The 8th European Congress on Computational Methods in Applied Sciences and Engineering
ECCOMAS Congress 2022
5-9 June 2022, Oslo, Norway

INVESTIGATION OF THE PANS METHOD FOR THE PREDICTION OF AERODYNAMIC NOISE AROUND A CIRCULAR CYLINDER

Arezoo Moosavifard[1,2], Elena Kolb[2], Michael Schäfer[1,2] and Suad Jakirlic[1,3]

[1] Computational Engineering Graduate School ,
Technical University of Darmstadt,
Dolivostr. 15, Darmstadt 64293, Hessen, Germany,
e-mail: moosavifard@gsc.tu-darmstadt.de

[2] Institute of Numerical Methods in Mechanical Engineering,
Technical University of Darmstadt,
Dolivostr. 15, Darmstadt 64293, Hessen, Germany

[3] Institute of Fluid Mechanics and Aerodynamics,
Technical University of Darmstadt,
Alarich-Weiss-Str. 10, Darmstadt 64287, Hessen, Germany

Keywords: *Partially-Averaged Navier–Stokes, Scale supplying variable, Computational aeroacoustics, Splitting approach, Circular cylinder flow.*

The Partially-Averaged Navier-Stokes (PANS) method is a seamless approach for hybrid RANS/LES modeling with coupling between RANS and LES. It combines the advantages of both methods to give more accurate results than RANS while having less computational cost than LES. This paper investigates the performance of a recent approach of the PANS method developed by Basara et al. [1] in the context of aeroacoustics. This specific PANS model solves an additional model equation called the scale-supplying variable (SSV) for the resolved kinetic energy. The model is first validated for a periodic 2D-Hill and is then used to study the flow around a circular cylinder. A hybrid method based on an acoustic/viscous splitting technique is applied for aeroacoustic computation. This method calculates the acoustic field by solving the linearized Euler equations (LEE) and the acoustic source by solving the incompressible Navier-Stokes equations. The flow field around the cylinder is calculated using PANS and compared with LES results [2]. Furthermore, by using the Kirchhoff wave extrapolation method, the far-field noise is evaluated, and the sound pressure level (SPL) spectra of PANS is compared with LES and with experimental data. The results show that the PANS method can give reasonable accurate prediction of the tonal and broadband noise with significantly lower computational cost.

REFERENCES

[1] Basara, B. and Pavlovic, Z. and Girimaji, S., A new approach for the calculation of the cut-off resolution parameter in bridging methods for turbulent flow simulation. *International Journal of Heat and Fluid Flow.*, Vol.**74**, pp. 76–88, 2018.

[2] Kolb, E. and Schäfer, M., Aeroacoustic simulation of flexible structures in low Mach number turbulent flows. *Computers & Fluids.*, Vol.**227**, 105020, 2021.