Analysis of Turbulent Noise

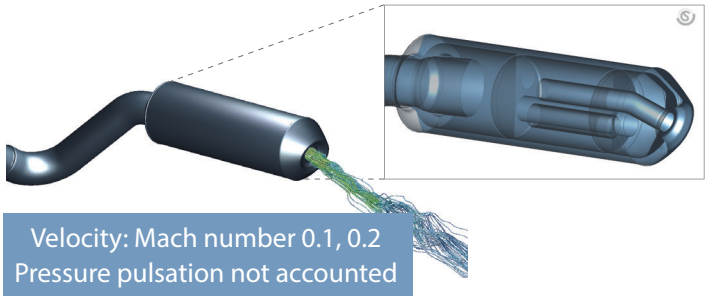
SC/Tetra Case Study

Coupling analysis of SC/Tetra and Actran

Analysis Objective

Turbulent noise is a broadband noise generated by turbulent flow. Predicting the noise from exhaust pipe requires sound propagation analysis, and simply using direct solvers to do this involves enormous calculation costs. As shown in the example of automobile exhaust pipes, coupling with acoustic analysis software Actran is more efficient.

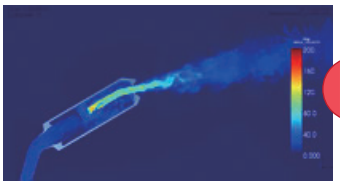
Analysis model



Velocity: Mach number 0.1, 0.2
Pressure pulsation not accounted

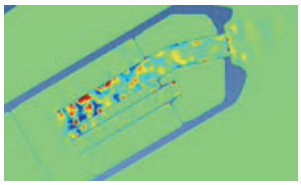
Analysis process

1. Fluid analysis with SC/Tetra



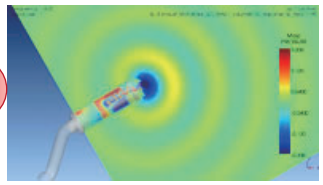
SC/Tetra analysis result
Actran can read the result and display the image.

2. Noise source extraction with Actran
(Similarity law of Lighthill and Mohring)



Noise source distribution per frequency
Noise sources are extracted and Fourier transformation is conducted every time step.

3. Acoustic analysis with Actran

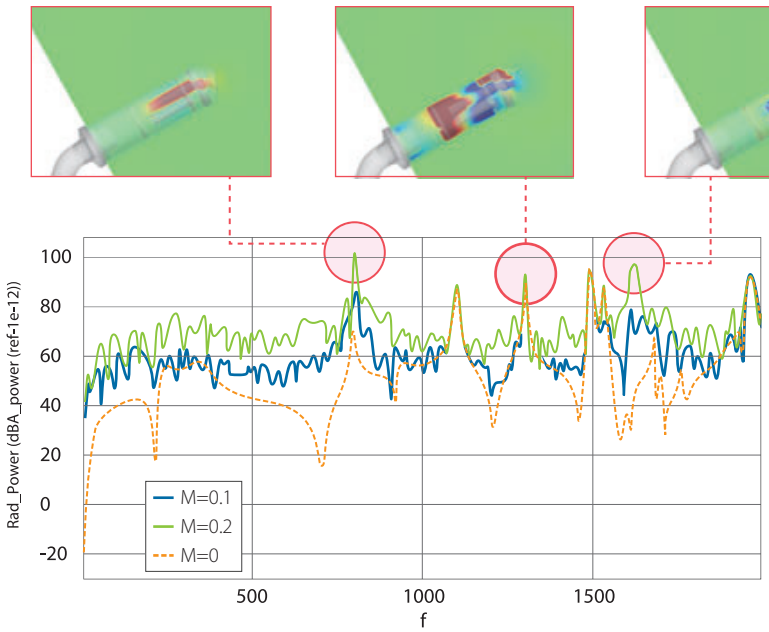


Sound pressure distribution per frequency
Time history analysis can also be conducted.

Reinforced coupling function

- Mapping of data where mesh is generated differently
- Minimizing data by only saving the required physical quantity and reducing the number of times to save geometry data to once
- When transient analysis ends, convert the finished time step into sound source

Analysis results



Sound pressure distribution inside/outside an exhaust pipe (when noise source is used with M=0.2)

Notes

- Turbulent noise of automobile exhaust pipes was analyzed using SC/Tetra and Actran.
- Reinforced coupling function has been implemented to execute analysis easily.
- By coupling analysis, it is possible to predict sound pressure distribution of outer and inner exhaust pipes per frequency.