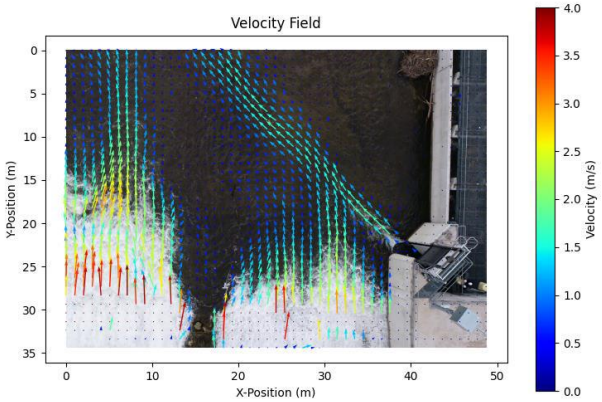
PhD thesis: Experimental and numerical study of jet in a free-surface transverse flow

In many applications, such as river confluences, headrace spillways or more specific structures such as fish passes, the jets emerging in a transverse flow are characteristic flows generating vortex structures and penetrating the main flow to a greater or lesser extent (Figure 1).



1).

Figure 1 : Measurement of the velocity of a jet discharging downstream from a hydroelectric power plant by LSPIV (top view)

In the literature, many studies have been carried out on these academic configurations of a jet opening into a transverse flow, but few have studied the influence of the presence of a free surface, for different injected jet heights, on the development of the jet and its penetration. 3D effects are predominant in this type of flow and the influence of the free surface and injection ratios are not known for low Froude number flows. From a more operational point of view, the sizing rules for free-surface flows, to determine their penetration and signature in the main flow, are still very qualitative or based on experience. As part of the activities of the OFB/IMFT/Pprime eco-hydraulics unit, we are therefore seeking to define these sizing criteria in order to assist in the design of effective structures to attract fish during the upstream migration.

The subject of this thesis concerns fluid mechanics, hydraulics and the interactions between a jet and a transverse flow for free-surface flows.

The experimental and numerical work will involve studying a number of parameters such as momentum injection ratios, jet height and jet angle for very different inlet conditions encountered behind a weir, at a turbine outlet or in a turbulent channel. The experiments will be carried out on the Pprime Institute's environmental hydrodynamics platform, mainly using optical measurements (PIV), and the simulations will be carried out using the StarCCM+ calculation code with unsteady approaches.

The candidate should have skills in fluid mechanics and free-surface flow hydraulics, as well as knowledge of measurement and/or numerical simulation.

Keywords: fluid mechanics, hydraulics, cross-flow, experimentation, numerical simulation

For any further information, please contact us as soon as possible and before the end of April 2025. The thesis will start as soon as possible, the fundings are validated.

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