Successive compression cycles of a 2D quasi-adiabatic cavity

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grid setup file

data_meshgen.dat

```
================================================================================
========================================
================================================================================
========================================
            DATA FILE FOR THE MESH GENERATOR MESHGEN (DESCRIPTIONS OF
DATA ARE GIVEN BELOW)
================================================================================
========================================
--------------------------------------------------------------------------------
---------------------------------------
Blocks of data are associated to segments along a specific direction
(There are as many blocks as segments)
See below the TEMPLATES to select your own block of data associated to
the selected distribution law)
--------------------------------------------------------------------------------
---------------------------------------
---------------------------------------
I-DIRECTION
---------------------------------------
Choice of the metric system :  in meter or dimensionless  (0)  -
angular in degrees (1)     :
&METRIC_UNIT         Type_of_Metric= 0 /
&MESH_FUNCTION_DATA Function_Name="TANH_ONE_SIDE"   Number_of_Cells= 96
Length= 1.19695D-02 Left_Cell_Size= 5.D-05 Reverse_Ordering= .true. /
&MESH_FUNCTION_DATA  Function_Name="TANH_TWO_SIDES" Number_of_Cells= 64
Length= 6.85D-03 Left_Cell_Size= 5.25D-05  Right_Cell_Size= 5.25d-05
Reverse_Ordering= .false. /
&MESH_FUNCTION_DATA Function_Name="TANH_ONE_SIDE"   Number_of_Cells= 96
Length= 1.19695D-02 Left_Cell_Size= 5.D-05 Reverse_Ordering= .false. /
&MESH_FUNCTION_DATA End_of_Data_Block = .true./
---------------------------------------
J-DIRECTION
---------------------------------------
Choice of the metric system :  in meter or dimensionless  (0)  -
angular in degrees (1)     :
&METRIC_UNIT         Type_of_Metric= 0 /
&MESH_FUNCTION_DATA  Function_Name="REGULAR"        Number_of_Cells= 8
```

```
Length= 9.525D-05 Reverse_Ordering= .false. /
&MESH_FUNCTION_DATA  Function_Name="TANH_TWO_SIDES" Number_of_Cells= 48
Length= 1.520D-03 Left_Cell_Size= 1.3D-05  Right_Cell_Size= 1.3D-05
Reverse_Ordering= .false. /
&MESH_FUNCTION_DATA  Function_Name="REGULAR"        Number_of_Cells= 8
Length= 9.525D-05 Reverse_Ordering= .false. /
&MESH_FUNCTION_DATA End_of_Data_Block = .true./
---------------------------------------
K-DIRECTION
---------------------------------------

&MESH_FUNCTION_DATA End_of_Data_Block = .true./
```

Main setup file

input3d.dat

```
================================================================================
================================================================================
            MAIN INPUT DATA FILE : LMN APPORACH FOR THERMOACOUSTIC
PROBLEMS
                                   MODELING THE ATCHLEY'S EXPERIMENT
(Atchley et al., JASA 1990)
                                   DIMENSIONAL FORM

                              symmetrical plan
            ------------------------------------------------------
                           |     plate          |
                           ----------------------
            <--->                                                  <--->
             Vl.sin(wt)
Vr.sin(wt)

                           ----------------------
                           |     plate          |
            ------------------------------------------------------
                              symmetrical plan


            D= 0.5 kx=0.35

================================================================================
================================================================================
&Version File_Version="VERSION2.0"/
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
+++++
                     GENERAL LAYOUT
                     (DIMENSIONLESS)
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
+++++
&Fluid_Properties  Variable_Density           = .true. ,
Constant_Mass_Flow = .false. , Variable_Fluid_Volume = .false. ,
                   Molecular_Mass=  4.D-03  ,
                   Heat_Transfer_Flow         = .true.  ,
                   Reference_Dynamic_Viscosity = 1.985000D-05,
                   Reference_Density          = 1.833106D-01 ,
                   Reference_Temperature      = 298.4  ,
                   Prandtl                    = 6.781648D-01 ,
                   Reference_Heat_Capacity    = 5193.0 ,
                   Heat_Capacity_Ratio        = 1.67  /

&Velocity_Initialization  I_Velocity_Reference_Value  = 1.D-04 ,
J_Velocity_Reference_Value = 0.0 , K_Velocity_Reference_Value = 0.0 /
&Temperature_Initialization Temperature_Reference_Value= 298.4 ,
Initial_Field_Option_For_Temperature= 0 /
==========================================================================
====
                    DOMAIN FEATURES
                     (DIMENSIONLESS)
==========================================================================
====
&Domain_Features Start_Coordinate_I_Direction=-0.0153945 ,
End_Coordinate_I_Direction= 0.0153945,
                 Start_Coordinate_J_Direction= 0.00 ,
End_Coordinate_J_Direction= 1.710500D-03,
                 Start_Coordinate_K_Direction= 0.00 ,
End_Coordinate_K_Direction= 0.00,
                 Cells_Number_I_Direction= 256
,Cells_Number_J_Direction= 64 ,Cells_Number_K_Direction= 1,
                 Regular_Mesh= .false. /
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
+++++++
              DEFINITION OF BOUNDARY CONDITIONS
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
+++++++
==========================================================================
======
                 WALL BOUNDARY CONDITION SETUP
==========================================================================
======

&Heat_Wall_Boundary_Condition_Setup
    Wall_BC_DataSetName     ="Set1",
    West_Heat_BC_Option     = 0    , East_Heat_BC_Option     = 0 ,
    Back_Heat_BC_Option     = 0    , Front_Heat_BC_Option    = 0 ,
```

```
    South_Heat_BC_Option    = 0    , North_Heat_BC_Option    = 0 /

&Heat_Wall_Boundary_Condition_Setup
    Wall_BC_DataSetName     ="Set2",
    West_Heat_BC_Option     = 2    , East_Heat_BC_Option     = 2 ,
    Back_Heat_BC_Option     = 2    , Front_Heat_BC_Option    = 2 ,
    South_Heat_BC_Option    = 2    , North_Heat_BC_Option    = 2,
    Material_Thermal_Conductivity= 7.296 ,
    Material_Mass_Heat_Capacity  = 1.67540D+03 ,
    Material_Density             = 1.0D+02 /

&Polyhedral_Immersed_Bodies Xi_1=-3.425D-03, Xj_1= 0.0000    , Xk_1=
0.0 ,
                            Xi_2= 3.425D-03, Xj_2= 0.0000    , Xk_2=
0.0 ,
                            Xi_3= 3.425D-03, Xj_3= 9.525D-05 , Xk_3=
0.0 ,
                            Xi_4=-3.425D-03, Xj_4= 9.525D-05 , Xk_4=
0.0 ,
                            Wall_BC_DataSetName="Set2" /

&Polyhedral_Immersed_Bodies Xi_1=-3.425D-03, Xj_1= 1.61525D-03   ,Xk_1=
0.0 ,
                            Xi_2= 3.425D-03, Xj_2= 1.61525D-03   ,Xk_2=
0.0 ,
                            Xi_3= 3.425D-03, Xj_3= 1.71050D-03   ,Xk_3=
0.0,
                            Xi_4=-3.425D-03, Xj_4= 1.71050D-03   ,Xk_4=
0.0 ,
                            Wall_BC_DataSetName="Set2" /

================================================================
======
               INLET AND OUTLET  BOUNDARY CONDITIONS
================================================================
======

&Inlet_Boundary_Conditions  Type_of_BC= "INLET", Direction_Normal_Plan=
1 ,
                            Plan_Location_Coordinate=  -0.0153945  ,
                            Start_Coordinate_of_First_Span =  0.00  ,
End_Coordinate_of_First_Span = 1.710500D-03 ,
                            Flow_Direction= 1 ,
                            Define_Velocity_Profile= 0,
                            Normal_Velocity_Reference_Value= 2.282681
,
                            Temperature_Reference_Value= 298.4 ,
                            Density_Reference_Value=  1.833106D-01 ,
                            Temperature_BC_Type="Neumann",
                            Density_BC_Type="Neumann",
                            Variable_Flowrate= 1 ,
```

```
                              Time_Fct_Name= "Sinus_zero_average" ,
Time_Fct_Threshold= 0.0 ,
                              Time_Fct_Time_Scale= 1.76173611342339D-03 ,
Time_Fct_Magnitude=  2.195749  /

&Inlet_Boundary_Conditions  Type_of_BC= "INLET", Direction_Normal_Plan=
1 ,
                              Plan_Location_Coordinate= 0.0153945  ,
                              Start_Coordinate_of_First_Span =  0.00  ,
End_Coordinate_of_First_Span = 1.710500D-03 ,
                              Flow_Direction=-1 ,
                              Define_Velocity_Profile= 0,
                              Normal_Velocity_Reference_Value= 2.051303
,
                              Temperature_Reference_Value= 298.4 ,
                              Density_Reference_Value=  1.833106D-01 ,
                              Temperature_BC_Type="Neumann",
                              Density_BC_Type="Neumann",
                              Variable_Flowrate= 1 ,
                              Time_Fct_Name= "Sinus_zero_average" ,
Time_Fct_Threshold= 0.0 ,
                              Time_Fct_Time_Scale= 1.76173611342339D-03 ,
Time_Fct_Magnitude=  2.195749 /

================================================================================
               BORDER BOUNDARY CONDITIONS
================================================================================
&Border_Domain_Boundary_Conditions West_BC_Name  = "None" ,
East_BC_Name  = "None" ,
                                   Back_BC_Name  = "Symmetric" ,
Front_BC_Name = "Symmetric" ,
                                   North_BC_Name = "None" ,
South_BC_Name = "None" /
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                  NUMERICAL METHODS
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
&Numerical_Methods
                     !!!NS_NumericalMethod= "BDF2-SchemeO2",
                     NS_NumericalMethod= "CN-SchemeO2",
                     !!!NS_NumericalMethod= "CN-SchemeO2-
SpecialLowMachFlow",
                     !!MomentumConvection_Scheme="Centered-O2-
Conservative" ,
                     MomentumConvection_Scheme="Centered-O2-
Convective_2" ,
                     !!!MomentumConvection_Scheme="Upwind-O1-
Convective" ,
```

```
                      TemperatureAdvection_Scheme="Centered-O2-
Convective_2" ,
                      !!!TemperatureAdvection_Scheme="Upwind-O1-
Convective" ,
                      !!!TemperatureAdvection_Scheme="Centered-O2-
Convective" ,
                     !Poisson_NumericalMethod="Home-
PartialDiagonalization"  ,
                     !Poisson_NumericalMethod="Home-SORMultigrid-
ConstantMatrixCoef"  ,
                      Poisson_NumericalMethod="Home-SORMultigrid-
VariableMatrixCoef"  ,
                      Off_Set_Poisson_Source_term= .true./

&HomeData_PoissonSolver SolverName="SOR"           ,!Successive Over-
Relaxation (SOR) method based on the red-black algorithm
                        MultiGrid_Type="V_Cycle",
                        Relaxation_Coefficient= 1.75     ,!Relaxation
coefficient of the SOR method ( 1 <= Relaxation_Coefficient < 2)
                        Number_max_Grid= 7          ,!Number of grid
levels
                        Number_max_Cycle= 5
                        Number_Iteration_FineToCoarseGrid=1   ,!number
of SOR iterations applied on any grid level during the restriction step
(before the coarsest grid computation)
                       Number_Iteration_CoarseToFineGrid= 10   ,!number
of SOR iterations applied on any grid level during the prolongation
step (after the Coarsest grid computation)
                       Number_Iteration_CoarsestGrid= 20   ,!number of
SOR iterations applied on the coarsest grid
                       ResidualNormalisation_Enabled= .true.,
                       !ConvergenceStrengthening_Enabled= .true. ,
                       Prolongation_Type="Linear" ,
                       Convergence_Criterion= 1.D-06
/!convergence tolerance on the residu of the Poisson's equation

+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
+++++++
                   SIMULATION MANAGEMENT
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
+++++++
The numerical time step is dynamic and is estimated by the constant CFL
coefficient

&Simulation_Management    Restart_Parameter= 0 ,
                          Steady_Flow_Stopping_Criterion_Enabled =
.true. , Steady_Flow_Stopping_Criterion = 1.D-16,
                          Temporal_Iterations_Number = 200000
, Final_Time = 7.5D-01  ,
                          TimeStep_Type     = 0 ,
                          !TimeStep_Max      =  1.76173611342339D-04,
```

```
                          TimeStep_Max      =  5.D-06,
                          CFL_Max      = 0.3 ,
                          Iterations_For_Timestep_Linear_Progress= 1 ,
                          Simulation_Backup_Rate = 1000   ,
Simulation_Checking_Rate = 101 /
================================================================================
======
                   PROBES MANAGEMENT
================================================================================
=======

&Simulation_Management    Probe_Recording_Rate = 21     /

&Probe_Quantities_Enabled  Temporal_Series_For_Quantity_Enabled(:)=
.true. , .true., .false., .True., .false., .false. /

&Probe_Location  Xi= -3.420D-03, Xj= 9.5000D-05 , Xk= 0.0 /
&Probe_Location  Xi=  3.420D-03, Xj= 9.5000D-05 , Xk= 0.0 /
&Probe_Location  Xi= -3.420D-03, Xj= 1.6155D-03 , Xk= 0.0 /
&Probe_Location  Xi=  3.420D-03, Xj= 1.6155D-03 , Xk= 0.0 /
&Probe_Location  Xi= -3.420D-03, Xj= 8.5525D-04 , Xk= 0.0 /
&Probe_Location  Xi=  3.420D-03, Xj= 8.5525D-04 , Xk= 0.0 /

================================================================================
======
           FIELDS RECORDING DECLARATION
================================================================================
======

!------------------------------
!--- Instantaneous fields
!------------------------------

&Field_Recording_Setup    Precision_On_Instantaneous_Fields= 1 /
&Simulation_Management    InstantaneousFields_TimeRecordingRate =
1.76D-04 InstantaneousFields_RecordingStartTime=0.71  /

&Instantaneous_Fields_Listing  Name_of_Field = "U     "  /      First
velocity component
&Instantaneous_Fields_Listing  Name_of_Field = "V     "  /      Second
velocity component
&Instantaneous_Fields_Listing  Name_of_Field = "P     "  /
&Instantaneous_Fields_Listing  Name_of_Field = "T     "  /
&Instantaneous_Fields_Listing  Name_of_Field = "RHO   "  /
!Instantaneous_Fields_Listing  Name_of_Field = "TRACE "  /
!Instantaneous_Fields_Listing  Name_of_Field = "divU  "  /
!Instantaneous_Fields_Listing  Name_of_Field = "divRU "  /
!Instantaneous_Fields_Listing  Name_of_Field = "PHI   "  /
!Instantaneous_Fields_Listing  Name_of_Field = "drho  "  /
!Instantaneous_Fields_Listing  Name_of_Field = "SRC_P "  /
```

```
!------------------------------
!--- Statistic fields
!------------------------------

&Simulation_Management    Start_Time_For_Statistics= 2.D+05
, Time_Range_Statistic_Calculation = 3.8D-01  /

&Statistical_Fields_Listing  Name_of_Field = "<U>   "  /
&Statistical_Fields_Listing  Name_of_Field = "<V>   "  /
&Statistical_Fields_Listing  Name_of_Field = "<T>   "  /
&Statistical_Fields_Listing  Name_of_Field = "<P>   "  /
&Statistical_Fields_Listing  Name_of_Field = "<Rho> "  /

!------------------------------
!--- Time series
!------------------------------

&Time_Series_Data Title= "VolumeFlowBalance" , Filename=
"check_volflux.dat" , iter_rec= 20 ,
                  Time_Start_Mean_Calculation= 2.D+05
,Range_Mean_Calculation= 1.76D-01
                  Restart_Enabled= .false. /

&Time_Series_Data Title= "LMN_Data" , Filename= "check_lmndata.dat" ,
iter_rec= 20 ,
                  Time_Start_Mean_Calculation= 2.D+05
,Range_Mean_Calculation= 1.76D-01
                  Restart_Enabled= .false. /

&Time_Series_Data Title= "KE_Average" , Filename=
"check_kin_energy.dat" , iter_rec= 20 ,
                  Time_Start_Mean_Calculation= 2.D+05
,Range_Mean_Calculation= 1.76D-01
                  Restart_Enabled= .false. /
```

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https://sunfluidh.lisn.upsaclay.fr/ - **Documentation du code de simulation numérique SUNFLUIDH**

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