Namelist "Gravity"

This data set is related to the characteristics of the gravity force.
If no gravitational effect is considered, this namelist can be omitted.

Full data set of the namelist

```
 &Gravity  Gravity_Enabled= .true. ,
           Gravity_Angle_IJ= 0.0   ,
           Gravity_Angle_IK= 90.0  ,
           Reference_Gravity_Constant= 9.81D+00/
```

Definition of the data set

Gravity_Enabled

- Type : boolean value
- The gravity effects are enabled or disabled
- Default value= .false.

Gravity_Angle_IJ

- Type : real value
- Angle between the I-axis and of the projection of $-\vec{G}$ on the IJ-plan (in degrees). The I-axis is the origin axis.
- Default value = 0.0

Gravity_Angle_IK

- Type : real value
- angle between the K-axis and $-\vec{G}$ (in degrees). The K-axis is the origin axis.
- Default value = 0.0

Reference_Gravity_Constant

- Type : real value
- Reference value of the gravity constant
- Default value = 9.81

IMPORTANT NOTE

The orientation of the gravity vector $\vec{g}$ in the cartesian referential $(\vec{I},\vec{J},\vec{K})$ is defined from the below formulation (spherical coordinates) : $$G_I= -G_0.cos(\text{Gravity_Angle_IJ}).sin(\text{Gravity_Angle_IK})$$ $$G_J= -G_0.sin(\text{Gravity_Angle_IJ}).sin(\text{Gravity_Angle_IK})$$ $$G_K= -G_0.cos(\text{Gravity_Angle_IK})$$

Where G_0 is norm of the force of gravity (or the buoyancy force).

Remarks

- The angle ranges are $ -90 \le $ Gravity_Angle_IJ $ \le +90$ and $ 0 \le $ Gravity_Angle_IK $ \le +180$.
- From the definition of angles, note that the vector $\vec{g}$ is oriented along the $-\vec{K}$ axis while Gravity_Angle_IK= 0 and $\vec{g}$ is in the plan IJ while Gravity_Angle_IK= 90.

Following the type of simulation and the choice on the form of equations (dimensional, dimensionless, the scales used in order to define the non-dimensional form of equations, etc ...), the term G_0 can be written following different ways. For instance, the buoyancy force can be read as : $$F_b= (\rho - \rho_0).g_0$$ in the momentum equations under Low Mach number hypothesis. In this case

- $G_O= g_0$ where g_0 is the constant of gravity.
- ρ_0 is the reference density defined in the namelist "Fluid_Properties".

The buoyancy force can also be read as : $$F_b= -\rho_0.\beta.g_0.(T - T_0)$$ in the momentum equations for incompressible flows under Boussinesq hypothesis. In this case

- $G_0= \beta.g_0$ where β is the thermal expansion coefficient of the fluid considered.
- T_0 is the reference temperature defined in the namelist "Fluid_Properties".

As a consequence the generalized form of G_0 in the code is : $$G_0= \beta.g_0$$ where g_0 is defined from the data “Reference_Gravity_Constant” and β from the data “Thermal_Expansion_Coefficient” (in the namelist "Fluid_Properties").
The Default values of these variables are :

- Reference_Gravity_Constant= 9.81
- Thermal_Expansion_Coefficient = 1.0

These values are automatically taken into account by the code if these variables are not explicitly modified by the user in the data file.
Clearly, the variable “Thermal_Expansion_Coefficient” is only needed in the simulations of incompressible flows with thermal buoyancy effect .

In every other cases, it can be omitted because the buoyancy/gravity force can be defined from the variable “Reference_Gravity_Constant” only.