

## MULTI-PHASE MODERNISATION OF THE SUBSONIC WIND TUNNEL ORIENTED TOWARDS INTEGRATION OF CFD & EXPERIMENT

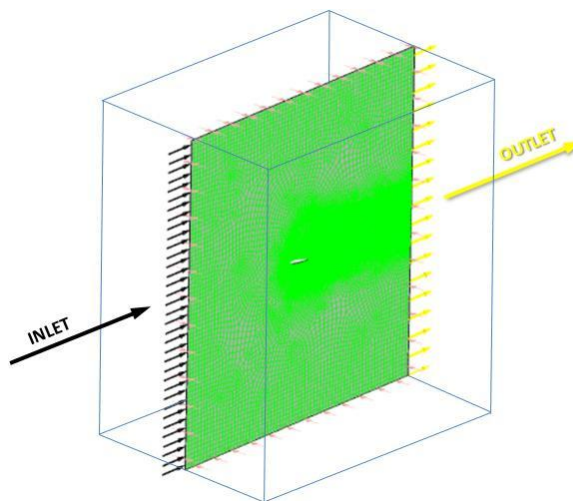
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In applied aerodynamics, an experiment supplementing theoretical or numerical analysis can be conducted in a wind tunnel as it is a basic tool for practical study. It gives a record of how rules of physics apply in the real world and can serve as means of validation. On the other hand, advantageous features of CFD (i.e. low cost, ability to predict 3D flow fields, and relatively short time for obtaining results) cannot be underestimated. Combining both techniques, CFD and experiment, provides full information about aerodynamics of the studied object.

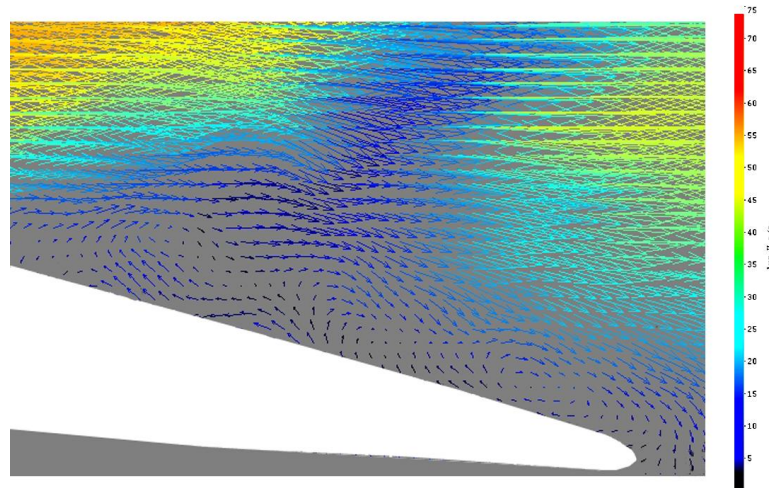
Awareness of the significance of a wind tunnel experiment for the research quality was the mainspring for the wind tunnel modernisation process at Institute of Turbomachinery (IMP) at the Technical University of Lodz (TUL). It was decided to provide IMP with the experimental stand of the high standard. The idea of working on the experimental stand was also inspired by the concept of CFD and EFD integration planned to be developed at IMP (Liśkiewicz et al., 2011). At the early stage of work, a decision was made to adapt formerly operated wind tunnel facility at the Institute of Turbomachinery (IMP WT hereafter) for modern applications. Character of performed actions can be classified as experimental with implementation of basic design. This paper summarizes the initial stage of modernisation process that covered four main areas and the following objectives:

- implementing CFD into wind tunnel design by performing numerical analysis in ANSYS CFX software (refer to *Figure 1*),



*Figure 1 Numerical domain used for quasi 2D simulations of the flow around aerofoil (NACA 0012) located inside the test section of the virtual wind tunnel*

- performing preliminary test in order to obtain insight into IMP WT flow quality and its characteristics,
- suggesting construction modifications and design of flow straightener structures aimed at improvement of IMP WT flow quality (mainly turbulence reduction),
- equipping IMP WT with PIV system and carrying out an experiment thus providing IMP with state-of-the-art experimental stand with modern measurement and data acquisition system (refer to **Figure 2**).



*Figure 2 Exemplary preliminary result obtained by means of PIV technique in IMP WT (velocity field near the trailing edge of NACA 0012 aerofoil)*

The article will show a comparison of CFD results with experimental data gathered in the tunnel for flow investigation around NACA 0012 profile. Additionally, main stages of IMP WT modernisation will be presented focusing on actions aimed at flow improvement and test stand adaption for PIV system installation.

## References

Liśkiewicz G., Karczewski M. (2011): *Review on Innovative Methods for Integration of Numerical Simulation with Experiment*, 14th International Symposium of Students and Young Mechanical Engineers "Advances in Chemical and Mechanical Engineering", vol. 2, pp. 25-29, Gdańsk