

Design optimization of a vaneless fish-friendly swirl injector for small water turbines

Ajith Airody and Sean Peterson

*Department of Mechanical and Mechatronics Engineering, University of Waterloo,
Waterloo, Canada*

In remote areas, small-scale hydro-electric facilities are an attractive option since they harvest from local water sources without the need for large supporting structures. The impact on the fauna drawn into the turbine, however, is still a concern. In order to mitigate the effect of turbine operations on the local fish populations, recent efforts have focused on the redesign of the small-scale facilities to make more fish-friendly. In support of this trend, Galt Green Energy has recently proposed a vaneless casing in order to replace the traditional inlet guide vane array. The casing will provide the rotor with the necessary rotational component while providing safe passage to the fish as they travel through. The flow through the casing is numerically modeled using ANSYS CFX in order to elucidate the evolution of the axial and circumferential velocity symmetry in various cross-section within and downstream of the injector. Pressure loss, swirl intensity as well as velocity distributions depend on the pitch angle and the number of revolutions of the casing. The optimization of the casing is done with an objective function based on velocity and pressure performance measures. The results of the optimization will be discussed.