Numerical Von Kàrmàn flow forcing by two rotating propeller using penalization method

Sebastian Kreuzahler[2], Holger Homann[1], Yannick Ponty[1]& Rainer Grauer[2]

[1] *Université de Nice-Sophia, CNRS, Observatoire de la Côte d'Azur, France*

[2]*Theoretische Physik I, Ruhr-Universität Bochum, Universitätsstrasse 150,* D44780 Bochum, Germany

Abstract

Simulations of impeller-driven flows in cylindrical geometry are compared to the Von Kàrmàn velocity experiment. The geometry of rotating impellers assembled of several basic objects is modelled via a penalization method and implemented in a massive parallel pseudo-spectral Navier-Stokes solver, called LaTu. Simulations of impellers with different numbers of blades and different curvature radii, especially one resembling the so-called TM28 configuration used in the experiment [1], were performed. Though the obtained Reynolds numbers of about 300 to 400 at a resolution of 256^3 grid points are far smaller than experimental values, DNS offers the possibility of a spatially resolved analysis of the flow structure. Visualizations of the mean velocity fields as well as flow profiles along the symmetry axes of each simulated flow reveal that all considered blade configurations have the same general structure: two flow cells, one on each side of the cylinder, mostly equal to the simple s2t2 flow, which is meant to generate dynamo action. The decomposition into poloidal and toroidal components allows to compare quantitatively DNS with experimental results, especially for the TM28 flow [1]. We analysed the flow structure close to the impeller blades which might lead to the dynamo-relevant alpha effect. Some preliminary dynamo results will be also presented.

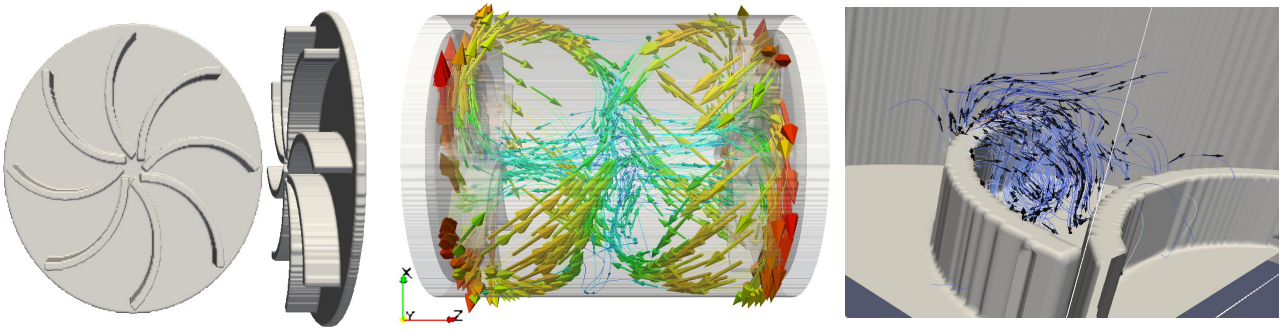

Figure 1: (left) Visualisation of the propeller built by penalisation leading to a Von Kàrmàn flow.
(centre) Visualisation of the temporal mean flow. (right) Visualisation of the vortex produce by the propeller inside the rotation frame.

References

[1] L. Marié, J. Burguete, F. Daviaud and J. Léorat «Numerical study of homogeneous dynamo based on experimental von Karman type flows» Volume **33**, Number 4, *The European Physical Journal B - Condensed Matter and Complex Systems,* 469-485, (2003).