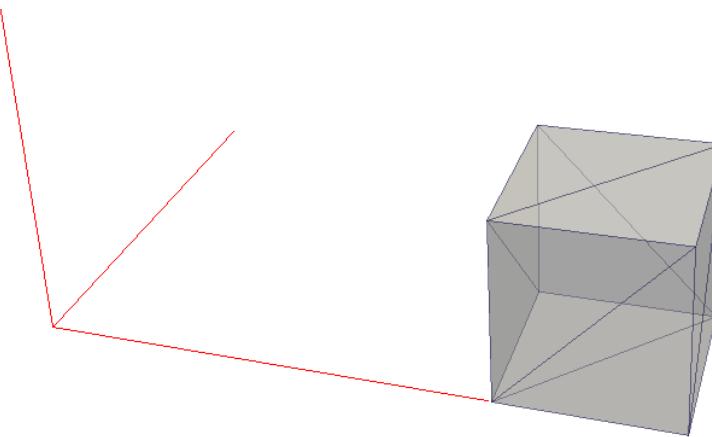
<rotate>: a starting vector and angle are given for object rotation

<matrixreset>: the modified matrix is replaced by the original one (identity matrix)

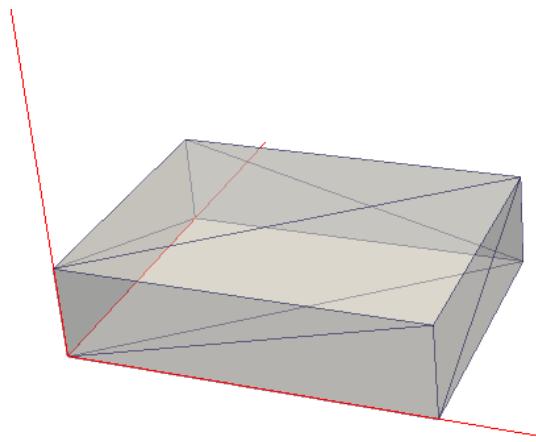
CASEDEF-GEOMETRY-COMMANDS-MAINLIST



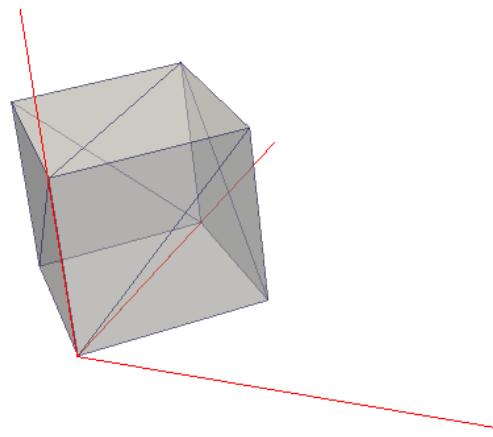
```
<drawbox ...>
```



```
<move x="0.5" y="0" z="0"/>  
<drawbox ...>
```



```
<scale x="2" y="1.5" z="0.5"/>  
<drawbox ...>
```



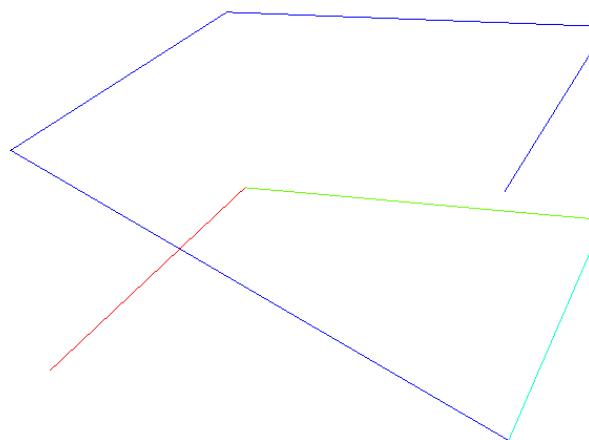
```
<rotate x="0" y="0" z="1" ang="45"/>  
<drawbox ...>
```

CASEDEF-GEOMETRY-COMMANDS-MAINLIST

```
- <mainlist>
  <setshapemode>dp | bound</setshapemode>
  <setmkbound mk="0"/>
  - <setlinebegin>
    <point x="0" y="0" z="0"/>
  </setlinebegin>
  - <drawlineto>
    <point x="0" y="1" z="0"/>
  </drawlineto>
  <setmknextbound next="true"/>
  - <drawline>
    <point x="0" y="1" z="0"/>
    <point x="1" y="1" z="0"/>
  </drawline>
  <setmknextbound next="true"/>
  - <drawline>
    <point x="1" y="1" z="0"/>
    <point x="1" y="0" z="0"/>
  </drawline>
  <setmknextbound next="true"/>
  - <drawlines>
    <point x="1" y="0" z="0"/>
    <point x="0" y="0" z="0.5"/>
    <point x="0" y="1" z="0.5"/>
    <point x="1" y="1" z="0.5"/>
    <point x="1" y="0" z="0.5"/>
  </drawlines>
  <shapeout file="Lines" reset="true"/>
</mainlist>
```

LINES

<setlinebegin>: sets the begining of the line with <drawlineto>
<drawlineto>: draws a line to a given point
<drawline>: draws a line between two points
<drawlines>: draws lines between several points



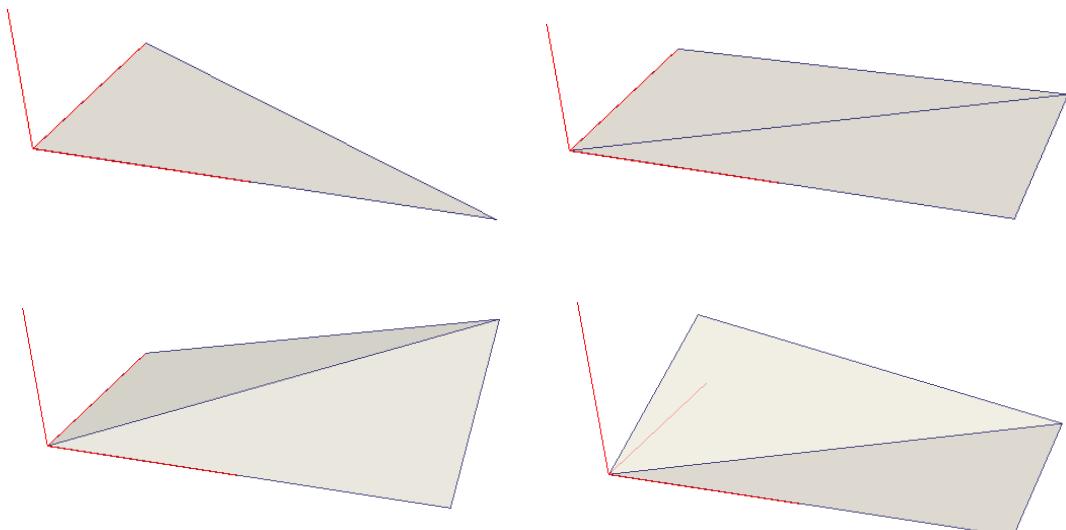
CASEDEF-GEOMETRY-COMMANDS-MAINLIST

```
- <mainlist>
  <setshapemode>dp | bound</setshapemode>
  <setmkbound mk="0"/>
  - <drawtriangle>
    <point x="0" y="0" z="0"/>
    <point x="1" y="0" z="0"/>
    <point x="0" y="0.5" z="0"/>
  </drawtriangle>
  <shapeout file="Triangle" reset="true"/>
- <drawquadri>
  <point x="0" y="0" z="0"/>
  <point x="1" y="0" z="0"/>
  <point x="1" y="0.5" z="0"/>
  <point x="0" y="0.5" z="0"/>
</drawquadri>
<shapeout file="Quadri" reset="true"/>
- <drawquadri>
  <point x="0" y="0" z="0"/>
  <point x="1" y="0" z="0"/>
  <point x="1" y="0.5" z="0.2"/>
  <point x="0" y="0.5" z="0"/>
</drawquadri>
<shapeout file="Quadri2" reset="true"/>
- <drawquadri>
  <point x="0" y="0" z="0"/>
  <point x="1" y="0" z="0"/>
  <point x="1" y="0.5" z="0"/>
  <point x="0" y="0.5" z="0.2"/>
</drawquadri>
<shapeout file="Quadri3" reset="true"/>
</mainlist>
```

TRIANGLES

<drawtriangle>: draws a triangle with tree points (points must always go counterclockwise)

<drawquadri>: draws the quadrilateral described by four points (points may not be in the same plane)

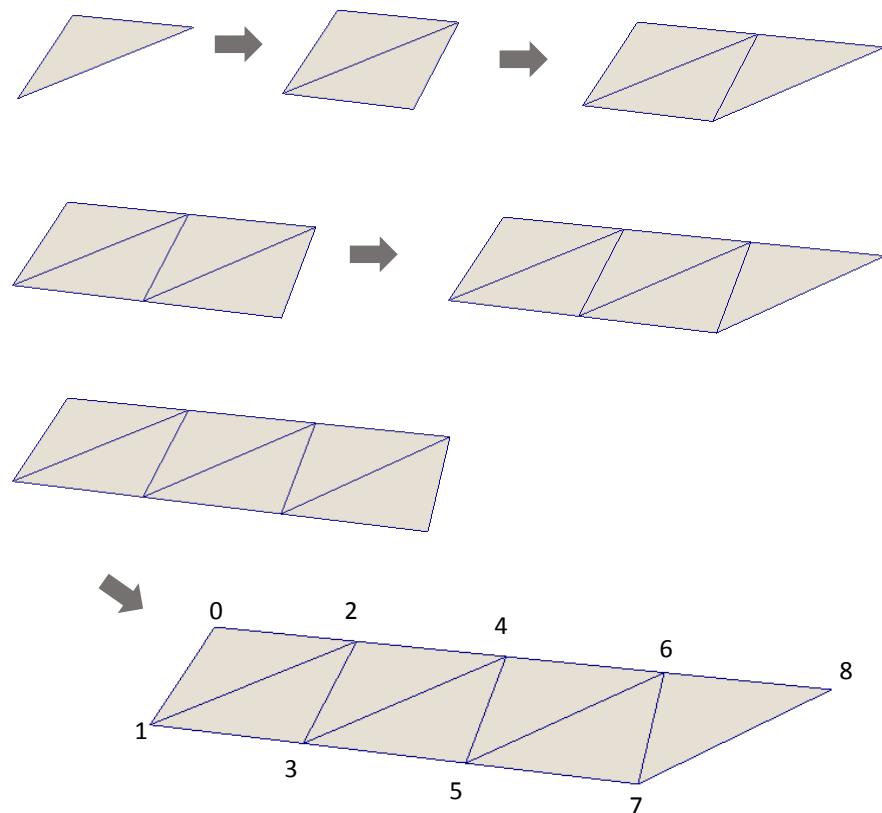


CASEDEF-GEOMETRY-COMMANDS-MAINLIST

```
- <mainlist>
  <setshapemode>dp | bound</setshapemode>
  <setmkbound mk="0"/>
- <drawtrianglesstrip>
  <point x="0" y="1" z="0"/>
  <point x="0" y="0" z="0"/>
  <point x="1" y="1" z="0"/>
  <point x="1" y="0" z="0"/>
  <point x="2" y="1" z="0"/>
  <point x="2" y="0" z="0"/>
  <point x="3" y="1" z="0"/>
  <point x="3" y="0" z="0"/>
  <point x="4" y="1" z="0"/>
</drawtrianglesstrip>
<shapeout file="TrianglesStrip9" reset="true"/>
</mainlist>
```

TRIANGLES

<drawtrianglesstrip>: draws a series of chained triangles

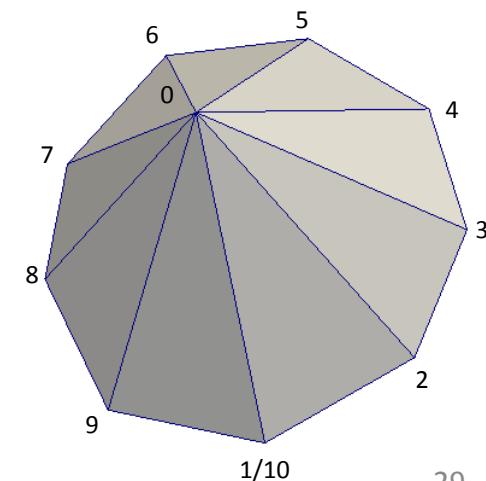
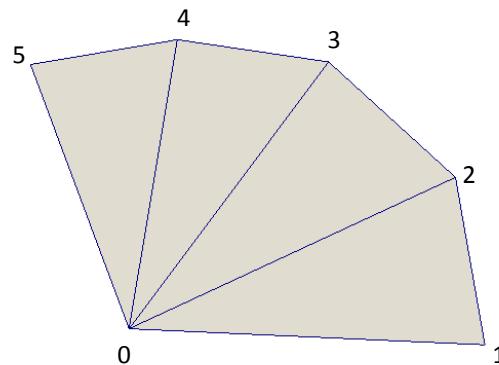


CASEDEF-GEOMETRY-COMMANDS-MAINLIST

```
- <mainlist>
  <setshapemode>dp | bound</setshapemode>
  <setmkbound mk="0"/>
- <drawtrianglesfan>
  <point x="0" y="0" z="0"/>
  <point x="1" y="0" z="0"/>
  <point x="0.9" y="0.5" z="0"/>
  <point x="0.5" y="0.9" z="0"/>
  <point x="0" y="1" z="0"/>
  <point x="-0.5" y="0.9" z="0"/>
</drawtrianglesfan>
<shapeout file="TrianglesFan" reset="true"/>
<setmkbound mk="0"/>
- <drawtrianglesfan>
  <point x="0" y="0" z="1"/>
  <point x="1" y="0" z="0"/>
  <point x="0.8" y="0.6" z="0"/>
  <point x="0.2" y="1" z="0"/>
  <point x="-0.5" y="0.9" z="0"/>
  <point x="-0.9" y="0.3" z="0"/>
  <point x="-0.9" y="-0.3" z="0"/>
  <point x="-0.5" y="-0.9" z="0"/>
  <point x="0.2" y="-1" z="0"/>
  <point x="0.8" y="-0.6" z="0"/>
  <point x="1" y="0" z="0"/>
</drawtrianglesfan>
<shapeout file="TrianglesFan2" reset="true"/>
</mainlist>
```

TRIANGLES

<drawtrianglesfan>: draws a range of triangles

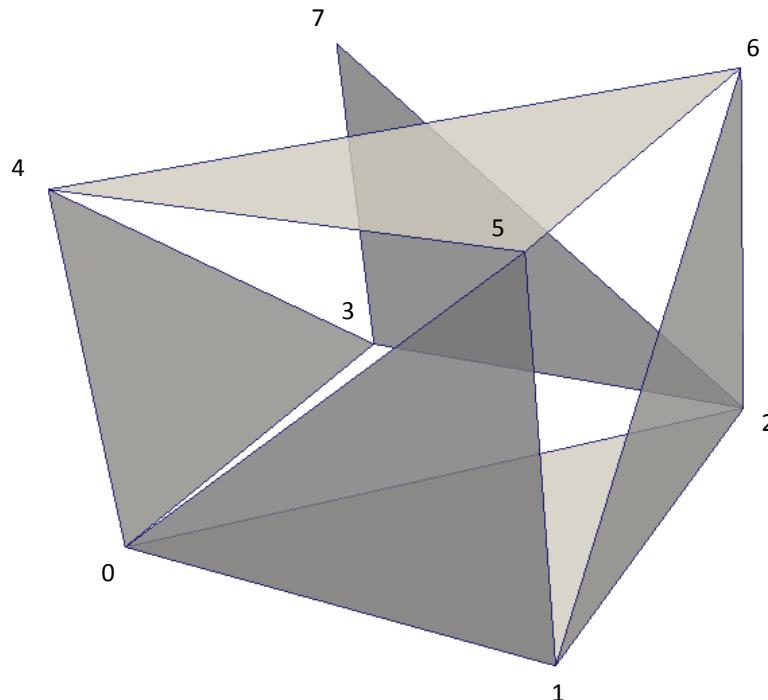


CASEDEF-GEOMETRY-COMMANDS-MAINLIST

```
- <mainlist>
  <setshapemode>dp | bound</setshapemode>
  <setmkbound mk="0"/>
- <drawtriangles>
  - <points>
    <point x="0" y="0" z="0"/>
    <point x="1" y="0" z="0"/>
    <point x="1" y="1" z="0"/>
    <point x="0" y="1" z="0"/>
    <point x="0" y="0" z="0.8"/>
    <point x="1" y="0" z="0.8"/>
    <point x="1" y="1" z="0.8"/>
    <point x="0" y="1" z="0.8"/>
  </points>
  - <triangles>
    <triangle x="0" y="1" z="5"/>
    <triangle x="1" y="2" z="6"/>
    <triangle x="2" y="3" z="7"/>
    <triangle x="3" y="0" z="4"/>
    <triangle x="0" y="2" z="1"/>
    <triangle x="4" y="5" z="6"/>
  </triangles>
</drawtriangles>
<shapeout file="Triangles" reset="true"/>
</mainlist>
```

TRIANGLES

<**drawtriangles**>: draws a series of triangles defined by a set of points or a set of triangles

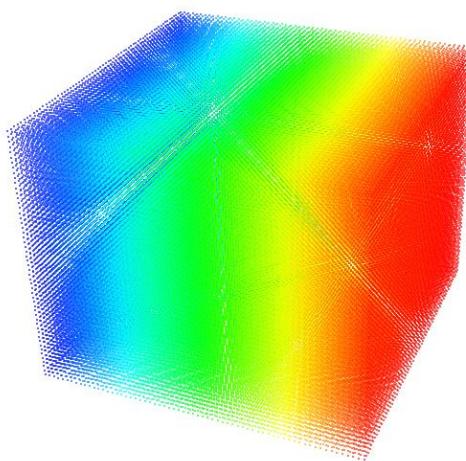


CASEDEF-GEOMETRY-COMMANDS-MAINLIST

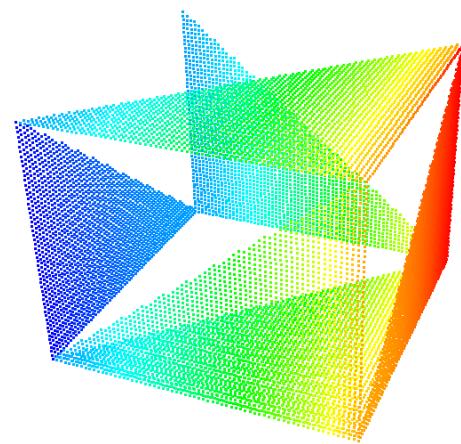
```
- <mainlist>
  <setshapemode>dp | bound</setshapemode>
  <setmkbound mk="0"/>
- <drawfigure>
  - <points>
    <point x="0" y="0" z="0"/>
    <point x="1" y="0" z="0"/>
    <point x="1" y="1" z="0"/>
    <point x="0" y="1" z="0"/>
    <point x="0" y="0" z="0.8"/>
    <point x="1" y="0" z="0.8"/>
    <point x="1" y="1" z="0.8"/>
    <point x="0" y="1" z="0.8"/>
  </points>
  - <triangles>
    <triangle x="0" y="1" z="5"/>
    <triangle x="1" y="2" z="6"/>
    <triangle x="2" y="3" z="7"/>
    <triangle x="3" y="0" z="4"/>
    <triangle x="0" y="2" z="1"/>
    <triangle x="4" y="5" z="6"/>
  </triangles>
</drawfigure>
</mainlist>
```

FIGURE

<**drawfigure**>: draws a solid figure consisting of all the interior points to the planes formed by the given triangles



DrawFigure
(*drawmode=solid*)



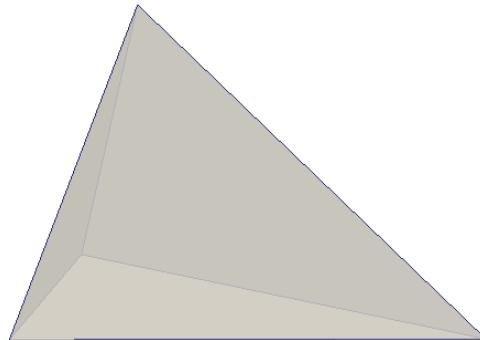
DrawTriangles or
DrawFigure (*drawmode=face*)

CASEDEF-GEOMETRY-COMMANDS-MAINLIST

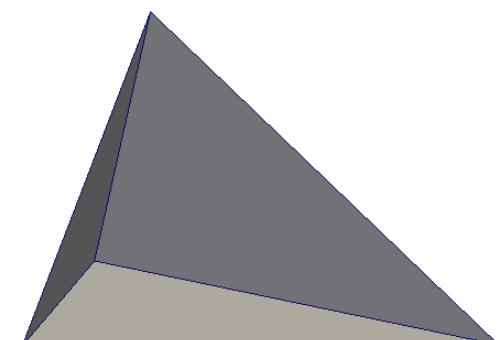
```
- <mainlist>
  <setshapemode>dp | bound</setshapemode>
  <setdrawmode mode="full"/>
  <setmkbound mk="0"/>
  - <drawpyramid mask="0">
    <point x="0.25" y="0.25" z="0.7"/>
    <point x="0" y="0" z="0"/>
    <point x="1" y="0" z="0"/>
    <point x="0" y="1" z="0"/>
  </drawpyramid>
  <shapeout file="Pyramid1" reset="true"/>
  - <drawpyramid mask="2">
    <point x="0.25" y="0.25" z="0.7"/>
    <point x="0" y="0" z="0"/>
    <point x="1" y="0" z="0"/>
    <point x="0" y="1" z="0"/>
  </drawpyramid>
  <shapeout file="Pyramid2" reset="true"/>
</mainlist>
```

<drawpyramid>: draws a pyramid with the top point and other points of the base (minimum 3)

mask indicates the faces to be hidden with bits
the first bit always corresponds to the base and the rest to
the faces following the order



Pyramid1
(*mask=0*)



Pyramid2
(*mask=2=0010*)

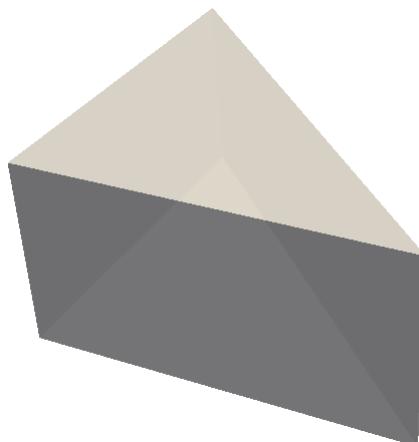
CASEDEF-GEOMETRY-COMMANDS-MAINLIST

PRISM

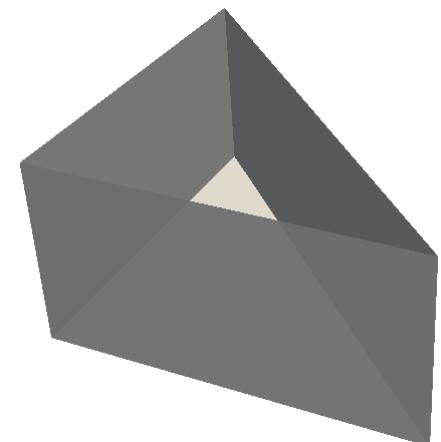
```
- <mainlist>
  <setshapemode>dp | bound</setshapemode>
  <setdrawmode mode="full"/>
  <setmkbound mk="0"/>
  - <drawprism mask="0">
    <point x="0" y="0" z="0"/>
    <point x="1" y="0" z="0"/>
    <point x="0" y="1" z="0"/>
    <point x="0" y="0" z="0.5"/>
    <point x="1" y="0" z="0.5"/>
    <point x="0" y="1" z="0.5"/>
  </drawprism>
  <shapeout file="Prism1" reset="true"/>
  - <drawprism mask="2">
    <point x="0" y="0" z="0"/>
    <point x="1" y="0" z="0"/>
    <point x="0" y="1" z="0"/>
    <point x="0" y="0" z="0.5"/>
    <point x="1" y="0" z="0.5"/>
    <point x="0" y="1" z="0.5"/>
  </drawprism>
  <shapeout file="Prism2" reset="true"/>
</mainlist>
```

<drawprism>: draws a prism with a minimum of 6 points
The first half of points are the base and the second half the top
(the number of points must be even)

mask indicates the faces to be hidden with bits
The first bit corresponds to the base, the second to the top and
the rest to the faces following the order



Prism1 (*mask=0*)



Prism2 (*mask=2=00010*)

CASEDEF-GEOMETRY-COMMANDS-MAINLIST

PRISM

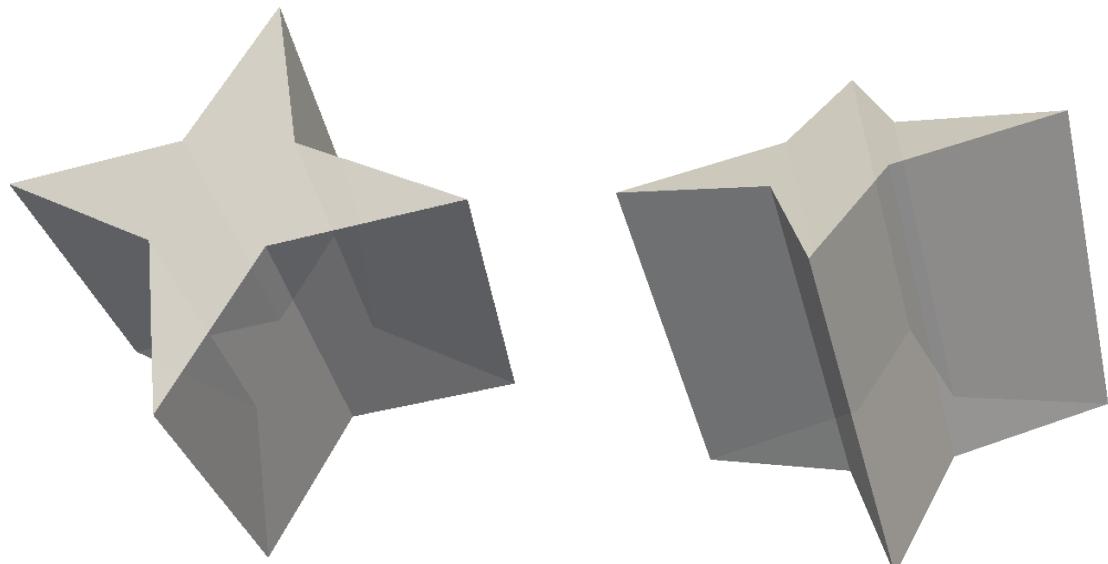
```
- <mainlist>
  <setshapemode>dp | bound</setshapemode>
  <setdrawmode mode="full"/>
  <setmkbound mk="0"/>
- <drawprism mask="0">
  <point x="0" y="0" z="0"/>
  <point x="1" y="-3" z="0"/>
  <point x="2" y="0" z="0"/>
  <point x="5" y="1" z="0"/>
  <point x="2" y="2" z="0"/>
  <point x="1" y="5" z="0"/>
  <point x="0" y="2" z="0"/>
  <point x="-3" y="1" z="0"/>
  <point x="0" y="0" z="6"/>
  <point x="1" y="-3" z="6"/>
  <point x="2" y="0" z="6"/>
  <point x="5" y="1" z="6"/>
  <point x="2" y="2" z="6"/>
  <point x="1" y="5" z="6"/>
  <point x="0" y="2" z="6"/>
  <point x="-3" y="1" z="6"/>
</drawprism>
<shapeout file="Prism3" reset="true"/>
</mainlist>
```

<drawprism>: draws a prism with a minimum of 6 points

The first half of points are the base and the second half the top
(the number of points must be even)

mask indicates the faces to be hidden with bits

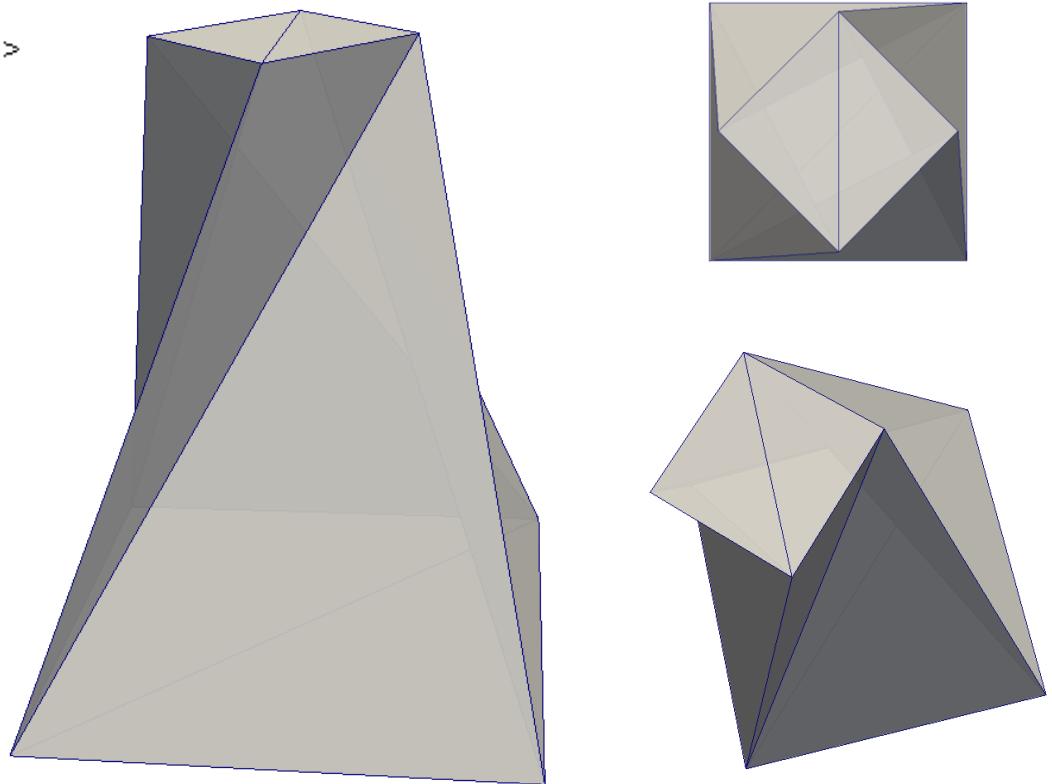
The first bit corresponds to the base, the second to the top and
the rest to the faces following the order



CASEDEF-GEOMETRY-COMMANDS-MAINLIST

PRISM

```
- <mainlist>
  <setshapemode>dp | bound</setshapemode>
  <setdrawmode mode="full"/>
  <setmkbound mk="0"/>
- <drawprism mask="0">
  <point x="0" y="0" z="0"/>
  <point x="4" y="0" z="0"/>
  <point x="4" y="4" z="0"/>
  <point x="0" y="4" z="0"/>
  <point x="2" y="1" z="5"/>
  <point x="3" y="2" z="5"/>
  <point x="2" y="3" z="5"/>
  <point x="1" y="2" z="5"/>
</drawprism>
<shapeout file="Prism4" reset="true"/>
</mainlist>
```



CASEDEF-GEOMETRY-COMMANDS-MAINLIST

MASK

mask indicates the faces to be hidden

Initially this is defined using BITS

FOR EXAMPLE: OBJECT WITH 4 FACES:

mask=“0”

decimal **0** is **0000** in binary

no faces are hidden

mask=“1”

decimal **1** is **0001** in binary

first face is hidden

mask=“2”

decimal **2** is **0010** in binary

second face is hidden

mask=“4”

decimal **4** is **0100** in binary

third face is hidden

mask=“8”

decimal **8** is **1000** in binary

fourth face is hidden

mask=“12”

decimal **12** is **1100** in binary

third and fourth face are hidden

CASEDEF-GEOMETRY-COMMANDS-MAINLIST

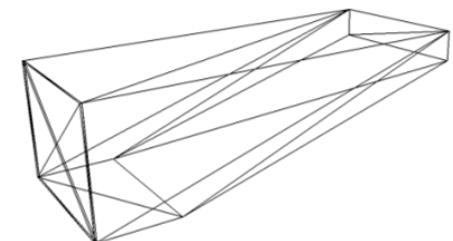
PRISM

There is a second and easiest system to use mask

mask can be also defined using the index of the faces instead of bits

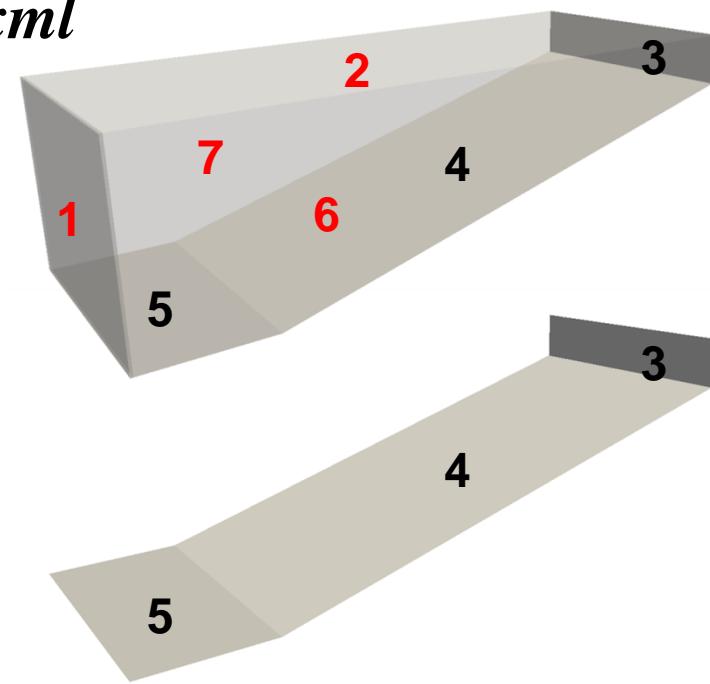
In this example, faces 1, 2, 6 and 7 are not created, only 3,4 and 5

It is important to use symbol “|” to detect this system!!!



EXAMPLE: *CaseWavemaker_Def.xml*

```
<setmkbound mk="0" />
<drawprism mask="1 | 2 | 6 | 7">
    <point x="5" y="0" z="1.5" />
    <point x="5" y="0" z="1.1" />
    <point x="1" y="0" z="0" />
    <point x="0" y="0" z="0" />
    <point x="0" y="0" z="1.5" />
    <point x="5" y="2" z="1.5" />
    <point x="5" y="2" z="1.1" />
    <point x="1" y="2" z="0" />
    <point x="0" y="2" z="0" />
    <point x="0" y="2" z="1.5" />
</drawprism>
```

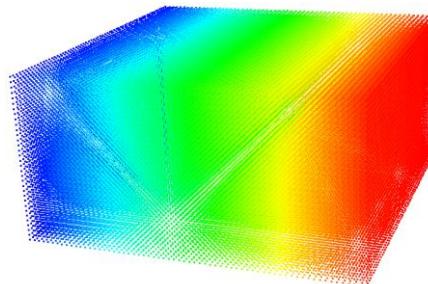


CASEDEF-GEOMETRY-COMMANDS-MAINLIST

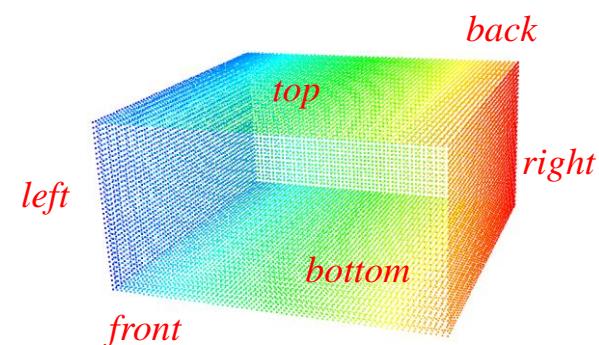
```
- <mainlist>
  <setshapemode>dp | bound</setshapemode>
  <setmkbound mk="0"/>
- <drawbox>
  <boxfill>solid</boxfill>
  <point x="0" y="0" z="0"/>
  <size x="1" y="1" z="0.5"/>
</drawbox>
<shapeout file="BoxSolid" reset="true"/>
- <drawbox>
  <boxfill>all</boxfill>
  <point x="0" y="0" z="0"/>
  <size x="1" y="1" z="0.5"/>
</drawbox>
<shapeout file="BoxA" reset="true"/>
- <drawbox>
  <boxfill>all ^ top</boxfill>
  <point x="0" y="0" z="0"/>
  <size x="1" y="1" z="0.5"/>
</drawbox>
<shapeout file="BoxB" reset="true"/>
- <drawbox>
  <boxfill>bottom | left | right</boxfill>
  <point x="0" y="0" z="0"/>
  <size x="1" y="1" z="0.5"/>
</drawbox>
<shapeout file="BoxC" reset="true"/>
</mainlist>
```

BOX

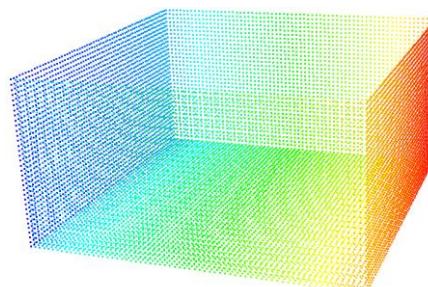
<drawbox>: draws a box with an initial point and the size
<boxfill> indicates if *solid* or *face* and the faces to be hidden



BoxSolid (solid)



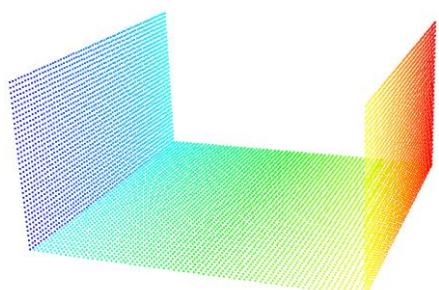
BoxA (all)



BoxB (all^top)

means

all faces excluding top

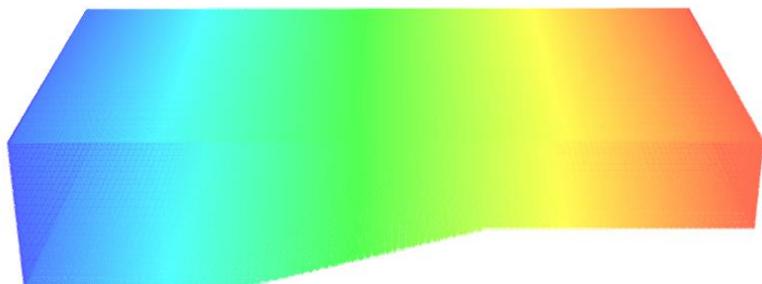


BoxC (bottom|left|right)

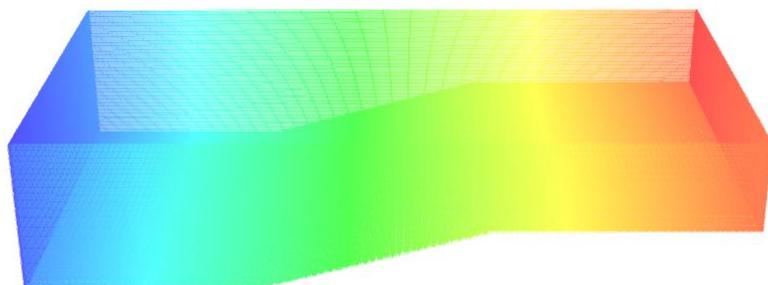
means only

bottom+left+right

CASEDEF-GEOMETRY-COMMANDS-MAINLIST



BeachFace



BeachFace
(mask="128")

BEACH

```
- <mainlist>
  <setshapemode>dp | solid</setshapemode>
  <setmkbound mk="10"/>
  <setdrawmode mode="face"/>
- <drawbeach mask="128">
  <point x="0" y="3" z="1.2"/>
  <point x="0" y="3" z="0"/>
  <point x="1.7" y="3" z="0"/>
  <point x="3.5" y="3" z="0.5"/>
  <point x="5.5" y="3" z="0.5"/>
  <point x="5.5" y="3" z="1.2"/>
</drawbeach>
</mainlist>
```

<drawbeach>: draws a beach with the lateral points that formed the profile of the beach
mask indicates the faces to be hidden .

mask="128"

decimal 128 is 10000000 in binary

eight face is hidden

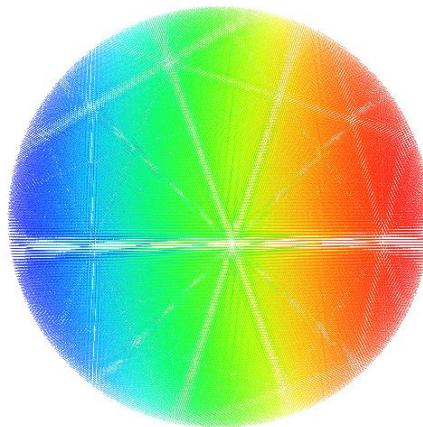
CASEDEF-GEOMETRY-COMMANDS-MAINLIST

SPHERE

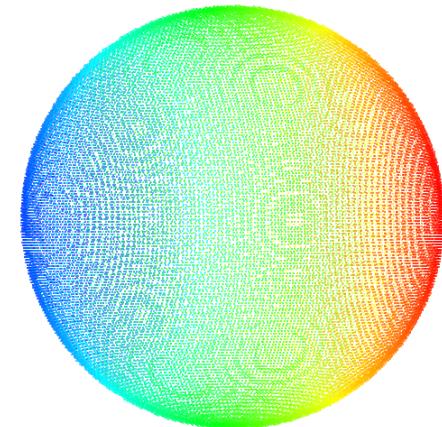
- <mainlist>

```
<setmkbound mk="0"/>
<setdrawmode mode="solid"/>
- <drawsphere radius="0.8">
  <point x="1" y="1" z="1"/>
</drawsphere>
<setdrawmode mode="face"/>
- <drawsphere radius="0.8">
  <point x="1" y="1" z="1"/>
</drawsphere>
</mainlist>
```

<drawsphere>: draws a sphere with the center point and the radius



Sphere
(*drawmode=solid*)



Sphere
(*drawmode=face*)

when *face*:

ctesphere indicates the width of the sphere

ctespherenum sides indicates the number of triangles used to create the VTK of polygons

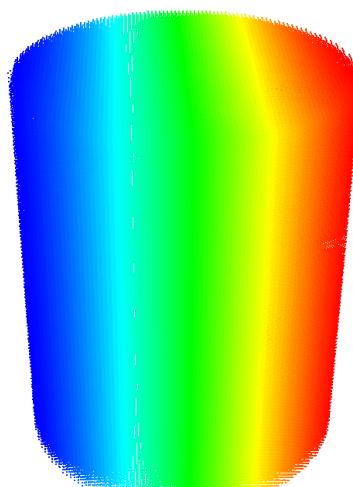
```
<setdpctes ctesphere="0.4"/>
<setdpctes ctespherenum sides="40"/>
```

CASEDEF-GEOMETRY-COMMANDS-MAINLIST

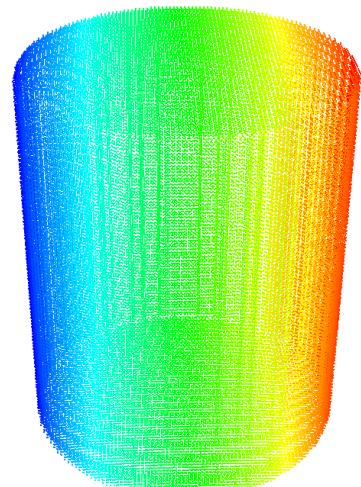
CYLINDER

- <mainlist>

```
<setmkbound mk="0"/>
<setdrawmode mode="solid"/>
- <drawcylinder radius="1" mask="0">
  <point x="1.5" y="1.5" z="0.5"/>
  <point x="1.5" y="1.5" z="3"/>
</drawcylinder>
<setdrawmode mode="face"/>
- <drawcylinder radius="1" mask="0">
  <point x="3.5" y="2.5" z="0.5"/>
  <point x="3.5" y="2.5" z="3"/>
</drawcylinder>
</mainlist>
```



Cylinder
(*drawmode=solid*)



Cylinder
(*drawmode=face*)

when *face*:

```
<setdpctes ctecylinertube="0.6"/>
<setdpctes ctecylindercover="0.7"/>
<setdpctes ctecylinernumsides="40"/>
```

ctecylinertube indicates the width of the tube

ctecylindercover indicates the width of the covers

ctespherenumsides indicates the number of triangles used to create the VTK of polygons

CASEDEF-GEOMETRY-COMMANDS-MAINLIST

```
- <mainlist>
  <setmkbound mk="0"/>
  <drawfilestl file="File.stl"/>
  <drawfileply file="File.ply"/>
  <drawfileply file="File.vtk"/>
  - <drawfilestl file="File.stl">
    <drawmove x="0.5" y="0" z="0"/>
    <drawrotate angx="10" angy="15" angz="30"/>
    <drawscale x="1" y="1" z="0.8"/>
  </drawfilestl>
  - <drawfileply file="File.ply">
    <drawmove x="0.5" y="0" z="0"/>
  </drawfileply>
  - <drawfileply file="File.ply">
    <drawmove x="0.5" y="0" z="0"/>
    <drawrotate angx="10" angy="15" angz="30"/>
  </drawfileply>
  - <drawfileply file="File.ply">
    <drawrotate angx="10" angy="15" angz="30"/>
  </drawfileply>
  - <drawfilevtk file="File.vtk">
    <polyselec>points</polyselec>
  </drawfilevtk>
  - <drawfilevtk file="File.vtk">
    <polyselec>points | lines</polyselec>
  </drawfilevtk>
  - <drawfilevtk file="File.vtk">
    <polyselec>triangles</polyselec>
  </drawfilevtk>
  - <drawfilevtk file="File.vtk">
    <polyselec>polygons</polyselec>
  </drawfilevtk>
</mainlist>
```

IMPORTING EXTERNAL GEOMETRIES

<drawfilevtk>: load a VTK file to be converted into points

<drawfileply>: load a PLY file to be converted into points

<drawfilestl>: load a STL file to be converted into points

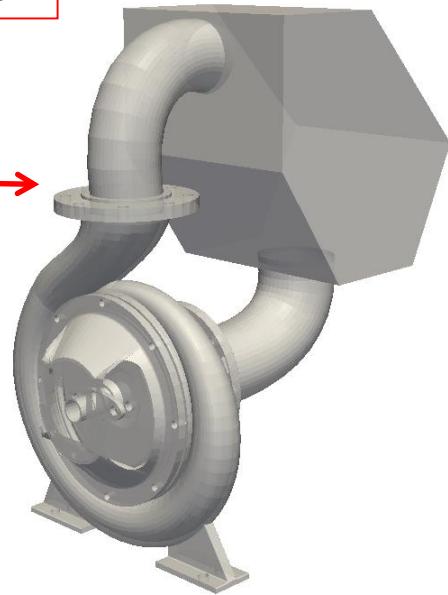
Some modifications can be applied to the VTK, PLY or STL
drawmove a displacement is applied to the external object
drawrotate a rotation is applied to the external object
drawscale scaling is applied to the external object

CASEDEF-GEOMETRY-COMMANDS-MAINLIST

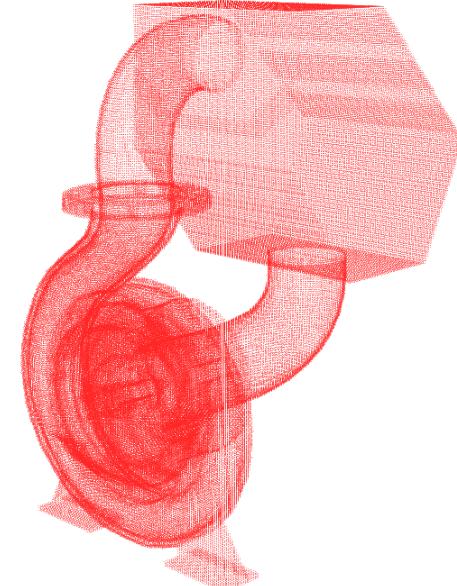
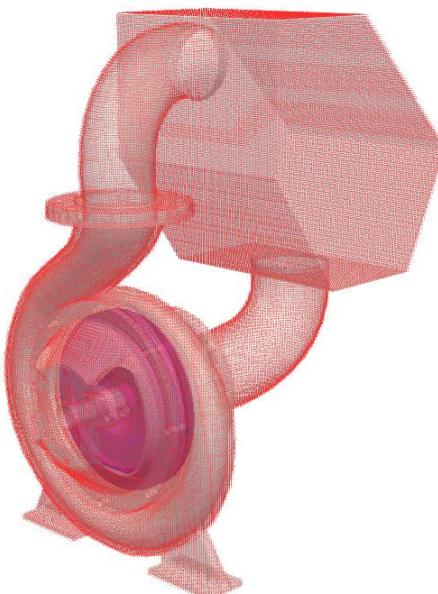
- <mainlist>

```
<setshapemode>real | bound | dp</setshapemode>
<setmkbound mk="0"/>
<drawfilevtk file="pump_fixed.vtk"/>
<setmkbound mk="1"/>
<drawfilevtk file="pump_moving.vtk"/>
<setmkfluid mk="0"/>
-<fillbox x="0.14" y="-0.1" z="-0.39">
  <modefill>void</modefill>
  <point x="-0.6" y="-0.39" z="-0.8"/>
  <size x="0.9" y="0.68" z="0.52"/>
</fillbox>
</mainlist>
```

IMPORTING EXTERNAL GEOMETRIES



from VTK to points



CASEDEF-GEOMETRY-COMMANDS-MAINLIST

```
- <mainlist>
  <setmkfluid mk="0"/>
  <fillvoidpoint x="3" y="2" z="1"/>
- <fillpoint x="3" y="2" z="1">
  <modefill>void</modefill>
</fillpoint>
- <fillpoint x="1" y="1" z="1" mkfluid="0">
  <modefill>fluid</modefill>
</fillpoint>
- <fillpoint x="1" y="1" z="1" mkboud="0">
  <modefill>bound</modefill>
</fillpoint>
- <fillpoint x="2" y="2" z="2" mkfluid="2" mkboud="8">
  <modefill>border | void | fluid | bound</modefill>
</fillpoint>
- <fillbox x="0" y="1" z="0">
  <modefill>border</modefill>
  <point x="0.1" y="1" z="1.1"/>
  <size x="3" y="4" z="2"/>
</fillbox>
- <fillprism x="2" y="3" z="5">
  <point x="0" y="0" z="0"/>
  <point x="1" y="0" z="0"/>
  <point x="0" y="1" z="0"/>
  <point x="0" y="0" z="0.5"/>
  <point x="1" y="0" z="0.5"/>
  <point x="0" y="1" z="0.5"/>
  <modefill>void</modefill>
</fillprism>
<debugout/>
</mainlist>
```

FILLING DOMAINS

<fillpoint>: fills with points starting from the seed

<fillbox>: fills with points starting from the seed within the limits defined by a box

<fillfigure>: fills with points starting from the seed within the limits defined by a figure

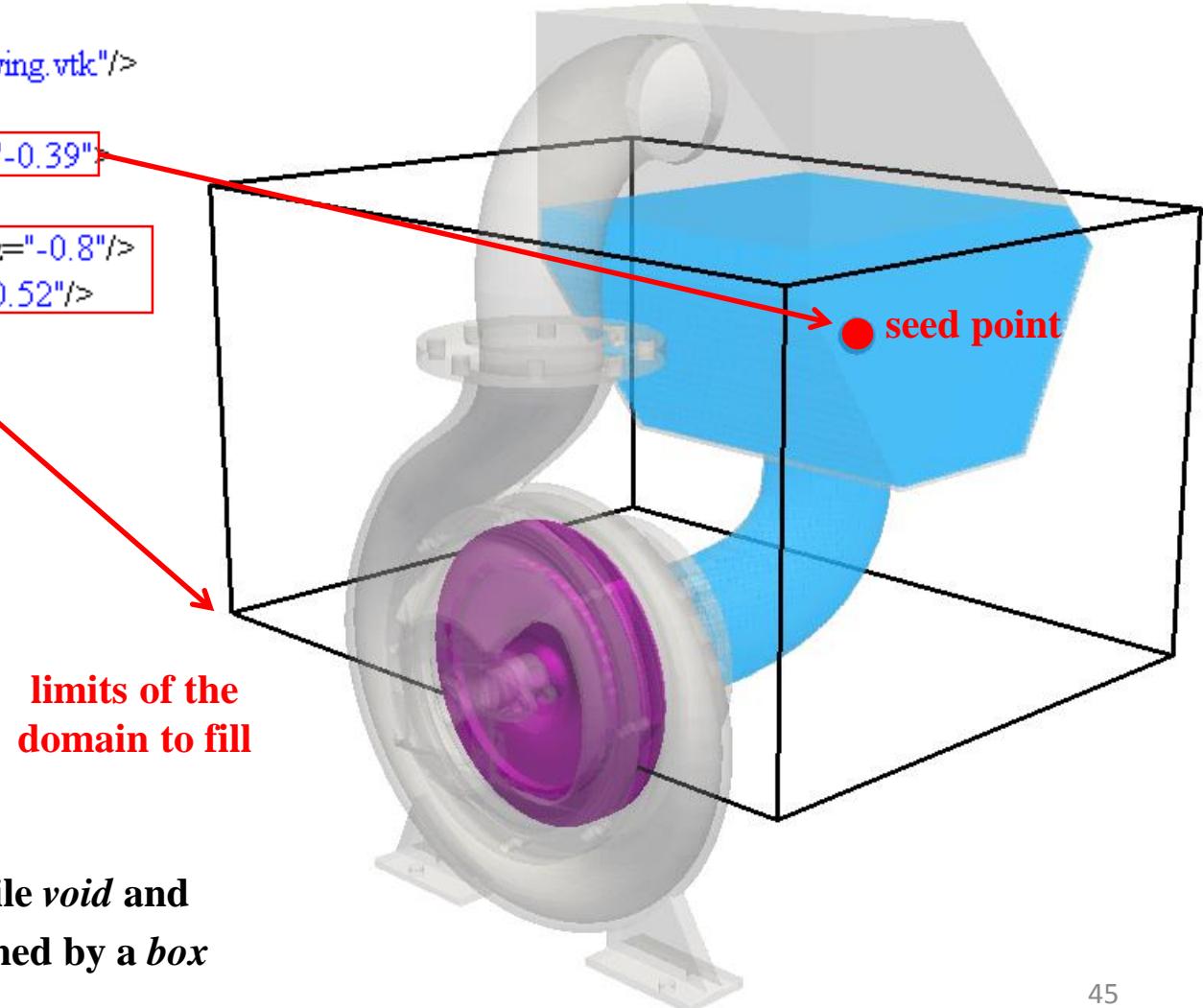
<fillprism>: fills with points starting from the seed within the limits defined by a prism

<modefill> indicates what type of points can be filled with *void*, *fluid*, *bound*, it fills with that type of points inside the specified limits or the presence of a given type of point using *border*

CASEDEF-GEOMETRY-COMMANDS-MAINLIST

```
- <mainlist>
  <setshapemode>real | bound | dp</setshapemode>
  <setmkbound mk="0"/>
  <drawfilevtk file="pump_fixed.vtk"/>
  <setmkbound mk="1"/>
  <drawfilevtk file="pump_moving.vtk"/>
  <setmkfluid mk="0"/>
- <fillbox x="0.14" y="-0.1" z="-0.39">
  <modefill>void</modefill>
  <point x="-0.6" y="-0.39" z="-0.8"/>
  <size x="0.9" y="0.68" z="0.52"/>
</fillbox>
</mainlist>
```

FILLING DOMAINS



CASEDEF-INITIALS

```
- <geometry>
  - <definition dp="0.01">
    <pointmin x="-1" y="-0.05" z="-0.05"/>
    <pointmax x="2" y="1.1" z="2"/>
  </definition>
  - <commands>
    - <mainlist>
      <setshapemode>real | dp | bound</setshapemode>
      <setdrawmode mode="full"/>
      <setmkfluid mk="1"/>
    - <drawsphere radius="0.15">
      <point x="-0.55" y="0.5" z="0.18"/>
    </drawsphere>
    <setmkfluid mk="2"/>
  - <drawbox>
    <boxfill>solid</boxfill>
    <point x="1.4" y="0.35" z="0.01"/>
    <size x="0.3" y="0.3" z="0.3"/>
  </drawbox>
</mainlist>
</commands>
</geometry>
- <initials>
  <velocity mkfluid="1" x="1.05" y="0" z="4.905"/>
  <velocity mkfluid="2" x="-0.875" y="0" z="5.886"/>
</initials>
```

INITIAL VELOCITIES

<initials>: special behaviours can be imposed to a set of fluid particles labeled with a *mk*, such as:

<velocity> initial velocity defined by a vector

<velwave> a solitary wave defined by *depth* and *amplitude*

CASEDEF-INITIALS

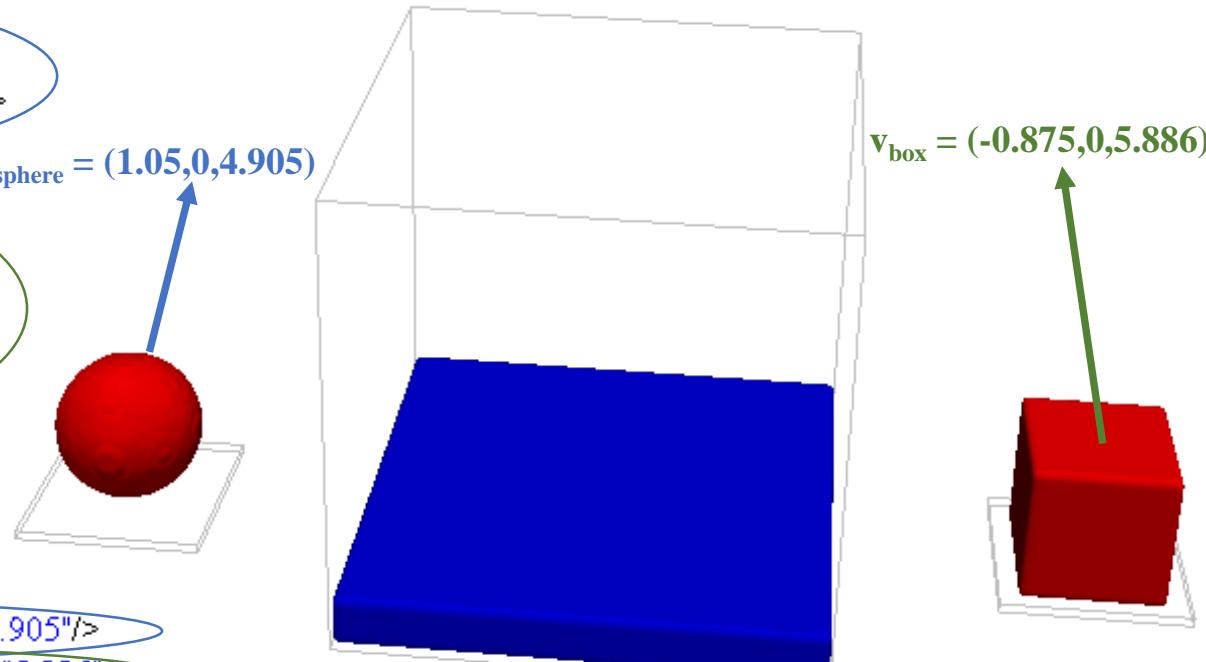
```

- <geometry>
  - <definition dp="0.01">
    <pointmin x="-1" y="-0.05" z="-0.05"/>
    <pointmax x="2" y="1.1" z="2"/>
  </definition>
  - <commands>
    - <mainlist>
      <setshapemode>real | dp | bound</setshapemode>
      <setdrawmode mode="full"/>
      <setmkfluid mk="1"/>
      - <drawsphere radius="0.15">
        <point x="-0.55" y="0.5" z="0.18"/>
      </drawsphere>
      <setmkfluid mk="2"/>
      - <drawbox>
        <boxfill>solid</boxfill>
        <point x="1.4" y="0.35" z="0.01"/>
        <size x="0.3" y="0.3" z="0.3"/>
      </drawbox>
    </mainlist>
  </commands>
</geometry>
- <initials>
  <velocity mkfluid="1" x="1.05" y="0" z="4.905"/>
  <velocity mkfluid="2" x="-0.875" y="0" z="5.886"/>
</initials>

```

INITIAL VELOCITIES

different initial velocities are imposed to two volumes of fluid $mk=1$ (sphere) and $mk=2$ (box)

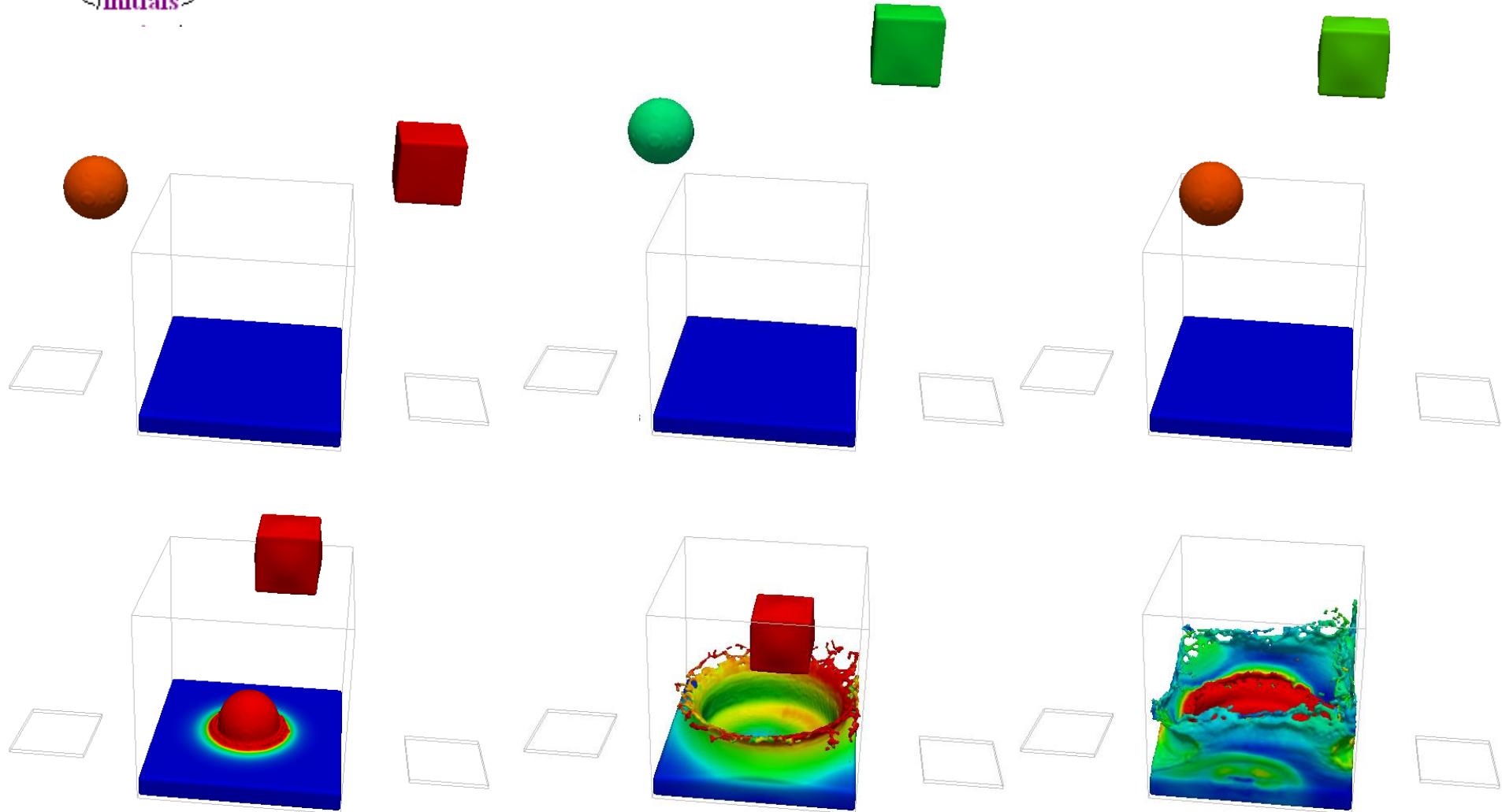


CASEDEF-INITIALS

```
-- <initials>
  <velocity mkfluid="1" x="1.05" y="0" z="4.905"/>
  <velocity mkfluid="2" x="-0.875" y="0" z="5.886"/>
</initials>
```

INITIAL VELOCITIES

colour represents velocity



CASEDEF-FLOATINGS

```
- <floatings>
  <floating mkbounds="0" relativeweight="1.3"/>
- <floating mkbounds="1" relativeweight="1.3">
  <velini x="1" y="3" z="2"/>
  <omegaini x="0.2" y="0.4" z="0.6"/>
</floating>
- <floating mkbounds="2">
  <massbody value="1300"/>
  <center x="11" y="12" z="13"/>
  <inertia x="20" y="22" z="24"/>
</floating>
- <floating mkbounds="3">
  <massbody value="1300"/>
  <center x="11" y="12" z="13"/>
  <inertia x="20" y="22" z="24"/>
  <velini x="1" y="3" z="2"/>
  <omegaini x="0.2" y="0.4" z="0.6"/>
</floating>
- <floating mkbounds="4">
  <massbody value="1300"/>
  <inertia x="20" y="22" z="24"/>
</floating>
</floatings>
```

DEFINING FLOATINGS

<floatings>: indicates that a set of particles labelled with the same *mk* constitutes a floating object

Only one of these values can be defined:
rhopbody density of the object
relativeweight in relation to the reference density
massbody total mass of the object

So that, the mass of a floating particles is:

masspart = massbody / nfloat **or**
masspart = relativeweight * rhop0 * dp^3 **or**
masspart = rhopbody * dp^3

These variables are computed by GenCase or can be also specified in advance:
center gravity center of the rigid object
inertia momentum of inertia of the rigid object
velini initial linear velocity of the object
omegaini initial angular velocity of the object

CASEDEF-FLOATINGS

DEFINING FLOATINGS

```
<floatings>
    <floating mkbound="9" relativeweight="2" property="steel + userdef01" />
    <floating mkbound="10-79" relativeweight="0.50" property="pvc" />
</floatings>
<properties>
    <propertyfile file="Floating_Materials.xml" path="materials" />
    <property name="userdef01" Restitution_Coefficient_User="0.70"
        comment="User redefinition for Restitution Coefficient (-)" />
    <links>
        <link mkbound="0" property="steel + userdef01" comment="Property for the tank"/>
    </links>
</properties>
```

When the interaction of solids (boundaries or floatings) is computed using **Discrete Element Method (DEM)** some extra properties with parameters used in DEM are loaded from “Floating_Materials.xml”:

```
<materials>
    <property name="steel">
        <Young_Modulus value="210000000000.0" comment="Young Modulus (N/m2)" />
        <PoissonRatio value="0.30" comment="Poisson Ratio (-)" />
        <Restitution_Coefficient value="0.80" comment="Restitution Coefficient (-)" />
        <Kfric value="0.45" comment="Kinetic friction coefficient" />
    </property>
</materials>
```

CASEDEF-PROPERTIES

DEFINING OTHER VARIABLES

Using section ***properties***, users can define variables to be assigned to one or more ***mk***.

```
<properties>
  <links>
    <link mkfluid="0" property="material_1" />
    <link mkbound="3-6,1" property="material_2+data_x" />
  </links>
  <propertyfile file="run/ftdata_ext.xml" path="case.materials" />
  <property name="material_1" weight="1.35" other="pepe"/>
  <property name="material_2" begin="168" count="973">
    <massbody value="4728.78" />
    <center x="4.99" y="5" z="7.03" />
  </property>
  <property name="data_x" weight="1.35" />
</properties>
```

Each label of ***property*** has a name and can group several values
that can be text (***other***) or a number (***weight***)

```
<property name="material_1" weight="1.35" other="pepe"/>
```

or other subvalues (***massbody*** and ***center***)

```
<property name="material_2" begin="168" count="973">
  <massbody value="4728.78" />
  <center x="4.99" y="5" z="7.03" />
</property>
```

CASEDEF-PROPERTIES

These properties can be loaded from an external file using *propertyfile*.

In this case, users have to indicate file name and path to access section with properties.

```
<propertyfile file="run/ftdata_ext.xml" path="case.materials" />
```

Example of file “ftdata_ext.xml”:

```
<case>
  <materials>
    <property name="uno" value="1.35"/>
    <property name="dos" value="168">
      <massbody value="4728.78" />
    </property>
  </materials>
</case>
```

Section *links* assigns one or more *property* to one or several values of *mk*:

- Values of *material_1* are assigned to fluid particles with *mk*=0
 - ```
<link mkfluid="0" property="material_1"/>
```
- Values of *material\_2* and *data\_x* are assigned to boundary particles with *mk*=1,3,4,5,6
  - ```
<link mkbound="3-6,1" property="material_2+data_x"/>
```

It is also possible to indicate one *property* directly in the definition of the *floatings*:

```
<floatings>
  ...
  <floating mkbound="4" property="Material_2">
    <massbody value="1300" />
    <inertia x="20" y="22" z="24" />
  </floating>
</floatings>
```

CASEDEF-PROPERTIES

GenCase reads the information from *case.casedef.properties* and writes in *case.execution.particles.properties*.

```
<particles np="1494" nb="313" nbf="313" mkboundsfirst="11" mkfluidfirst="1">
    <fixed mkbounds="0" mk="11" begin="0" count="229" />
    <fixed mkbounds="1" mk="12" begin="229" count="28" property="data_x+material_2" />
    <fixed mkbounds="2" mk="13" begin="257" count="28" />
    <fixed mkbounds="4" mk="15" begin="285" count="28" property="data_x+material_2" />
    <fluid mkfluid="0" mk="1" begin="313" count="1146" property="material_1" />
    <fluid mkfluid="1" mk="2" begin="1459" count="35" />
<properties>
    <links>
        <link mk="1" property="material_1" />
        <link mk="12,15" property="data_x+material_2" />
    </links>
    <property name="material_1" weight="1.35" other="pepe"/>
    <property name="material_2" begin="168" count="973">
        <massbody value="4728.78" />
        <center x="4.99" y="5" z="7.03" />
    </property>
    <property name="data_x" weight="1.35" />
</properties>
</particles>
```

Thus, *DualSPHysics* can access to assigned values to each *mk*.

The object of type *JSpaceParts* is used to obtain the assigned properties to each block of particles

CASEDEF-MOTION

- Motion01: uniform rectilinear motion (<mvrect />) that also includes pauses (<wait />)

```
- <motion>
  - <objreal ref="1">
    <begin mov="1" start="0" finish="5.4"/>
    - <mvrect id="1" duration="0.6" next="2">
      <vel x="1" y="0" z="0"/>
    </mvrect>
    <wait id="2" duration="0.3" next="3"/>
    - <mvrect id="3" duration="0.6" next="4">
      <vel x="1" y="0" z="0"/>
    </mvrect>
    <wait id="4" duration="0.3" next="5"/>
    - <mvrect id="5" duration="0.6" next="6">
      <vel x="1" y="0" z="0"/>
    </mvrect>
    <wait id="6" duration="0.3" next="7"/>
    - <mvrect id="7" duration="-1" next="1">
      <vel x="-1.8" y="0" z="0"/>
    </mvrect>
  </objreal>
</motion>
```

movement defined for the set of particles with *mk=1*

first **mov=1** during 0.6s,
then **wait=2** for 0.3s,
then mov=3 during 0.6s,
then wait=4 for 0.3s,
then mov=5 during 0.6s...

<mvrect>: uniform rectilinear movement

vel indicates the constant velocity vector

CASEDEF-MOTION

- *Motion01*: uniform rectilinear motion (<mvrect />) that also includes pauses (<wait />)



Time: 0.00 s



Time: 0.30 s



Time: 0.60 s



Time: 0.90 s



Time: 1.20 s



Time: 1.50 s



Time: 1.80 s



Time: 2.10 s



Time: 2.40 s



Time: 2.70 s

CASEDEF-MOTION

- *Motion02*: combination of two uniform rectilinear motions (<mvrect />)

```
- <motion>
  - <objreal ref="1">
    <begin mov="1" start="0"/>
    - <mvrect id="1" duration="2" next="2">
      <vel x="1" y="0" z="0"/>
    </mvrect>
    - <mvrect id="2" duration="1" next="1">
      <vel x="-2" y="0" z="0"/>
    </mvrect>
    <begin mov="3" start="0.5"/>
    - <mvrect id="3" duration="1.3" next="4">
      <vel x="0" y="1" z="0"/>
    </mvrect>
    - <mvrect id="4" duration="1.3" next="3">
      <vel x="0" y="-1" z="0"/>
    </mvrect>
  </objreal>
</motion>
```

<mvrect>: uniform rectilinear movement

vel indicates the constant velocity vector

CASEDEF-MOTION

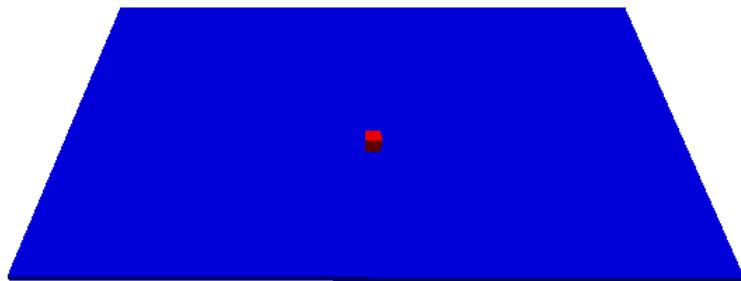
- *Motion02*: combination of two uniform rectilinear motions (<mvrect />)



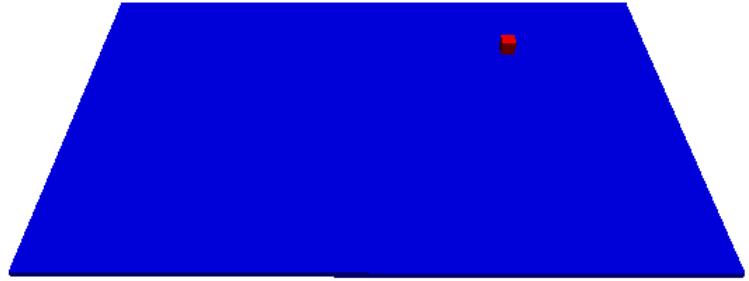
Time: 0.00 s



Time: 0.50 s



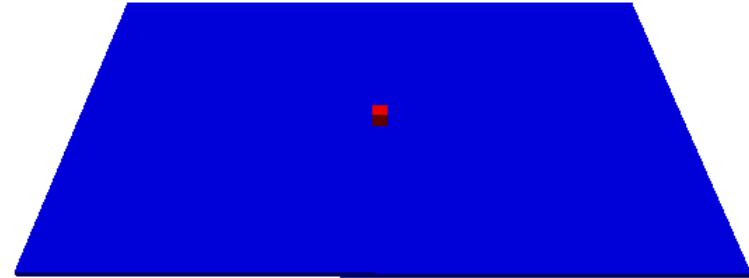
Time: 1.00 s



Time: 1.50 s



Time: 2.00 s



Time: 2.50 s

CASEDEF-MOTION

```
- <motion>
  - <objreal ref="1">
    <begin mov="1" start="0"/>
    - <mvrect id="1" duration="1.5" next="2">
      <vel x="1" y="0" z="0"/>
    </mvrect>
    - <mvrect id="2" duration="1.5" next="1">
      <vel x="-1" y="0" z="0"/>
    </mvrect>
    <begin mov="3" start="0.1"/>
    - <mvrect id="3" duration="1.1" next="4">
      <vel x="0" y="1" z="0"/>
    </mvrect>
    - <mvrect id="4" duration="1.1" next="3">
      <vel x="0" y="-1" z="0"/>
    </mvrect>
  - <objreal ref="2">
```



```
    <begin mov="1" start="0.2"/>
    - <mvrect id="1" duration="0.45" next="2">
      <vel x="1" y="0" z="0"/>
    </mvrect>
    - <mvrect id="2" duration="0.45" next="3">
      <vel x="0" y="1" z="0"/>
    </mvrect>
    - <mvrect id="3" duration="0.45" next="4">
      <vel x="-1" y="0" z="0"/>
    </mvrect>
    - <mvrect id="4" duration="0.45" next="1">
      <vel x="0" y="-1" z="0"/>
    </mvrect>
  </objreal>
</objreal>
</motion>
```

- *Motion03*: movement of an object depending on the movement of another (hierarchy of objects)

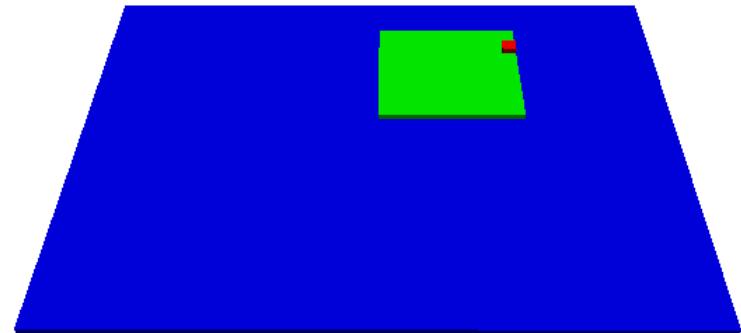
movement defined for the set of particles with $mk=2$ that also moves according to the movement defined for $mk=1$

CASEDEF-MOTION

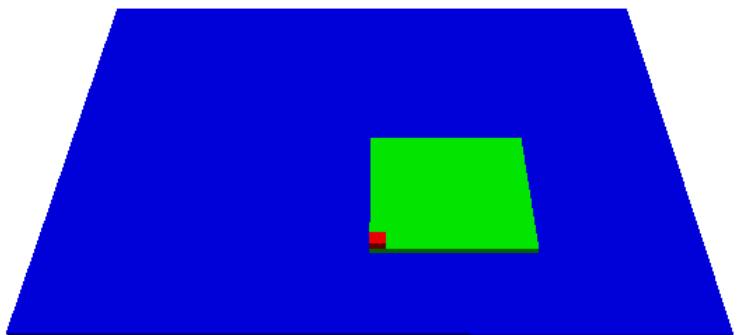
- *Motion03*: movement of an object depending on the movement of another (hierarchy of objects)



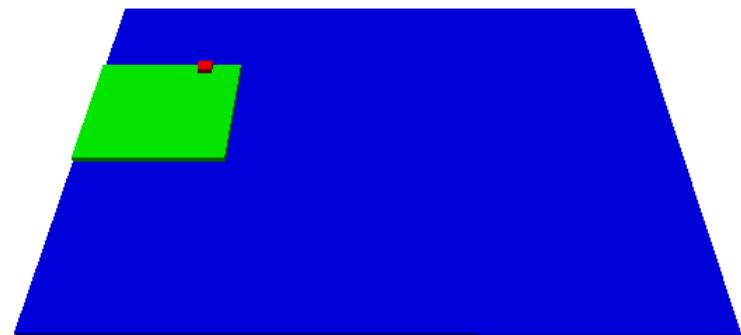
Time: 0.00 s



Time: 1.00 s



Time: 2.00 s



Time: 3.00 s

CASEDEF-MOTION

- Motion04: accelerated rectilinear motion (<mvrectace />)

```
- <motion>
  - <objreal ref="1">
    <begin mov="1" start="0"/>
    - <mvrectace id="1" duration="1.411" next="2">
      <velini x="0" y="0" z="0"/>
      <ace x="2" y="0" z="0"/>
    </mvrectace>
    - <mvrectace id="2" duration="1">
      <velini x="-2" y="5" z="0"/>
      <ace x="0" y="-10" z="0"/>
    </mvrectace>
  </objreal>
</motion>
```

<mvrectace>: accelerated rectilinear movement

velini indicates the initial velocity vector

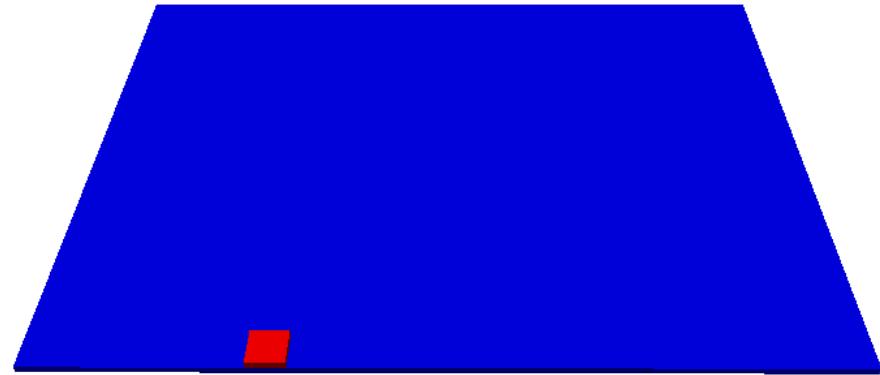
ace indicates the acceleration vector

CASEDEF-MOTION

- *Motion04*: accelerated rectilinear motion (<**mvrectace** />)



Time: 0.00 s



Time: 0.75 s



Time: 1.50 s



Time: 2.25 s

CASEDEF-MOTION

- *Motion05*: rotational motion (<**mvrot** />)

```
- <motion>
  - <objreal ref="3">
    <begin mov="1" start="0"/>
    - <mvrot id="1" duration="1000">
      <vel ang="20"/>
      <axisp1 x="0.5" y="0.5" z="0"/>
      <axisp2 x="0.5" y="0.5" z="1"/>
    </mvrot>
  </objreal>
  - <objreal ref="4">
    <begin mov="1" start="0"/>
    - <mvrot id="1" duration="1000">
      <vel ang="240"/>
      <axisp1 x="0.5" y="0.5" z="0"/>
      <axisp2 x="0.5" y="0.5" z="1"/>
    </mvrot>
  </objreal>
</motion>
```

<**mvrot**>: rotational movement

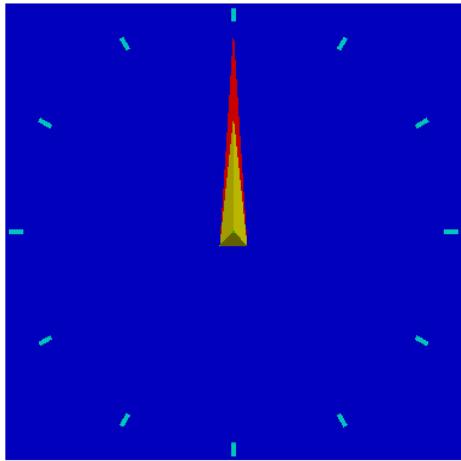
vel indicates the angular velocity

axisp1 first point of the rotation axis

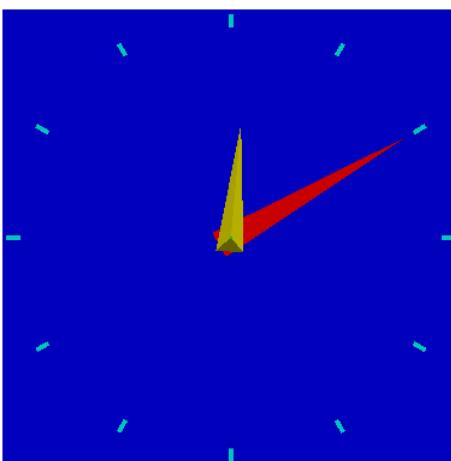
axisp2 second point of the rotation axis

CASEDEF-MOTION

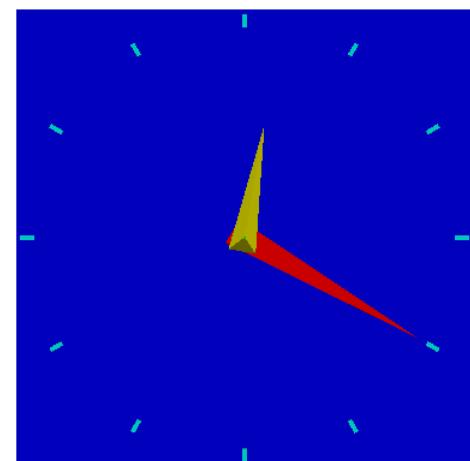
- *Motion05*: rotational motion (<**mvrot** />)



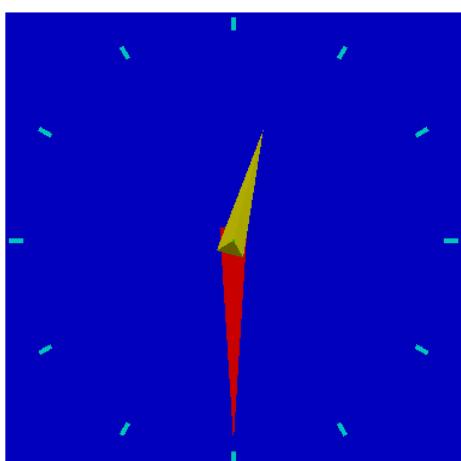
Time: 0.00 s



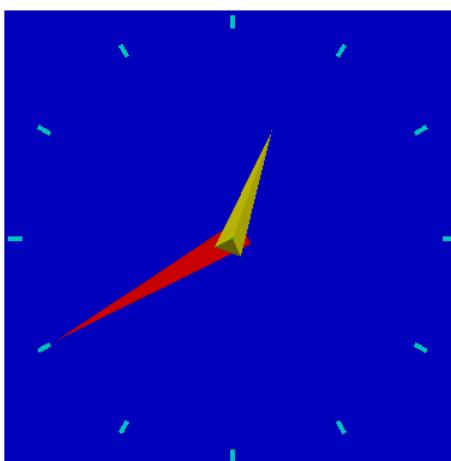
Time: 0.25 s



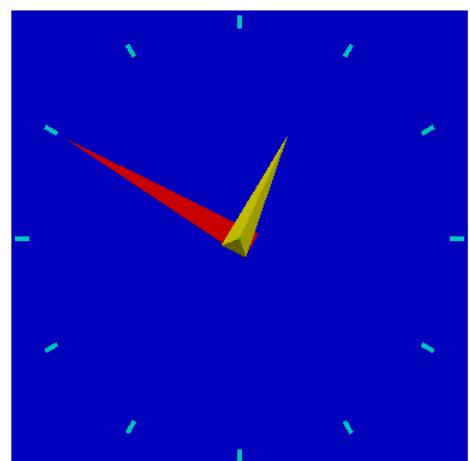
Time: 0.50 s



Time: 0.75 s



Time: 1.00 s



Time: 1.25 s

CASEDEF-MOTION

- Motion06: accelerated rotation motion (<**mvrotate** />) and accelerated circular motion (<**mvcirace** />).

```
- <motion>
  - <obj>
    <objreal ref="1"/>
    <objreal ref="3"/>
    <objreal ref="4"/>
    <begin mov="1" start="0"/>
  - <mvrotate id="1" duration="1000">
    <ace ang="9"/>
    <velini ang="-50"/>
    <axisp1 x="0" y="0" z="1.85"/>
    <axisp2 x="0" y="1" z="1.85"/>
  </mvrotate>
</obj>
- <objreal ref="5">
  <begin mov="1" start="0"/>
  - <mvcirace id="1" duration="1000">
    <ace ang="9"/>
    <velini ang="-50"/>
    <ref x="1.3" y="-0.7" z="1.85"/>
    <axisp1 x="0" y="0" z="1.85"/>
    <axisp2 x="0" y="1" z="1.85"/>
  </mvcirace>
</objreal>
</motion>
```

<**mvrotate**>: accelerated rotational movement

ace indicates the angular acceleration

velini indicates the initial angular velocity

axisp1 first point of the rotation axis

axisp2 second point of the rotation axis

<**mvcirace**>: accelerated circular movement

ace indicates the angular acceleration

ref indicates the point of the object that rotates with the axis

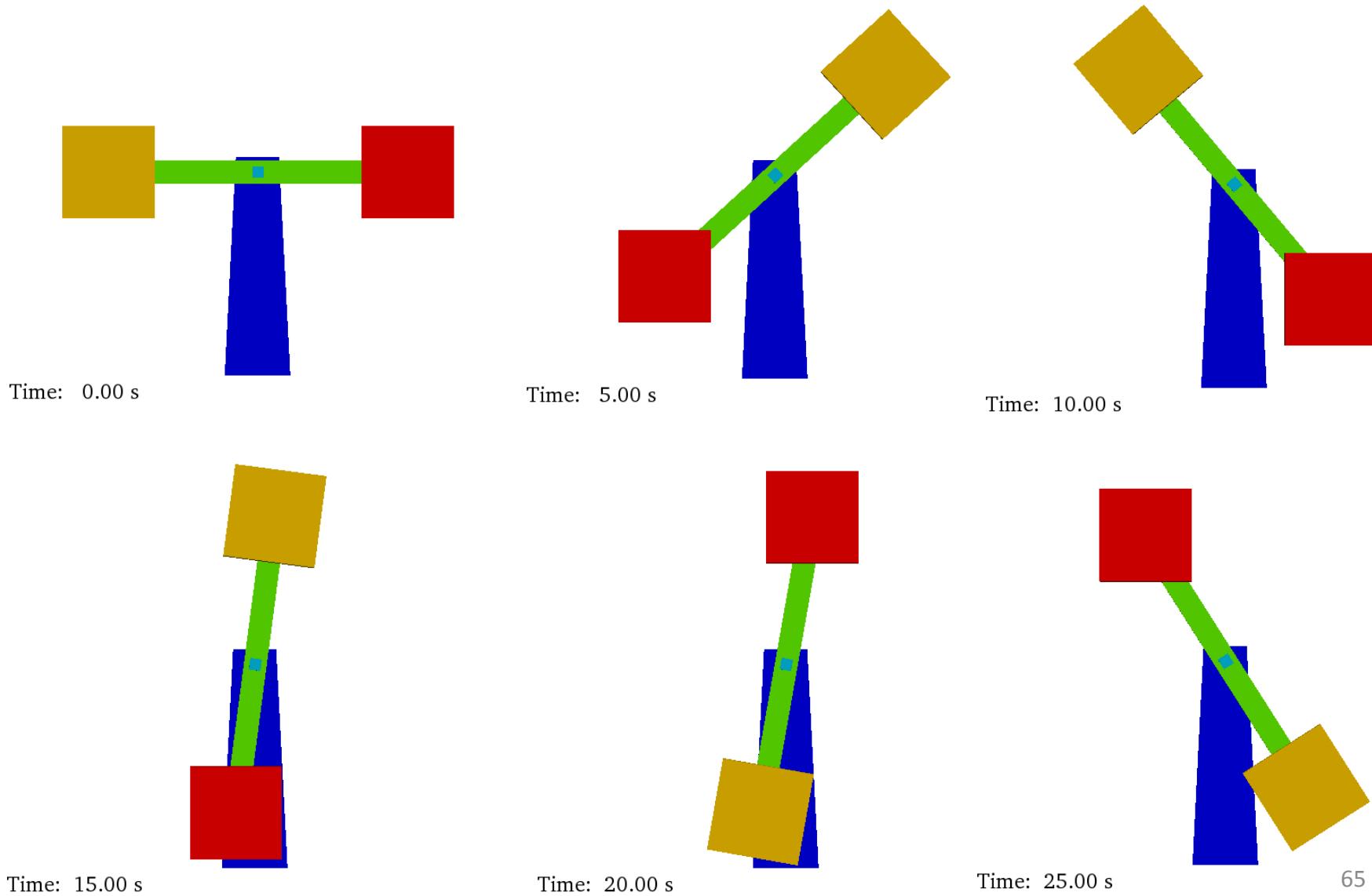
velini indicates the initial angular velocity

axisp1 first point of the rotation axis

axisp2 second point of the rotation axis

CASEDEF-MOTION

- Motion06: accelerated rotation motion (**<mvrotate >**) and accelerated circular motion (**<mvcirace >**).



CASEDEF-MOTION

- Motion07: sinusoidal movement (<mvrectsinu />, <mvrotsinu />, <mvcirsinu />)

```
- <motion>
- <objreal ref="4">
  <begin mov="1" start="0"/>
- <mvrotsinu id="1" duration="5" next="2">
  <axisp1 x="0" y="0" z="2.85"/>
  <axisp2 x="0" y="1" z="2.85"/>
  <freq v="0.2"/>
  <ampl v="60"/>
  <phase v="0"/>
</mvrotsinu>
- <mvrotsinu id="2" duration="5" next="1">
  <axisp1 x="0" y="0" z="2.85"/>
  <axisp2 x="0" y="1" z="2.85"/>
  <freq v="0.4"/>
  <ampl v="75"/>
</mvrotsinu>
</objreal>
- <objreal ref="5">
  <begin mov="1" start="0"/>
- <mvcirsinu id="1" duration="5" next="2">
  <ref x="0" y="-0.7" z="0.2"/>
  <axisp1 x="0" y="0" z="2.85"/>
  <axisp2 x="0" y="1" z="2.85"/>
  <freq v="0.2"/>
  <ampl v="60"/>
  <phase v="0"/>
</mvcirsinu>
- <mvcirsinu id="2" duration="5" next="1">
  <ref x="0" y="-0.7" z="0.2"/>
  <axisp1 x="0" y="0" z="2.85"/>
  <axisp2 x="0" y="1" z="2.85"/>
  <freq v="0.4"/>
  <ampl v="75"/>
  <phase v="0"/>
</mvcirsinu>
</objreal>
- <objreal ref="6">
  <begin mov="1" start="0"/>
- <mvrectsinu id="1" duration="5" next="2">
  <freq x="0.2" y="0" z="0"/>
  <ampl x="2.30" y="0" z="0"/>
  <phase x="0" y="0" z="0"/>
</mvrectsinu>
- <mvrectsinu id="2" duration="5" next="1">
  <freq x="0.4" y="0" z="0"/>
  <ampl x="2.55" y="0" z="0"/>
  <phase x="0" y="0" z="0"/>
</mvrectsinu>
</objreal>
</motion>
```

<**mvrectsinu**>: sinusoidal rectilinear movement

<**mvrotsinu**>: sinusoidal rotational movement

<**mvcirsinu**>: sinusoidal circular movement

axisp1 first point of the rotation axis

axisp2 second point of the axis

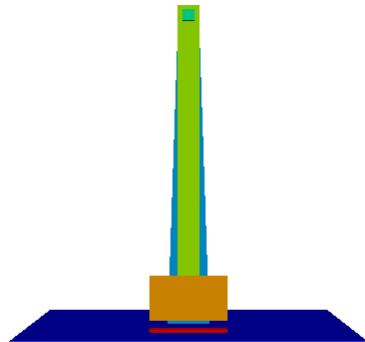
freq frequency

ampl amplitude

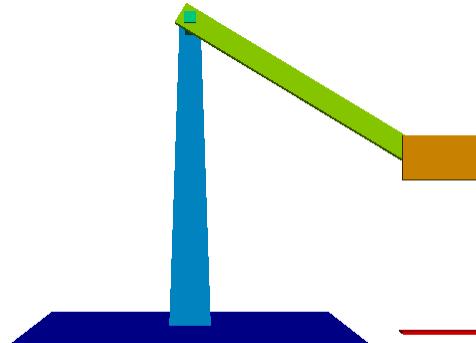
phase phase

CASEDEF-MOTION

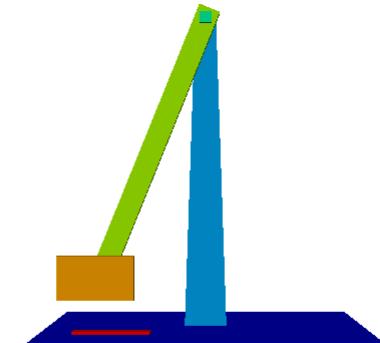
- Motion07: sinusoidal movement (<mvrectsinu />, <mvrotsinu />, <mvcirsinu />)



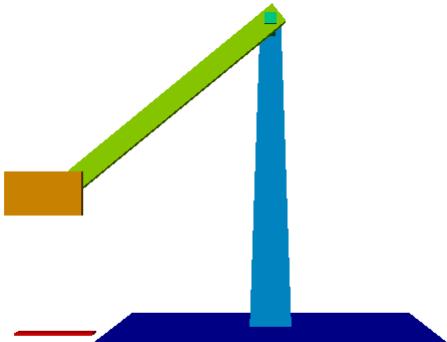
Time: 0.00 s



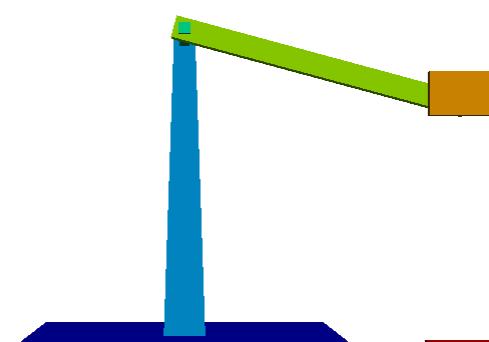
Time: 1.40 s



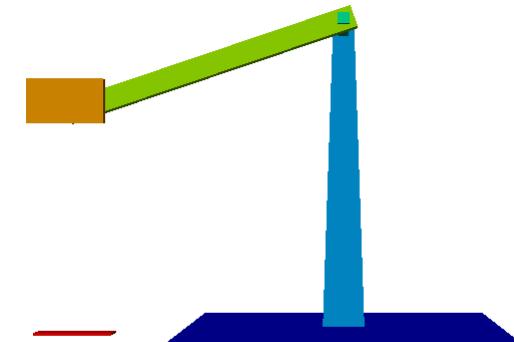
Time: 2.80 s



Time: 4.20 s



Time: 5.60 s



Time: 7.00 s

CASEDEF-MOTION

- Motion08: predefined movement with data from an external file (<mvpref /> or <mvfile />)

```
- <motion>
  - <objreal ref="200">
    <begin mov="1" start="0"/>
    - <mvpref id="1" duration="10">
      <file name="motion08mov_f3.out" fields="4" fieldtime="0" fieldx="1" fieldy="2" fieldz="3"/>
    </mvpref>
  </objreal>
  - <objreal ref="150">
    <begin mov="1" start="0"/>
    - <mvpref id="1" duration="8" next="2">
      <file name="motion08mov_f3.out" fields="4" fieldtime="0" fieldx="1" fieldy="2"/>
    </mvpref>
    - <mvrect id="2" duration="-1">
      <vel x="0" y="0" z="-0.02"/>
    </mvrect>
  </objreal>
  - <objreal ref="151">
    <begin mov="1" start="0"/>
    - <mvpref id="1" duration="10">
      <file name="motion08mov_f3.out" fields="4" fieldtime="0" fieldx="1" fieldz="3"/>
    </mvpref>
  </objreal>
  - <objreal ref="152">
    <begin mov="1" start="0"/>
    - <mvpref id="1" duration="10">
      <file name="motion08mov_f3.out" fields="4" fieldtime="0" fieldy="2" fieldz="3"/>
    </mvpref>
  </objreal>
</motion>
```

<mvpref /> or <mvfile />:
prescribed motion loaded from a file

name name of the file
fields number of columns of the file
fieldtime column with time
fieldx column with X-position
fieldy column with Y-position
fieldz column with Z-position

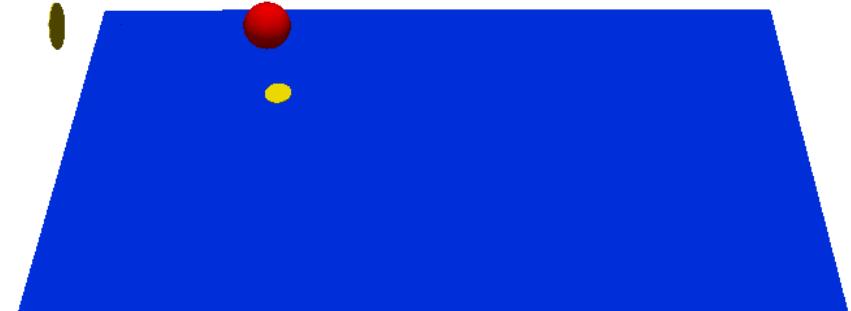
first field (or column) has reference "0"
second field (or column) has reference "1"

CASEDEF-MOTION

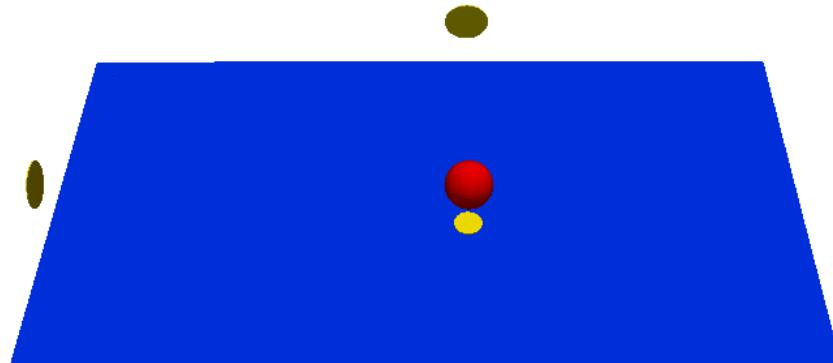
- *Motion08*: predefined movement with data from an external file (<mvpredef /> or <mvfile />)



Time: 0.00 s



Time: 3.00 s



Time: 6.00 s



Time: 9.00 s

CASEDEF-MOTION

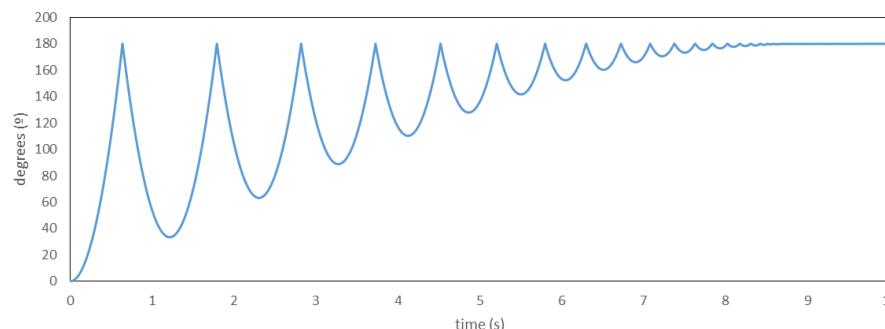
- *Motion09*: predefined movement with data from an external file (<mvrotfile />)

<**mvrotfile** />: prescribed motion loaded from a file *with degrees*

name name of the file

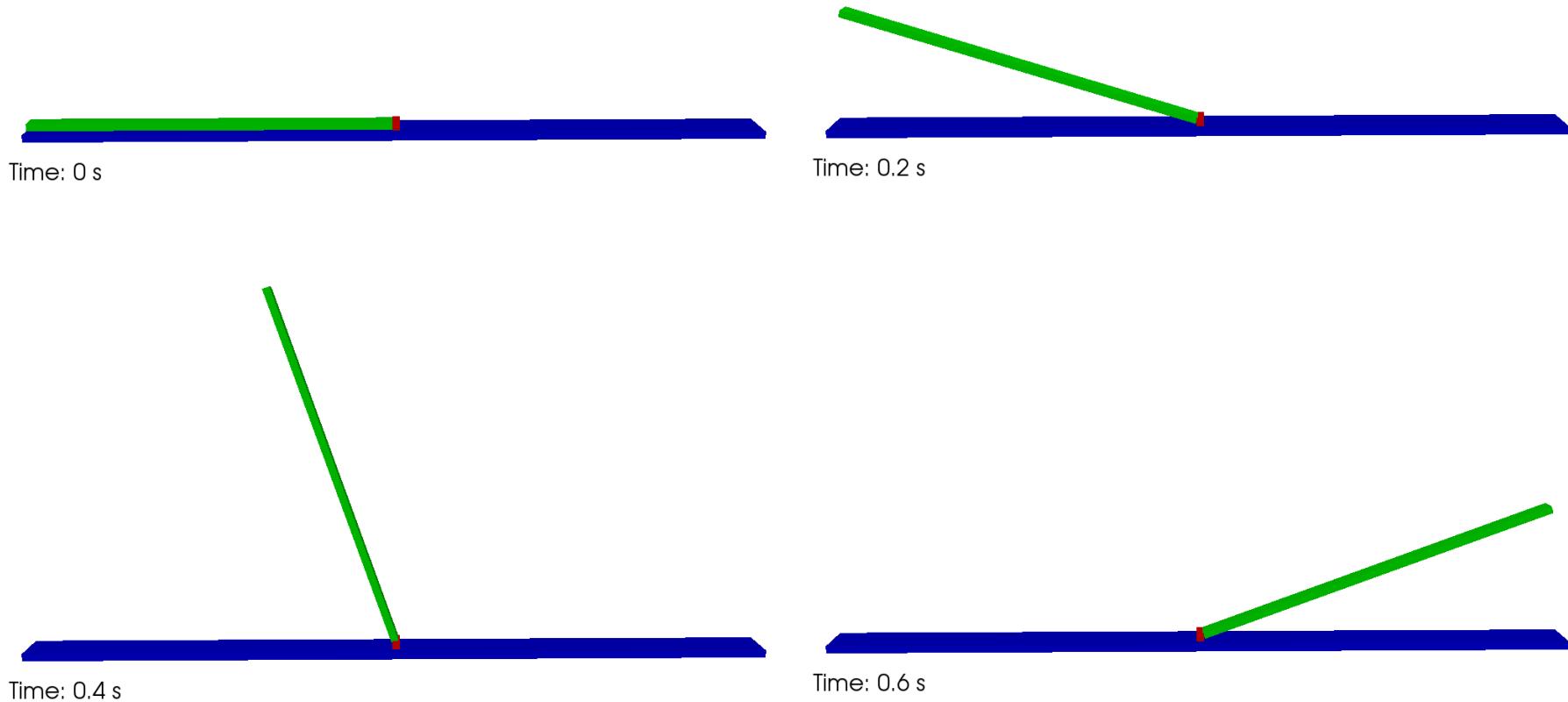
axisp1 & axisp2 two points to define the axis of rotation

```
<motion>
    <objreal ref="1">
        <begin mov="1" start="0" finish="100" />
        <mvrotfile id="1" duration="9" next="2" anglesunits="degrees">
            <file name="Motion09mov_deg.csv" />
            <axisp1 x="1" y="1" z="0.03" />
            <axisp2 x="1" y="-1" z="0.03" />
        </mvrotfile>
        <mvrotfile id="2" duration="9" anglesunits="radians">
            <file name="Motion09mov_rad.csv" />
            <axisp1 x="1" y="-1" z="0.03" />
            <axisp2 x="1" y="1" z="0.03" />
        </mvrotfile>
    </objreal>
</motion>
```



CASEDEF-MOTION

- *Motion09*: predefined movement with data from an external file (<mvrotfile />)



XML file EXECUTION-SPECIAL-WAVEPADDLES-PISTON

Generation of regular waves

```
<piston>
  <mkbound value="10" comment="Mk-Bound of selected particles" />
  <waveorder value="2" comment="Order wave generation 1:1st order, 2:2nd order (def=1)" />
  <start value="0" comment="Start time (def=0)" />
  <duration value="0" comment="Movement duration, Zero is the end of simulation (def=0)" />
  <depth value="0.27" comment="Fluid depth (def=0)" />
  <fixeddepth value="0" comment="Fluid depth without paddle (def=0)" />
  <pistondir x="1" y="0" z="0" comment="Movement direction (def=(1,0,0))" />
  <waveheight value="0.1" comment="Wave height" />
  <waveperiod value="1.3" comment="Wave period" />
  <phase value="0" comment="Initial wave phase in function of PI (def=0)" />
  <ramp value="0" comment="Periods of ramp (def=0)" />
  <savemotion periods="24" periodsteps="20" xpos="2" zpos="-0.15"
    comment="Saves motion data. xpos and zpos are optional. zpos=-depth" />
</piston>
```

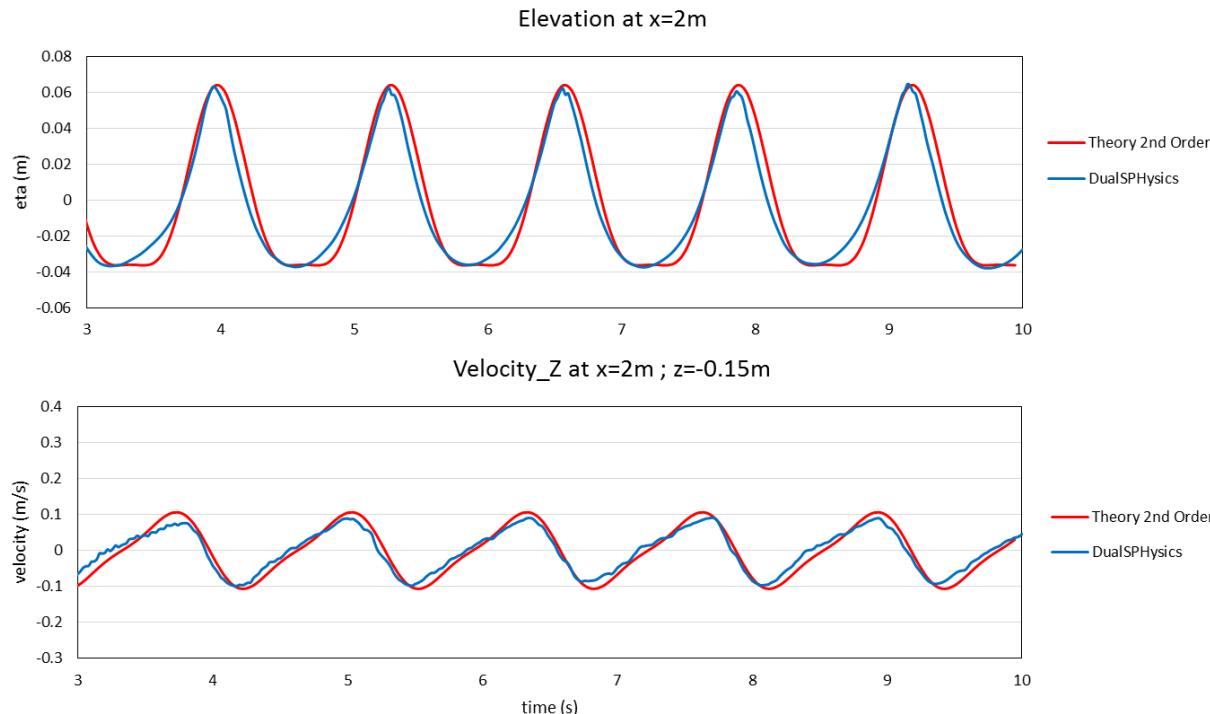
- *waveorder*: order of wave generation (1st order or 2nd order)
- *depth*: depth at front of the piston
- *waveheight*: wave height H
- *waveperiod*: wave period T
- *ramp*: number of periods to smooth the movement of the piston
- *savemotion*: saves theoretical results of elevation and orbital velocities at xpos and zpos
(being zpos=-depth of the measuring point)

XML file EXECUTION-SPECIAL-WAVEPADDLES-PISTON

Generation of regular waves

- *waveorder*: order of wave generation (1st order or 2nd order)
- *depth*: depth at front of the piston
- *waveheight*: wave height H
- *waveperiod*: wave period T
- *ramp*: number of periods to smooth the movement of the piston (being $zpos=-depth$ of the measuring point)
- *savemotion*: saves theoretical results of elevation and orbital velocities at *xpos* and *zpos*

```
<savemotion periods="24" periodsteps="20" xpos="2" zpos="-0.15" />
```



EXECUTION-SPECIAL-WAVEPADDLES-PISTON_SPECTRUM

Generation of irregular waves

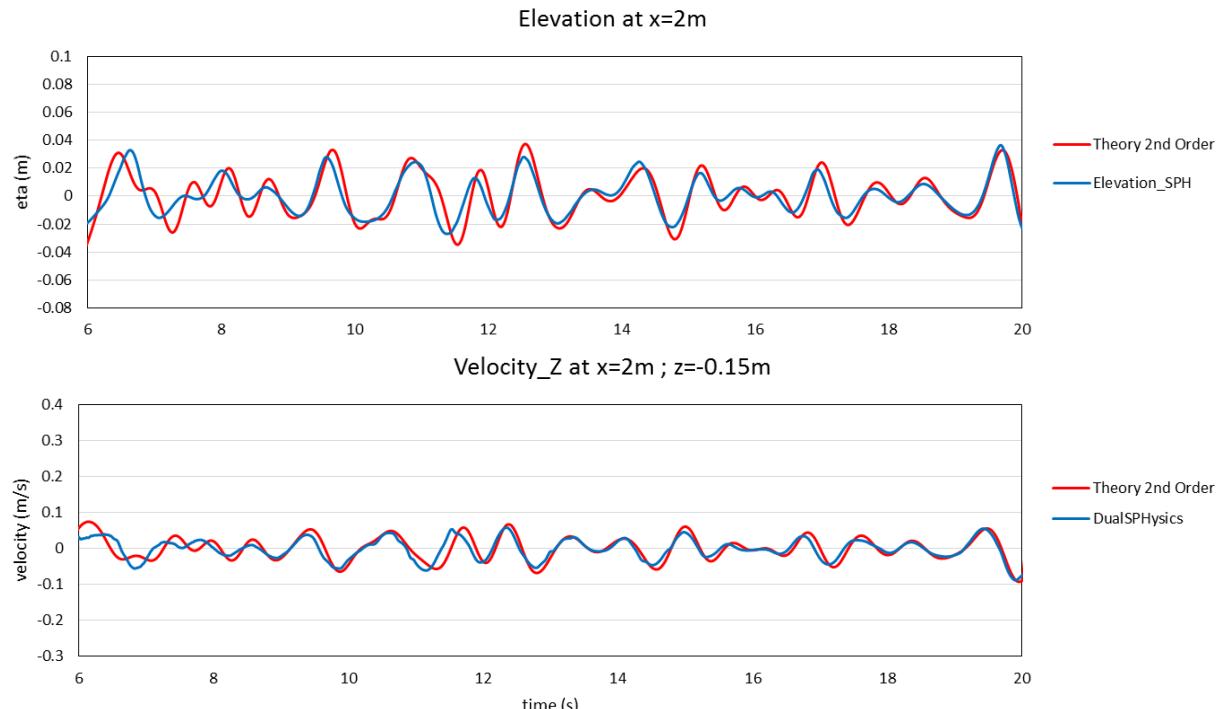
```
<piston_spectrum>
  <mkbound value="10" comment="Mk-Bound of selected particles" />
  <waveorder value="2" comment="Order wave generation 1:1st order, 2:2nd order (def=1)" />
  <start value="0" comment="Start time (def=0)" />
  <duration value="0" comment="Movement duration, Zero is the end of simulation (def=0)" />
  <depth value="0.27" comment="Fluid depth (def=0)" />
  <fixeddepth value="0" comment="Fluid depth without paddle (def=0)" />
  <pistondir x="1" y="0" z="0" comment="Movement direction (def=(1,0,0))" />
  <spectrum value="jonswap" comment="Spectrum type: jonswap,pierson-moskowitz" />
  <discretization value="stretched"
    comment="Spectrum discretization: regular,random,stretched,cosstretched (def=stretched)" />
  <waveheight value="0.1" comment="Wave height" />
  <waveperiod value="1.3" comment="Wave period" />
  <peakcoef value="3.3" comment="Peak enhancement coefficient (def=3.3)" />
  <waves value="128" comment="Number of waves to create irregular waves (def=50)" />
  <randomseed value="2" comment="Random seed to initialize a pseudorandom number generator" />
  <serieini value="2.8" comment="Initial time in irregular wave serie (def=0)" />
  <rampertime value="1" comment="Time of ramp (def=0)" />
  <savemotion time="50" timedt="0.05" xpos="2" zpos="-0.15"
    comment="Saves motion data. xpos and zpos are optional. zpos=-depth" />
  <saveserie timemin="0" timemax="1300" timedt="0.05" xpos="0" comment="Saves serie data (optional)" />
  <saveseriewaves timemin="0" timemax="1000" xpos="2" comment="Saves serie heights" />
</piston_spectrum>
```

EXECUTION-SPECIAL-WAVEPADDLES-PISTON_SPECTRUM

Generation of irregular waves

- *waveorder*: order of wave generation (1st order or 2nd order)
- *spectrum*: type of spectrum (Jonswap or Pierson-Moskowitz)
- *waveheight*: significant wave height H_s
- *waveperiod*: peak wave period T_p
- *serieini*: initial series of the irregular train is chosen from “WavePaddle_mkb0010_Serie.csv”
- *ramptime*: time to slowly start a smoothed movement of the piston (being $zpos=-depth$ of the measuring point)
- *savemotion*: saves theoretical results of elevation and orbital velocities at *xpos* and *zpos*

```
< savemotion time="50" timedt="0.05" xpos="2" zpos="-0.15" />
```



**Parameters for execution in
DualSPHysics**

```

<parameters>
    <parameter key="PosDouble" value="1" comment="Precision in particle interaction 0:Simple, 1:Double, 2:Uses and saves double (default=0) " />
    <parameter key="StepAlgorithm" value="1" comment="Step Algorithm 1:Verlet, 2:Symplectic (default=1)" />
    <parameter key="VerletSteps" value="40" comment="Verlet only: Number of steps to apply Euler timestepping (default=40)" />
    <parameter key="Kernel" value="1" comment="Interaction Kernel 1:Cubic Spline, 2:Wendland (default=2)" />
    <parameter key="ViscoTreatment" value="1" comment="Viscosity formulation 1:Artificial, 2:Laminar+SPS (default=1)" />
    <parameter key="Visco" value="0.1" comment="Viscosity value" />
    <parameter key="ViscoBoundFactor" value="1" comment="Multiply viscosity value with boundary (default=1)" />
    <parameter key="DeltaSPH" value="0" comment="DeltaSPH value, 0.1 is the typical value, with 0 disabled (default=0)" />
    <parameter key="#Shifting" value="0" comment="Shifting mode 0:None, 1:Ignore bound, 2:Ignore fixed, 3:Full (default=0)" />
    <parameter key="#ShiftCoef" value="-2" comment="Coefficient for shifting computation (default=-2)" />
    <parameter key="#ShiftTFS" value="1.5" comment="Threshold to detect free surface. Typically 1.5 for 2D and 2.75 for 3D (default=0)" />
    <parameter key="RigidAlgorithm" value="1" comment="Rigid Algorithm 1:SPH, 2:DEM (default=1)" />
    <parameter key="FtPause" value="0.0" comment="Time to freeze the floatings at simulation start (warmup) (default=0)" units_comment="seconds" />
    <parameter key="CoefDtMin" value="0.05" comment="Coefficient to calculate minimum time step dtmin=coefdmin*h/speedsound (default=0.05)" />
    <parameter key="#DtIni" value="0.0001" comment="Initial time step (default=h/speedsound)" units_comment="seconds" />
    <parameter key="#DtMin" value="0.00001" comment="Minimum time step (default=coefdmin*h/speedsound)" units_comment="seconds" />
    <parameter key="#DtFixed" value="DtFixed.dat" comment="Dt values are loaded from file (default=disabled)" />
    <parameter key="DtAllParticles" value="0" comment="Velocity of particles used to calculate DT. 1:All, 0:Only fluid/floating (default=0)" />
    <parameter key="TimeMax" value="1.5" comment="Time of simulation" units_comment="seconds" />
    <parameter key="TimeOut" value="0.01" comment="Time out data" units_comment="seconds" />
    <parameter key="IncZ" value="1" comment="Increase of Z+" units_comment="decimal" />
    <parameter key="PartsOutMax" value="1" comment="Allowed %/100 of fluid particles out the domain (default=1)" units_comment="decimal" />
    <parameter key="RhoutMin" value="700" comment="Minimum rhop valid (default=700)" units_comment="kg/m^3" />
    <parameter key="RhoutMax" value="1300" comment="Maximum rhop valid (default=1300)" units_comment="kg/m^3" />
</parameters>
```

Double precision

```
<parameter key="PosDouble" value="2"
comment="Precision in particle interaction 0:Simple, 1:Double, 2:Uses and saves double" />
```

DualSPHysics v4.0 includes now implementation with double precision.

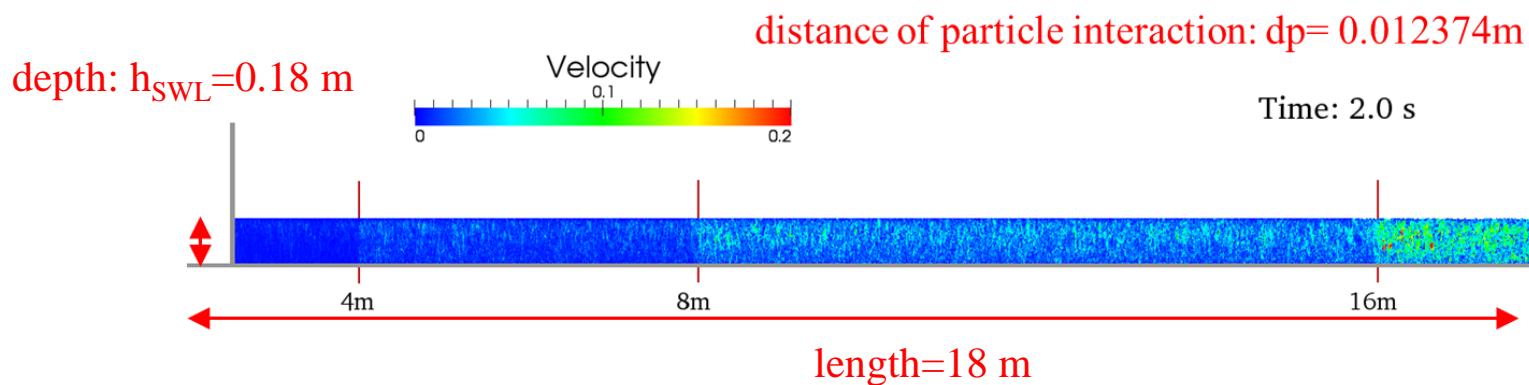
Precision in particle interaction (the most time consuming part) can be:

0: particle interaction is performed using simple precision for variables of position

Necessary when “dp” is much smaller than size of the domain:

1: particle interaction is performed using double precision for variables of position but final position is stored using simple precision

2: particle interaction is performed using double precision for variables of position and final position is stored using double precision



The problems of precision mainly appear when the domain is huge in comparison to the distance of interaction between particles

$\text{length} > \text{depth} >> \text{dp}$

Time integrator scheme

```

<parameter key="StepAlgorithm" value="1"
           comment="Step Algorithm 1:Verlet, 2:Symplectic (default=1) " />
<parameter key="VerletSteps" value="40"
           comment="Verlet only: Number of steps to apply Euler timestepping (default=40) " />

```

Verlet algorithm

$$\begin{aligned}\mathbf{v}_a^{n+1} &= \mathbf{v}_a^{n-1} + 2\Delta t \mathbf{F}_a^n \\ \mathbf{r}_a^{n+1} &= \mathbf{r}_a^n + \Delta t \mathbf{V}_a^n + 0.5\Delta t^2 \mathbf{F}_a^n \\ \rho_a^{n+1} &= \rho_a^{n-1} + 2\Delta t \mathbf{D}_a^n\end{aligned}$$

once every **M** time steps

$$\begin{aligned}\mathbf{v}_a^{n+1} &= \mathbf{v}_a^n + \Delta t \mathbf{F}_a^n \\ \mathbf{r}_a^{n+1} &= \mathbf{r}_a^n + \Delta t \mathbf{V}_a^n + 0.5\Delta t^2 \mathbf{F}_a^n \\ \rho_a^{n+1} &= \rho_a^n + \Delta t \mathbf{D}_a^n\end{aligned}$$

```

<parameter key="StepAlgorithm" value="2"
           comment="Step Algorithm 1:Verlet, 2:Symplectic (default=1) " />

```

Symplectic algorithm

$$\begin{aligned}\mathbf{r}_a^{\frac{n+1}{2}} &= \mathbf{r}_a^n + \frac{\Delta t}{2} \mathbf{v}_a^n \\ \rho_a^{\frac{n+1}{2}} &= \rho_a^n + \frac{\Delta t}{2} \mathbf{D}_a^n\end{aligned}$$

Predictor

$$\begin{aligned}\mathbf{v}_a^{n+1} &= \mathbf{v}_a^{\frac{n+1}{2}} + \frac{\Delta t}{2} \mathbf{F}_a^{\frac{n+1}{2}} \\ \mathbf{r}_a^{n+1} &= \mathbf{r}_a^{\frac{n+1}{2}} + \frac{\Delta t}{2} \mathbf{v}_a^{n+1}\end{aligned}$$

Corrector

Kernel function

$$\frac{d\boldsymbol{v}_a}{dt} = - \sum_b m_b \left(\frac{\boldsymbol{P}_b + \boldsymbol{P}_a}{\rho_b \cdot \rho_a} + \boldsymbol{\Pi}_{ab} \right) \nabla_a W_{ab} + \boldsymbol{g}$$

```
<parameter key="Kernel" value="1"
           comment="Interaction Kernel 1:Cubic Spline, 2:Wendland (default=2)"/>
```

Cubic Spline

$$W(r,h) = \alpha_D \begin{cases} 1 - \frac{3}{2}q^2 + \frac{3}{4}q^3 & 0 \leq q \leq 1 \\ \frac{1}{4}(2-q)^3 & 1 \leq q \leq 2 \\ 0 & q \geq 2 \end{cases}$$

where α_D is equal to $10/7\pi h^2$ in 2-D and $1/\pi h^3$ in 3-D

Wendland

$$W(r,h) = \alpha_D \left(1 - \frac{q}{2} \right)^4 (2q+1) \quad 0 \leq q \leq 2$$

where α_D is equal to $7/4\pi h^2$ in 2-D and $21/16\pi h^3$ in 3-D

Viscosity treatment

```

<parameter key="ViscoTreatment" value="1"
           comment="Viscosity formulation 1:Artificial, 2:Laminar+SPS (default=1)" />
<parameter key="Visco" value="0.02" comment="Viscosity value" />
<parameter key="ViscoBoundFactor" value="1"
           comment="Multiply viscosity value with boundary (default=1)" />

```

$$\frac{d\boldsymbol{v}_a}{dt} = -\sum_b m_b \left(\frac{P_b + P_a}{\rho_b \cdot \rho_a} + \boxed{\Pi_{ab}} \right) \nabla_a W_{ab} + \boldsymbol{g}$$

$$\Pi_{ab} = \begin{cases} -\frac{\alpha \overline{c}_{ab} \mu_{ab}}{\rho_{ab}} & \boldsymbol{v}_{ab} \cdot \boldsymbol{r}_{ab} < 0 \\ 0 & \boldsymbol{v}_{ab} \cdot \boldsymbol{r}_{ab} > 0 \end{cases}$$

$\alpha=0.01$ for wave tanks

higher values of α for dam-break (depends on dp)

Viscosity treatment

```

<parameter key="ViscoTreatment" value="1"
           comment="Viscosity formulation 1:Artificial, 2:Laminar+SPS (default=1) " />
<parameter key="Visco" value="0.02" comment="Viscosity value" />
<parameter key="ViscoBoundFactor" value="1"
           comment="Multiply viscosity value with boundary (default=1)" />

```

$$\frac{d\boldsymbol{v}_a}{dt} = - \sum_b m_b \left(\frac{P_b + P_a}{\rho_b \cdot \rho_a} + \Pi_{ab} \right) \nabla_a W_{ab} + \boldsymbol{g}$$

$$\Pi_{ab} = \begin{cases} -\alpha \frac{\overline{c}_{ab} \overline{\mu}_{ab}}{\rho_{ab}} & \boldsymbol{v}_{ab} \cdot \boldsymbol{r}_{ab} < 0 \\ 0 & \boldsymbol{v}_{ab} \cdot \boldsymbol{r}_{ab} > 0 \end{cases}$$

α_{FF} for interaction fluid-fluid

α_{FB} for interaction fluid-boundary

$$\alpha_{FB} = \text{ViscoBoundFactor} \cdot \alpha_{FF}$$

Viscosity treatment

```
<parameter key="ViscoTreatment" value="2"
           comment="Viscosity formulation 1:Artificial, 2:Laminar+SPS (default=1) " />
<parameter key="Visco" value="0.000001" comment="Viscosity value" units_comment="m^2/s" />
```

$$\frac{d\mathbf{v}_a}{dt} = -\sum_b m_b \left(\frac{P_b}{\rho_b^2} + \frac{P_a}{\rho_a^2} \right) \nabla_a W_{ab} + \mathbf{g} + \sum_b m_b \left(\frac{4v_o r_{ab} \cdot \nabla_a W_{ab}}{(\rho_a + \rho_b)(r_{ab}^2 + \eta^2)} \right) \mathbf{v}_{ab} + \sum_b m_b \left(\frac{\vec{\tau}_{ij}^b}{\rho_b^2} + \frac{\vec{\tau}_{ij}^a}{\rho_a^2} \right) \nabla_a W_{ab}$$

v_o is kinematic viscosity (typically 10^{-6} m²s for water)

DeltaSPH formulation

```
<parameter key="DeltaSPH" value="0.1"
    comment="DeltaSPH value, 0.1 is the typical value, with 0 disabled (default=0) " />
```

$$\frac{d\rho_a}{dt} = \sum_b m_b \mathbf{v}_{ab} \cdot \nabla_a W_{ab} + 2\delta h \sum_b m_b c_{ab} \left(\frac{\rho_a}{\rho_b} - 1 \right) \frac{\mathbf{r}_{ab}}{\mathbf{r}_{ab}^2 + \eta^2} \cdot \nabla_a W_{ab}$$

Shifting algorithm

```

<parameter key="Shifting" value="2"
           comment="Shifting mode 0:None, 1:Ignore bound, 2:Ignore fixed, 3:Full (default=0) " />
<parameter key="ShiftCoef" value="-2"
           comment="Coefficient for shifting computation (default=-2) " />
<parameter key="ShiftTFS" value="1.5"
           comment="Threshold to detect free surface. Typically 1.5 for 2D and 2.75 for 3D" />

```

$$\delta \mathbf{r} = D \cdot \nabla C_i$$

$D = A_s h \|\mathbf{u}\|_i \Delta t$

$$\nabla C_i = \sum_j \frac{m_j}{\rho_j} \nabla W_{ij}$$

Shifting update

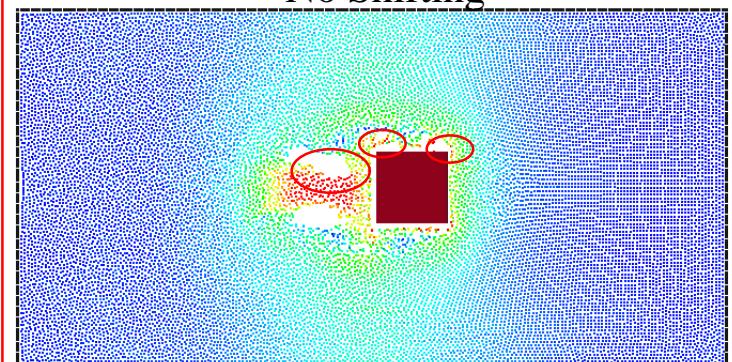
Concentration gradient

SHIFTING
SHIFTING IN THE NORMAL DIRECTION
IS NOT APPLIED FOR PARTICLES
AT THE FREE SURFACE

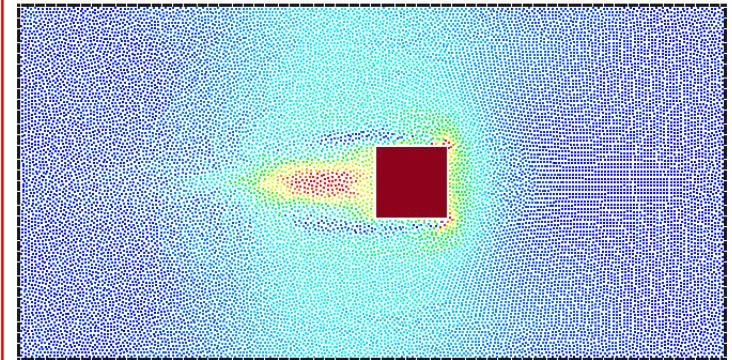
$\nabla \cdot \mathbf{r} > 1.5$
 Particle divergence

$$\nabla \cdot \mathbf{r} = \sum_j \frac{m_j}{\rho_j} \mathbf{r}_{ij} \cdot \nabla_i W_{ij}$$

No Shifting

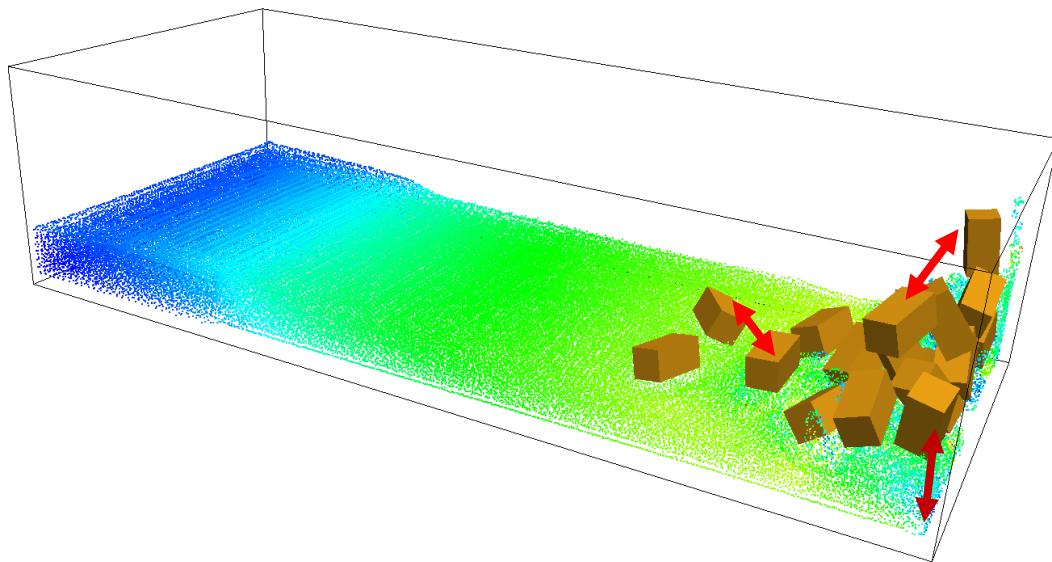


Shifting that ignores fixed boundaries



Interaction between solids

```
<parameter key="RigidAlgorithm" value="1"  
comment="Rigid Algorithm 1:SPH, 2:DEM (default=1) " />  
<parameter key="FtPause" value="0.0"  
comment="Time to freeze the floatings at simulation start (warmup) (default=0)  
units_comment="seconds" />
```

DEM is recommended**Interaction between floatings
SPH or DEM****Interaction between floating and bottom
SPH or DEM**

Time step computation

```

<parameter key="CoefDtMin" value="0.05"
           comment="Coefficient to calculate minimum time step dtmin=coefdmin*h/speedsound />
<parameter key="#DtIni" value="0.0001"
           comment="Initial time step (default=h/speedsound" units_comment="seconds" />
<parameter key="#DtMin" value="0.00001"
           comment="Minimum time step (default=coefdmin*h/speedsound)" units_comment="seconds" />
<parameter key="#DtFixed" value="DtFixed.dat"
           comment="Dt values are loaded from file (default=disabled) " />
```

$$\Delta t_{minimum} = 0.05 \cdot \frac{h}{c_s}$$

$$\Delta t_{init} = \frac{h}{c_s}$$

```
<parameter key="DtAllParticles"
           comment="Velocity of particles used to calculate DT.
           1:All, 0:Only fluid/floating (default=0) " />
```

$$\Delta t_f = \min_a \left(\sqrt{h/|f_a|} \right)$$

$$\Delta t = 0.3 \cdot \min(\Delta t_f, \Delta t_{cv})$$

$$\Delta t_{cv} = \min_a \frac{h}{c_s + \max_b \left| \frac{h \mathbf{v}_{ab} \cdot \mathbf{r}_{ab}}{\mathbf{r}_{ab}^2} \right|}$$

0: $b \in$ fluid/floating
 OR
 1: $b \in$ fluid/floating + boundaries

Physical time and frequency to store data

```
<parameter key="TimeMax" value="10"
           comment="Time of simulation" units_comment="seconds" />
<parameter key="TimeOut" value="0.1"
           comment="Time out data" units_comment="seconds" />
```

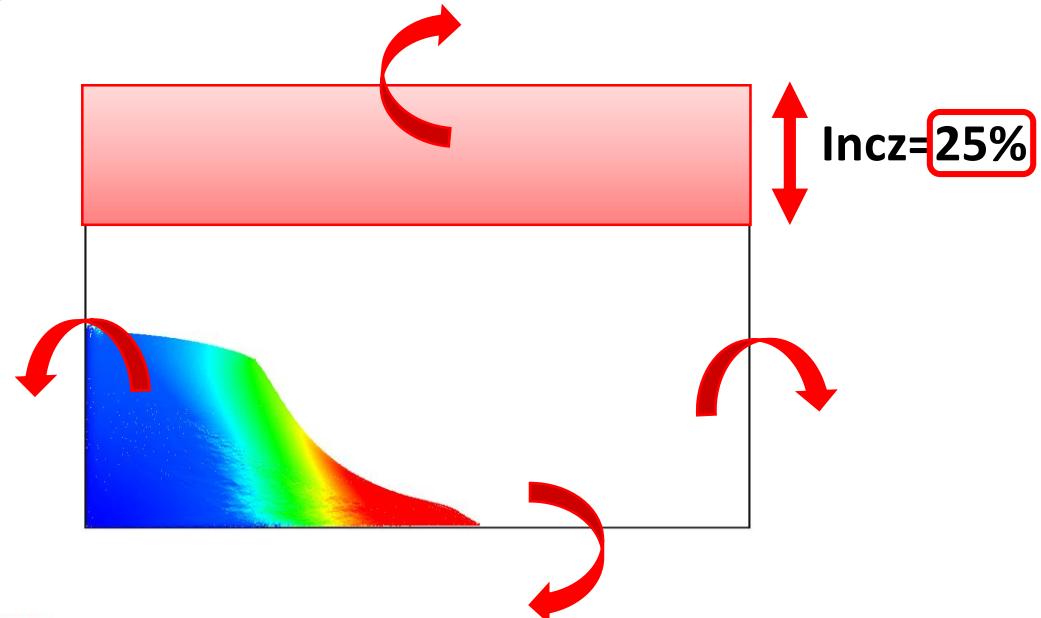
Number of output files $= \text{TimeMax} / \text{TimeOut}$
 $= 10 / 0.1 = 100$ files

```

<parameter key="IncZ" value="0.25"
           comment="Increase of Z+" units_comment="decimal" />
<parameter key="PartsOutMax" value="1"
           comment="%/100 of fluid particles allowed to be excluded
from domain before termination of simulation (default=1)"
           units_comment="decimal" />

```

Excluding particles by position



```

<parameter key="RhopOutMin" value="700"
           comment="Minimum rhop valid (default=700) units_comment="kg/m^3" />
<parameter key="RhopOutMax" value="1300"
           comment="Maximum rhop valid (default=1300) units_comment="kg/m^3" />

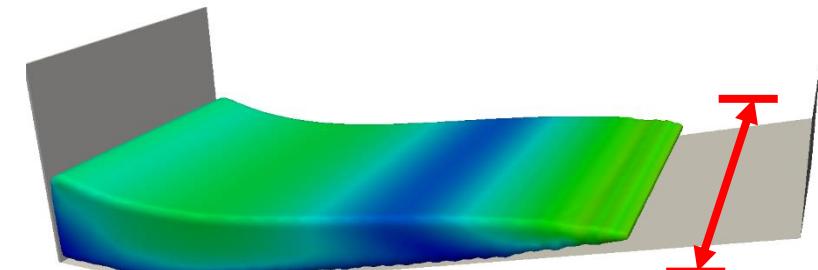
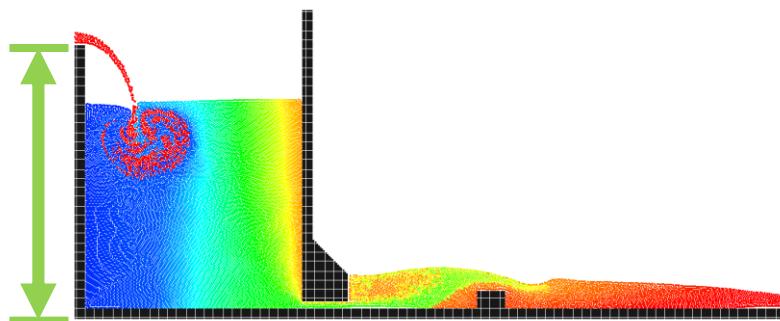
```

Excluding particles by density

$$700 < \rho_0 < 1300$$

Periodicity

```
<parameter key="XPeriodicIncZ" value="0.3"  
| comment="Increase of Z with periodic BC" units_comment="metres (m) " />  
<parameter key="YPeriodicIncZ" value="0.0"  
| comment="Increase of Z with periodic BC" units_comment="metres (m) " />
```

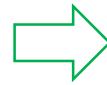
 $\Delta z=0.3 \text{ m}$  $\Delta z=0 \text{ m}$

XML file

Case_Def.xml



GENCASE



Case.xml

```

<case>
  <casedef>
    <lattice bound="1" fluid="1" />
    <gravity x="0" y="0" z="-9.81" comment="Gravitational acceleration" units_comment="m/s^2" />
    <cfnumber value="0.2" comment="Coefficient to multiply Dt" />
    <chwl value="0" auto="true" comment="Maximum still water level to calculate speedofsound using coefsound" units_comment="metres (m)" />
    <speedsystems value="0" auto="true" comment="Maximum system speed (by default the dam-break propagation is used)" />
    <coefsound value="20" comment="Coefficient to multiply speedsystems" />
    <speedsound value="0" auto="true" comment="Speed of sound to use in the simulation (by default speedofsound=coefsound*speedsystems)" />
    <coef value="1.0" comment="Coefficient to calculate the smoothing length (H=coefficient*sqrt(3*dp^2) in 3D)" />
    <gamma value="7" comment="Politropic constant for water used in the state equation" />
    <rhop0 value="1000" comment="Reference density of the fluid" units_comment="kg/m3" />
  </casedef>
  <mkmconfig bounount="240" fluidcount="10" />
  <geometry>
    <definition dp="0.01" units_comment="metres (m)">
      <pointmin x="-1" y="0" z="-1" />
      <pointmax x="4.5" y="0" z="3.5" />
    </definition>
    <commands>
      <mainlist>
        <seedrandom mode="full" />
        <setmkfluid mk="0" />
        <drawbox>
          <boxfill>solid</boxfill>
          <point x="0" y="-1" z="0" />
          <size x="1" y="2" z="3" />
        </drawbox>
        <setmkbound mk="0" />
        <drawbox>
          <boxfill>bottom | left | right | front | back</boxfill>
          <point x="0" y="1" z="0" />
          <size x="4" y="2" z="3" />
        </drawbox>
      </mainlist>
    </commands>
  </geometry>
  <execution>
    <parameters>
      <parameter key="StepAlgorithm" value="1" comment="Step Algorithm 1:Verlet, 2:Symplectic (default=1)" />
      <parameter key="VerletSteps" value="40" comment="Verlet only: Number of steps to apply Euler timestepping (default=40)" />
      <parameter key="VerletTimestep" value="0.001" comment="Interaction Kernel 1:Cubic Spline, 2:Wendland, 3:Laplacian (default=2)" />
      <parameter key="ViscoTreatment" value="1" comment="Viscosity formulation 1:Artificial, 2:Laminar+SFS (default=1)" />
      <parameter key="Visco" value="0.02" comment="Viscosity value" />
      <parameter key="ViscoBoundFactor" value="1" comment="Multiply viscosity value with boundary (default=1)" />
      <parameter key="DeltaSPH" value="0.1" comment="DeltaSPH value, 0.1 is the typical value, with 0 disabled (default=0)" />
      <parameter key="Shift" value="0" comment="Shifting mode 0:None, 1:Ignore bound, 2:Ignore fixed, 3:Full (default=0)" />
      <parameter key="#ShiftCoef" value="2" comment="Coefficient for shifting computation (default=-2)" />
      <parameter key="#ShiftTTS" value="1.5" comment="Threshold to detect free surface. Typically 1.5 for 2D and 2.75 for 3D (default=0)" />
      <parameter key="RigidAlgorithm" value="1" comment="Rigid Algorithm 1:SFM, 2:DEM (default=1)" />
      <parameter key="FtPause" value="0.0" comment="Time to freeze the floatings at simulation start (warmup) (default=0)" units_comment="seconds" />
      <parameter key="CoedMin" value="0.05" comment="Coefficient to calculate minimum time step dtmin=coedtmin/h/speedsound (default=0.05)" />
      <parameter key="#DtInit" value="0.0001" comment="Initial time step (default=h/speedsound" units_comment="seconds" />
      <parameter key="#DMin" value="0.00001" comment="Minimum time step (default=coedtmin/h/speedsound" units_comment="seconds" />
      <parameter key="#DtFixed" value="DtFixed.dat" comment="Dt values are loaded from file (default=disabled)" />
      <parameter key="DtAllParticles" value="0" comment="Velocity of particles used to calculate DT. 1:AII, 0:Only fluid/floating (default=0)" />
      <parameter key="TimeMax" value="0.72" comment="Time of simulation" units_comment="seconds" />
      <parameter key="TimeOut" value="0.01" comment="Time out data" units_comment="seconds" />
      <parameter key="Ind2" value="1" comment="Increase of Z+" units_comment="decimal" />
      <parameter key="PartsOutMax" value="1" comment="Allowed /100 of fluid particles out the domain (default=1)" units_comment="decimal" />
      <parameter key="Rhop0Min" value="700" comment="Minimum rhop valid (default=700)" units_comment="kg/m3" />
      <parameter key="Rhop0Max" value="1300" comment="Maximum rhop valid (default=1300)" units_comment="kg/m3" />
    </parameters>
  </execution>
</case>

```

```

<case>
  <casedef>
    <constantdef>
      <gravity x="0" y="0" z="-9.81" units_comment="m/s^2" />
      <cfnumber value="0.2" comment="Coefficient to multiply Dt" />
      <chwl value="0" auto="true" comment="Maximum still water level to calculate speedofsound using coefsound" units_comment="metres (m)" />
      <speedsystems value="0" auto="true" comment="Maximum system speed (by default the dam-break propagation is used)" />
      <coefsound value="20" comment="Coefficient to multiply speedsystems" />
      <speedsound value="0" auto="true" comment="Speed of sound to use in the simulation (by default speedofsound=coefsound*speedsystems)" />
      <coef value="1.0" comment="Coefficient to calculate the smoothing length (H=coefficient*sqrt(3*dp^2) in 3D)" />
      <gamma value="7" comment="Politropic constant for water used in the state equation" />
      <rhop0 value="1000" comment="Reference density of the fluid" units_comment="kg/m3" />
    </constantdef>
    <mkmconfig bounount="240" fluidcount="10" />
    <geometry>
      <definition dp="0.01" units_comment="metres (m)">
        <pointmin x="-1" y="0" z="-1" />
        <pointmax x="4.5" y="0" z="3.5" />
      </definition>
    </geometry>
    <commands>
      <mainlist>
        <setdrawmode mode="full" />
        <setmkfluid mk="0" />
        <drawbox>
          <boxfill>solid</boxfill>
          <point x="0" y="-1" z="0" />
          <size x="1" y="2" z="3" />
        </drawbox>
        <setmkbound mk="0" />
        <drawbox>
          <boxfill>bottom | left | right | front | back</boxfill>
          <point x="0" y="1" z="0" />
          <size x="4" y="2" z="3" />
        </drawbox>
      </mainlist>
    </commands>
  </geometry>
  <casedef>
  <execution>
    <parameters>
      <parameter key="StepAlgorithm" value="1" comment="Step Algorithm 1:Verlet, 2:Symplectic (default=1)" />
      <parameter key="VerletSteps" value="40" comment="Verlet only: Number of steps to apply Euler timestepping (default=40)" />
      <parameter key="Kernel" value="2" comment="Interaction Kernel 1:Cubic Spline, 2:Wendland (default=2)" />
      <parameter key="Visco" value="1" comment="Viscosity formulation 1:Artificial, 2:Laminar+SFS (default=1)" />
      <parameter key="Visco" value="0.02" comment="Viscosity value" />
      <parameter key="ViscoBoundFactor" value="1" comment="Multiply viscosity value with boundary (default=1)" />
      <parameter key="DeltaSPH" value="0.1" comment="DeltaSPH value, 0.1 is the typical value, with 0 disabled (default=0)" />
      <parameter key="Shift" value="0" comment="Shifting mode 0:None, 1:Ignore bound, 2:Ignore fixed, 3:Full (default=0)" />
      <parameter key="#ShiftCoef" value="-2" comment="Coefficient for shifting computation (default=-2)" />
      <parameter key="#ShiftTTS" value="1.5" comment="Threshold to detect free surface. Typically 1.5 for 2D and 2.75 for 3D (default=0)" />
      <parameter key="RigidAlgorithm" value="1" comment="Rigid Algorithm 1:SFM, 2:DEM (default=1)" />
      <parameter key="FtPause" value="0.0" comment="Time to freeze the floatings at simulation start (warmup) (default=0)" units_comment="seconds" />
      <parameter key="CoedMin" value="0.05" comment="Coefficient to calculate minimum time step dtmin=coedtmin/h/speedsound (default=0.05)" />
      <parameter key="#DtInit" value="0.0001" comment="Initial time step (default=h/speedsound" units_comment="seconds" />
      <parameter key="#DMin" value="0.00001" comment="Minimum time step (default=coedtmin/h/speedsound" units_comment="seconds" />
      <parameter key="#DtFixed" value="DtFixed.dat" comment="Dt values are loaded from file (default=disabled)" />
      <parameter key="DtAllParticles" value="0" comment="Velocity of particles used to calculate DT. 1:AII, 0:Only fluid/floating (default=0)" />
      <parameter key="TimeMax" value="0.72" comment="Time of simulation" units_comment="seconds" />
      <parameter key="TimeOut" value="0.01" comment="Time out data" units_comment="seconds" />
      <parameter key="Ind2" value="1" comment="Increase of Z+" units_comment="decimal" />
      <parameter key="PartsOutMax" value="1" comment="Allowed /100 of fluid particles out the domain (default=1)" units_comment="decimal" />
      <parameter key="Rhop0Min" value="700" comment="Minimum rhop valid (default=700)" units_comment="kg/m3" />
      <parameter key="Rhop0Max" value="1300" comment="Maximum rhop valid (default=1300)" units_comment="kg/m3" />
    </parameters>
  </execution>
</case>

```

XML file

Summary of the number of created particles and computed constants

```
<particles np="21001" nb="1001" nbf="1001" mkboundsfirst="11" mkfluidfirst="1">
    <fixed mkbounds="0" mk="11" begin="0" count="1001" />
    <fluid mkfluid="0" mk="1" begin="1001" count="20000" />
</particles>
<constants>
    <gravity x="0" y="0" z="-9.81" units_comment="m/s^2" />
    <cflnumber value="0.2" />
    <gamma value="7" />
    <rhop0 value="1000" units_comment="kg/m^3" />
    <dp value="0.01" units_comment="metres (m)" />
    <h value="1.4142135624E-002" units_comment="metres (m)" />
    <b value="1.1155371429E+006" units_comment="metres (m)" />
    <massbound value="1.0000000000E-001" units_comment="kg" />
    <massfluid value="1.0000000000E-001" units_comment="kg" />
</constants>
<motion />
```

np=total number of particles
nb=boundary particles
nbf=fixed boundary particles and final **mk** of the objects

NOTE value of final “mk”
mk=mkbounds+11
mk=mkfluid+1

mass=rhop0*dp*dp*dp in 3D
mass=rhop0*dp*dp in 2D

YOU SHOULD ALWAYS CHECK
Case_All.vtk, Case_Bound.vtk, Case_Fluid.vtk

Input & output files

Run.out

Text file with execution log

```
1 DualSPHysics v4 (10-11-2015)
2 -----
3 [Select CUDA Device]
4 Device 0: "GeForce GTX 590"
5   Compute capability:      2.0
6   Multiprocessors:        16 (512 cores)
7   Memory global:          1536 MB
8   Clock rate:             1.23 GHz
9   Run time limit on kernels: Yes
10  ECC support enabled:    No
11 Device 1: "GeForce 8400 GS"
12   Compute capability:     1.1
13   Multiprocessors:        1 (8 cores)
14   Memory global:          512 MB
15   Clock rate:              1.63 GHz
16   Run time limit on kernels: Yes
17   ECC support enabled:    No
18
19 [GPU Hardware]
20 Device default: 0 "GeForce GTX 590"
21 Compute capability: 2.0
22 Memory global: 1536 MB
23 Memory shared: 49152 Bytes
24 [Initialising JSphGpuSingle v0.70 24-11-2015 15:40:36]
25 **Basic case configuration is loaded
26 **Special case configuration is loaded
27 Loading initial state of particles...
28 Loaded particles: 5281
29 MapRealPos(border)=(-7.07107e-006,0.0999929,-7.07107e-006)-(1.60001,0.100007,0.400007)
30 MapRealPos(final)=(-7.07107e-006,0.0999929,-7.07107e-006)-(1.60001,0.100007,0.600014)
31 **Initial state of particles is loaded
32 **2D-Simulation parameters:
33 CaseName="CaseDambreak2D"
34 RunName="CaseDambreak2D"
35 SvDouble=False
36 SvTimers=True
37 SvTimersStep=0.000000
38 StepAlgorithm="Verlet"
39 VerletSteps=40
40 Kernel="Wendland"
41 Viscosity="Artificial"
42 Visco=0.300000
43 ViscoBoundFactor=0.000000
44 DeltaSph="None"
45 Shifting="None"
46 RenCorrection=0.000000
47 Splitting=False
48 FloatingFormulation="None"
49 FloatingCount=0
```

Domain dimensions
computed starting from
minimum and maximum
positions of the particles
created initially

Input & output files

Run.out

Text file with execution log

```
50 CaseNp=5281
51 CaseNbound=481
52 CaseNfixed=481
53 CaseNmoving=0
54 CaseNfloat=0
55 CaseNfluid=4800
56 PeriodicActive=0
57 Dx=0.005
58 H=0.007071
59 CoefficientH=1
60 CteB=165368.578125
61 Gamma=7.000000
62 RhopZero=1000.000000
63 Eps=0
64 Cs0=34.0232
65 CFLnumber=0.200000
66 DtIni=0.000207631
67 DtMin=1.03915e-005
68 DtAllParticles=False
69 MassFluid=0.025000
70 MassBound=0.025000
71 Bwen (wendland)=-7877736.000000
72 TimeMax=2
73 TimePart=0.02
74 Gravity=(0.000000,0.000000,-9.810000)
75 NpMinimum=481
76 RhopOut=True
77 RhopOutMin=700.000000
78 RhopOutMax=1300.000000
79 **Requested gpu memory for 5281 particles: 0.6 MB.
80 CellOrder="XYZ"
81 CellMode="2H"
82 Hdiv=1
83 MapCells=(114,1,43)
84 DomCells=(114,1,43)
85 DomCellCode="13_8_11"
86
87 PtxasFile="../../../../EXECS/DualSPHysics_win64_ptxasinfo"
88 Use code for compute capability 2.0 on hardware 2.0
89 BsForcesBound=128 (36 regs)
90 BsForcesFluid=128 (50 regs)
91
92 **CellDiv: Requested gpu memory for 5545 particles: 0.0 MB.
93 **CellDiv: Requested gpu memory for 1488 cells (CellMode=2H): 0.0 MB.
94 RunMode="Pos-Simple, Single-Gpu"
95 Allocated memory in CPU: 475290 (0.45 MB)
96 Allocated memory in GPU: 745752 (0.71 MB)
97 Part_0000      5281 particles successfully stored
```

Input & output files

Run.out

Text file with execution log

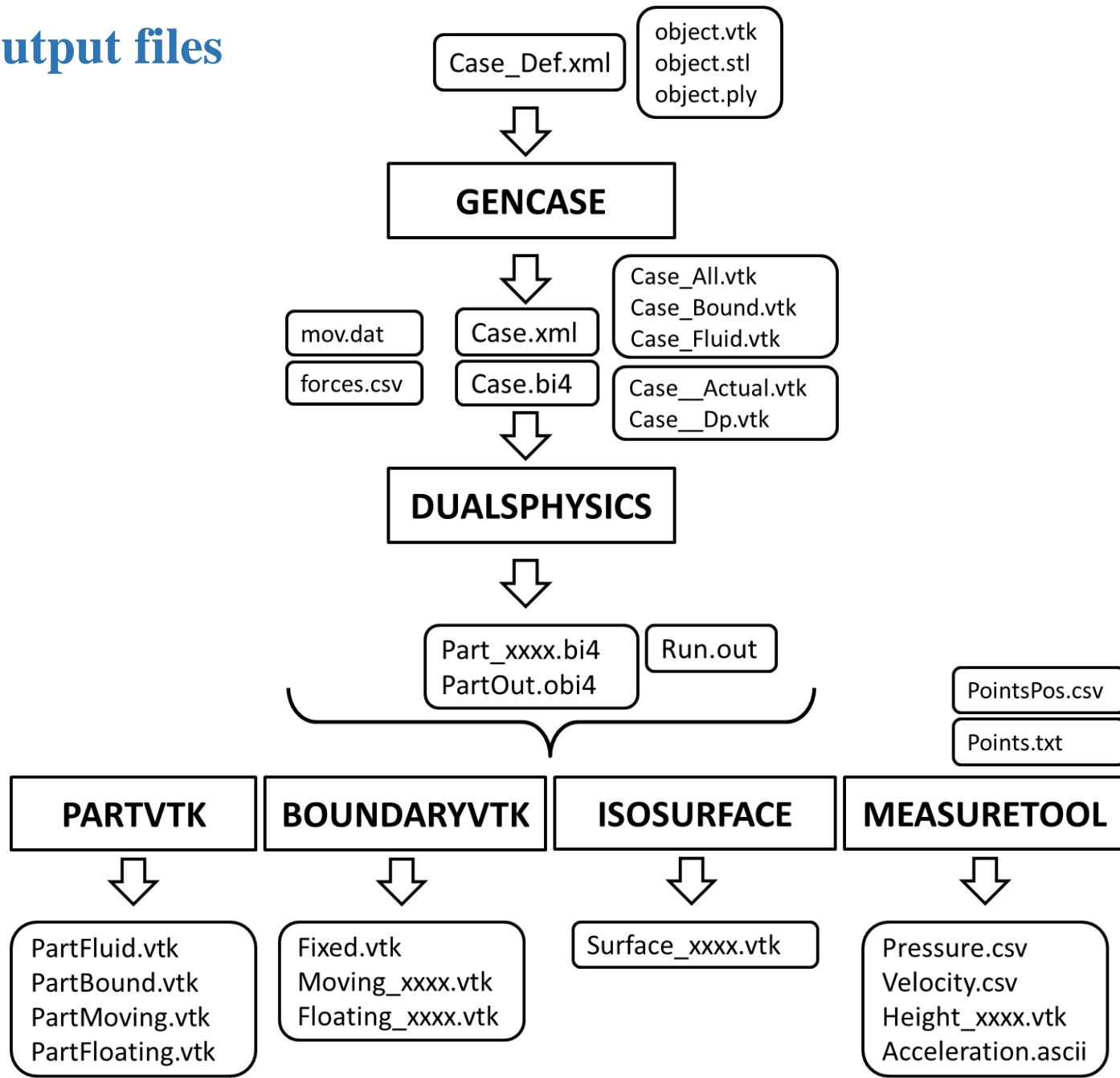
```
92 **CellDiv: Requested gpu memory for 5545 particles: 0.0 MB.
93 **CellDiv: Requested gpu memory for 1488 cells (CellMode=2H): 0.0 MB.
94 RunMode="Pos-Simple, Single-Gpu"
95 Allocated memory in CPU: 475290 (0.45 MB)
96 Allocated memory in GPU: 745752 (0.71 MB)
97 Part_0000      5281 particles successfully stored
98
```

```
.00 [Initialising simulation (m15001k0) 24-11-2015 15:40:36]
PART      PartTime      TotalSteps      Steps      Time/Seg      Finish time
.01 ======  ======  ======  ======  ======  ======
.02 Part_0001      0.020027      484      484      47.06  24-11-2015 15:42:10
.03 Part_0002      0.040010      970      486      47.60  24-11-2015 15:42:10
.04 Part_0003      0.060019     1460      490      48.01  24-11-2015 15:42:11
.05 Part_0004      0.080034     1953      493      47.73  24-11-2015 15:42:11
.06 Part_0005      0.100001     2447      494      48.86  24-11-2015 15:42:11
.07 ...
.08 ...
.09 ...
.10 Part_0100      2.000038     49060      484      67.06  24-11-2015 15:42:14
.11
```

```
.12 [Simulation finished 24-11-2015 15:42:14]
.13 Particles of simulation (initial): 5281
.14 DTs adjusted to DtMin.....: 0
.15 Excluded particles.....: 0
.16 Total Runtime.....: 98.489380 sec.
.17 Simulation Runtime.....: 98.427155 sec.
.18 Time per second of simulation.....: 49.212650 sec.
.19 Steps per second.....: 498.439697
.20 Steps of simulation.....: 49060
.21 PART files.....: 101
.22 Maximum number of particles.....: 5281
.23 Maximum number of cells.....: 2850
.24 CPU Memory.....: 475290 (0.45 MB)
.25 GPU Memory.....: 777144 (0.74 MB)
.26
.27 [GPU Timers]
.28 VA-Init.....: 0.036532 sec.
.29 NL-Limits.....: 2.969780 sec.
.30 NL-PreSort.....: 0.258268 sec.
.31 NL-RadixSort.....: 33.559845 sec.
.32 NL-CellBegin.....: 4.946213 sec.
.33 NL-SortData.....: 0.639390 sec.
.34 NL-OutCheck.....: 0.114177 sec.
.35 CF-PreForces.....: 3.701347 sec.
.36 CF-Forces.....: 11.354674 sec.
.37 SU-ComputeStep.....: 0.961830 sec.
.38 SU-Floating.....: 0.000000 sec.
.39 SU-Motion.....: 0.000000 sec.
```

Input & output files

Pre-Processing



Post-Processing