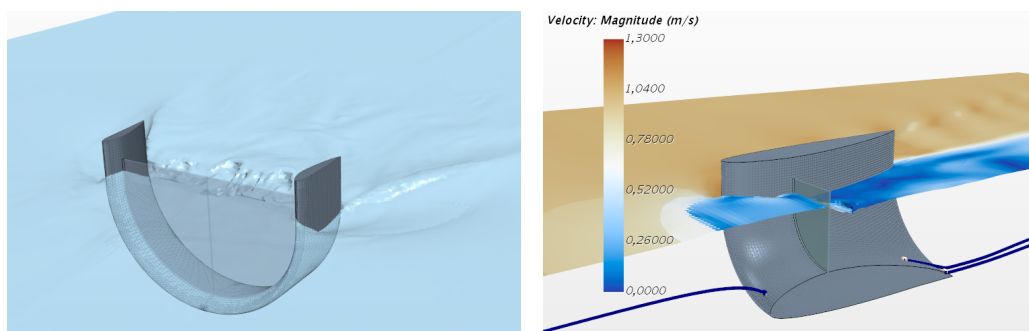




## Numerical and experimental investigation of the ducting of free-surface hydraulic devices

Master's thesis at the *Lehrstuhl für Strömungsmechanik und Strömungstechnik*

Work is currently underway in the institute aiming to evaluate the performance of low-impact hydraulic devices operating near the surface of river and tidal flows, as part of the *Fluss-Strom* project. Because of the very low specific energy available to these machines, it is desirable to optimize their operating conditions so as to maximize their power density and minimize their power-specific installation costs. One aspect of this optimization involves the use of ducts (static and presumably inexpensive components) around the mobile parts of such machines.



An attempt at characterizing the influence of ducts on free-surface machines in the most general terms has already been made at the institute, using a series of CFD simulations covering a wide range of flow cases [1]. In that experiment, the mapping of parameters was too broad and coarse to permit the prediction of the optimum duct size. A new series of experiments focused on a narrower range of parameters could overcome this limitation.

The aim of this Master's thesis is to determine, in terms as general as possible, the potential of a duct for increasing the power density of a given free-surface hydraulic device. The project will include the following phases:

- Review of relevant literature, (one-dimensional theory describing ducting and its effects, and wave drag reduction on ship hulls);
- Design and set-up of a series of CFD experiments to characterize the behavior of a selected duct geometry in two-phase flow;
- Comparison of numerical results with measurements carried out on a model in the institute's water channel;
- Characterization of the performance of a duct, and comparison against experimental measurements using a model water wheel in the water channel.

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[1] O. Cleynen, S. Hoerner, and D. Thévenin. "Performance mapping of ducted free-stream hydropower devices". In: *Proceedings of the 4<sup>th</sup> IAHR Europe Congress*. 2016.