Instantaneous river-wide hydrodynamic measurements at fine scales for use in fish movement study at FishPass

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ABSTRACT:

This work describes a pilot study performed to test the suitability of Infrared Quantitative Image Velocimetry (IR-QIV) for use at FishPass. IR-QIV is a non-contact velocimetry method that uses infrared images of the surface of rivers or other flowing water to measure the surface velocity field (Schweitzer & Cowen, 2021). IR-QIV is capable of measuring at very high spatial and temporal resolution. It is unique among velocimetry methods in that it is capable of resolving the instantaneous velocity field, including turbulence metrics of the flow, continuously for extended periods of time, without requiring external illumination or particle seeding. This makes it uniquely suited for applications such as studying or managing fish movement behavior, since it can be correlated with other information on fish navigation or behavioral decisions. In this study we acquired infrared imagery with multiple cooled infrared cameras at the Boardman Weir in Traverse City, MI, and performed IR-QIV analysis on these images, in order to explore the suitability of IR-QIV for use at FishPass once constructed, and better understand constraints or requirements for applying IR-QIV at FishPass. The results of the study were very encouraging. Excellent image quality was obtained with all three cameras used, at a variety of locations and orientations near the weir, and over a range of environmental conditions and times of day. Comparison of IR-QIV velocity records with velocity measured by ADV showed excellent agreement between the velocity records of the two methods. For example, a comparison of measurements by the two methods over two time periods, of 11 and 7 minute duration, at different times of day and under different environmental conditions, showed a difference of less than 0:25 % in the mean velocity measured in each period (approximately 1 mm/s difference with mean velocity approximately 0:5 m/s). We believe IR-QIV will be an excellent tool for use at FishPass, and will perform well under most environmental conditions, providing detailed measurements of the velocity field and metrics of turbulence over a large spatial area of the water surface.