

**(Project Work and) Master's Thesis  
FS 2024**

Head: Prof. Dr. Robert Boes  
Supervision: Kamal Prasad Pandey  
Dr. Ismail Albayrak  
Dr. Armin Peter

# Development of turbulent Eddies-based behavioral fish Guidance System (EGS) for safe fish passage at hydropower intakes

Downstream migrating fish in rivers need to pass over multiple run-of-river hydropower plants (HPPs). Fish passing through turbine or spillway of these HPPs can result in high injury and mortality rates, which lead to a decline in fish populations. In this multi-disciplinary international [FishPath project](#), a turbulent Eddies-based behavioral fish Guidance System (EGS) will be developed for a safe downstream fish passage at HPP and other water intakes. The EGS will be based on the knowledge on fish behavioral responses to various types of turbulent eddies obtained from the previous tests for Atlantic salmon and European eel (Fig. 1, left). Vertical, horizontal and streamwise eddies will be created using different types of elements, (e.g. cylinders, hydrofoils). Combination of such elements with different geometrical arrangements will create the EGS with a bypass system and tested with Atlantic salmon in a large etho-hydraulic laboratory flume (Fig. 1, right).

In this Master's thesis, live-fists of different EGSs will be conducted at two inflow velocities and the fish behavior and fish guidance efficiency of the EGSs will be evaluated from the video recordings using a 3D fish tracking system. Flow fields will be determined using a 3D numerical model of the EGS for two different inflow velocities by the project partner, Vattenfall laboratory in Sweden. The student will participate in live-fish tests in the laboratory, analyze visual observations data, obtain digital track of the fish along with simulated hydraulic data i.e., flow velocities and turbulence intensity. The obtained results will be used to identify the effectiveness of different EGS and suggested improvements. A basic knowledge on turbulent flows and knowledge of Matlab/Python or another programming language is advantageous.

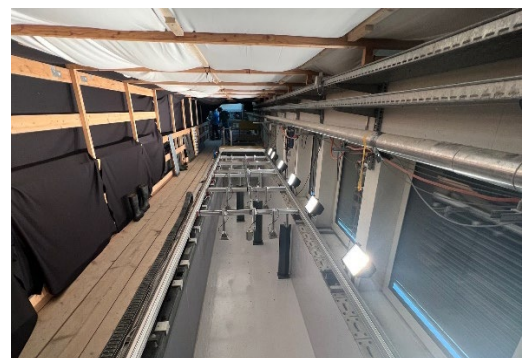


Fig 1: Photo of live-fish tests with Atlantic salmon in spring 2023 (left) and representative photo of an EGS with vertical-axis vortex generating elements (right)

**Contact:**

Kamal Prasad Pandey  
Hydraulic Engineering Division,  
HIA – C54.1 - +41 44 633 34 45, [pandey@vaw.baug.ethz.ch](mailto:pandey@vaw.baug.ethz.ch)

**Remarks:**

Project oriented thesis; thesis communication and report in English.  
*For Civil Engineering: Project must be continued with a follow-up project as part of the Master's thesis (only Master's thesis or Project Work is not possible). For Environmental Engineering: Can only be chosen as a Master's thesis.*