EXTENDING OPENFOAM COMPUTATIONAL AEROACOUSTICS CAPABILITIES

ILYA EVDOKIMOV[1], MATVEY KRAPOSHIN[1], ANDREY EPIKHIN[1]
[1]*Institute for System Programming of the Russian Academy of Sciences, i.evdokimov@ispras.ru*

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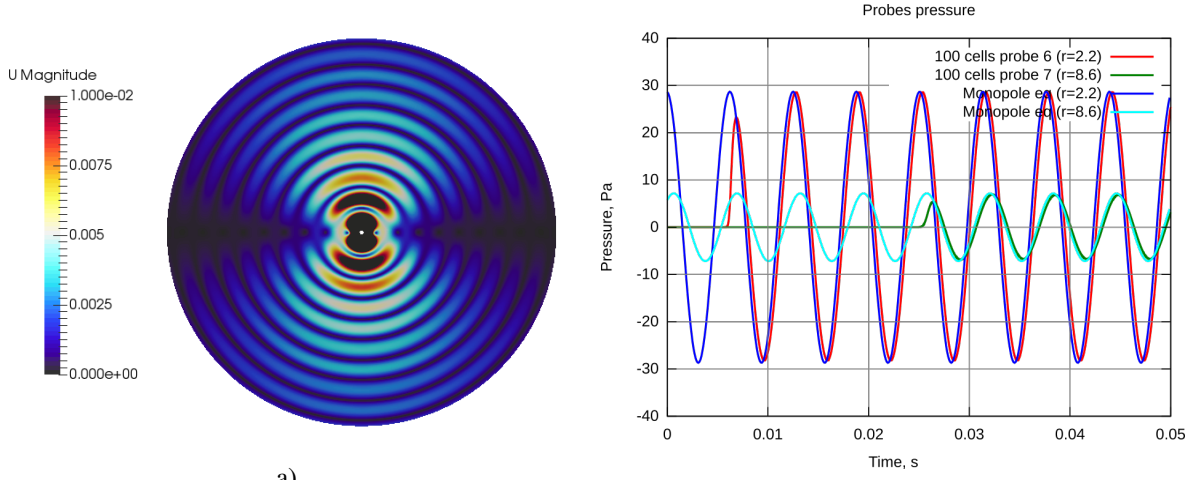
Present OpenFOAM extension libAcoustics was developed on base of the functionObject class. The early version of the library implemented Curle analogy and the Fast-Fourier Transform was computed using external FFTW library. The next step of the development libAcoustics includes several enhancements.
The new FwocsWilliams-Hawkings acoustic analogy implementation uses both functionObject and libSampling classes. The approach is pretty similar to the well-developed Curle analogy and includes libSampling capabilities to read triangulated control surface and to perform various operations with interpolated and sampled computational data. Exclusion of the FFTW library is dedicated to increase code compactness. Instead of FFTW the noizefft OpenFOAM class is used for the purpose of the Fast-Fourier Transform calculation.
Several test cases were added to validate library analogies and guarantee correctness of the chosen numerical schemes



a) b)

Figure 1: .

and grid independent result. The main feature of these cases is the presence of the analytical solution ([1]). It concerns such linear acoustic problems as: infinitesimal pipe (one-dimensional case with harmonic wave excitation), breathing sphere and baffled piston (acoustic monopole), trembling sphere (acoustic dipole, see fig. 1, a).
The listed cases are very useful not only for library testing but also for non-reflecting boundary conditions development and solver validation. For example we have used 1D-pipe, monopole and dipole cases for newly developed pisoCentral(DyM)Foam testing (see fig. 1, b). It was proven that this solver could be applied for direct sound wave simulation and proper schemes could be selected using very simple and low cost 1D test cases. The pisoCentral(DyM)Foam coupling with other boundary element solver is investigating and could be implemented using the same validation cases.

References

[1] Y.-H. Kim, *Sound Propagation: An Impedance Based Approach*, 1st ed. John Wiley Sons, 2010.