Simulation of swimmers performing a dolphin kick

St. Pacholak*, A. Rudert*, Ch. Brücker* and R. Blickhan†

For several years Australia and the United States have led the top of international swimming competitions. Their advantage is gained after the turn period by performing a dolphin kick which is part of the butterfly motion. Understanding this physical process would help to improve the technique of swimmers and lead to a more efficient way of underwater propulsion.

Therefore the TU Bergakademie Freiberg (TUBAF) and the Friedrich Schiller Universität Jena (FSU) pursue scientific researches corporately in a DFG-Project to acquire important technical and athletic success. While simulating the undulatory dolphin motion in numerical computation in Freiberg, Jena is doing measurement at a living swimmer with the help of the olympic center of Heidelberg and the Institut fr Angewandte Traningswissenschaft in Leipzig (IAT) to validate correct results in undulating movement.

In order to find the optimal frequency and amplitude of dolphin kick in dependence on the current situation and also to check the usability of vortex flow around the passed body a numerical model with a deforming mesh is employed. Figure 1 (A) shows a simplified 5-panel-model[1] of a body flapping by doplhin motions. Further examinations have shown how to optimize this dolphin motion to get a maximum efficiency. The presented numerical simulations use a three dimensional surface modell of a human swimmer that is shown in Figure 1 (B). Displayed is the 3D-scan data of a human, that was taken by a body scanner from the IAT. This geometry makes it possible to examine flow and 3D vortex structes near the surface of the swimmer and around the head. It also allows to observe the process of vortex recapturing in detail and its meaning to thrust.

The simulations are performed with the Open Source CFD package OpenFOAM and the results are compared to the experimental findings with the open-source, multiplatform data analysis and visualization application Paraview. The numerical results from Freiberg and the experimental findings from Jena show good agreement.

*TUBAF Fak.4, D-09599 Freiberg, Germany.
†FSU, D-07749 Jena, Germany.
[1]Gaulke, *Entw. eines. num. Modells f. Strömungsunters.*, (2008).

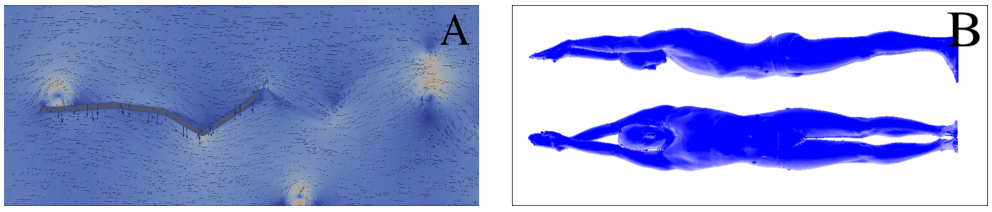

Figure 1: (A) Numerical results of flow around a simplified body. (B) Body Scan Data of a human.