Omni3D Tutorial

Jin Wang   *https://link.springer.com/article/10.1007/s00348-019-2700-y*

1. The Algorithm

To understand the algorithm, one needs to read the published paper about this method. There is a PDF version inside, named "Omni3D Paper.pdf".

There are three versions of this method, which can handle different situations:

Omni3D_Standard should only be used when acceleration errors are nearly uniformly distributed.

Omni3D_Weighted is used when at some regions, acceleration errors are not uniform, e.g. boundary layer flow, vortex flow.

Omni3D_Selected is opted when one needs to exclude some region from the integration domain, using thresholding of acceleration error or mask. Omni3D_Selected method can be applied to compound boundaries, e.g. flow around an object by marking the object as an extremely high-error region.

2. Parameter Files.

The parameter file "Parameter_Omni3D.dat" is universal for all three versions. A sample of the parameter file is as follows:

51	GridSizex
46	GridSizey
26	GridSizez
0.005003000000000	Deltax
0.005003000000000	Deltay
0.005003000000000	Deltaz
1	density
1	Scale. Usually set to one.
0.7	Parallel line spacing divided by the grid spacing
10242	Number of grid points on the sphere determining angles
GridIcosahedronDivide6.dat	file containing coordinates of points on the sphere
.\AccelerationFilesSample\	acceleration folder
.\PressureSample\	Pressure to be stored. Can be automatically created
4	Total number of iteration steps. Suggest: 4-20.
200	Threshold for "Omni3D_Selected" method

To set the threshold, one needs to look at the output of curl of material acceleration "CurlofMaterialAcc_Sample.dat", which is generated by the Omni3D_Weighted and Omni3D_Selected method. This file contains the curl of material acceleration for each grid point.

------------------------------------Hidden parameters---------------------------------------

Below the last parameter, six blank lines are intentionally left (should be kept), which are the hidden parameters for "Region of Interest" as follows.

ROIstarti

ROIendi

ROIstartj

ROIendj

ROIstartk

ROIendk

When they are blank, the default values will be set in the program as:

ROIstarti=0

ROIendi=GridSizex-1

ROIstartj=0
ROIendj=GridSizey-1
ROIstartk=0
ROIendk=GridSizez-1

3. Format of Acceleration Files

The input acceleration files should have 7 columns, and be in Tecplot format with 3 headerlines.
The delimiter can be multiple spaces. The 7 variables are as follows:
x y z D*u*/D*t* D*v*/D*t* D*w*/D*t* IsMasked
The IsMasked value is binary, i.e. either 1 or 0. The value of 0 means this point is masked out, and vice versa. When Omni3D_Selected method is used, the thresholding value will be multiplied with this mask. For batch processing, acceleration files are put in the acceleration folder. All of them will be processed in one time.
A sample acceleration files can be found in the sample folder.

4. Running Environment and Dependency

The program (x64) is compiled based on GPU Cuda 8.0 toolkit, and corresponding libraries are needed.
cudart64_80.dll (basic libraries for Cuda environment)
The program used MFC library (CString) in C++ and complied with Visual Studio 2013, which means the following libraries should be included.
mfc120.dll
msvcp120.dll
msvcr120.dll
When visual studio 2013 is installed, these files are in the C:/Windows/System32/ folder. To facilitate the user, these three files are already in the folder together with the cudart library file.

5. Common Errors when Running the Program.

 "Folder does not exist", check the folder name, there is a limitation on the length and space is not allowed.
If you have any questions email me at jwang186@jhu.edu.