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Alternative method for estimating the cross-sectional interpolation errors of discharge measurements using the velocity-area method

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Quantifying the quality of discharge measurements by uncertainty analysis is a challenge in the hydrometric community. Discharge measurements are the first step to produce hydrometric data which are used in many hydrological studies like design of hydraulic structures or calibration of hydrological models for flood forecasting and warning. Thus associated uncertainty has to be estimated carefully. The velocity-area method is a common approach for estimating river discharge. It consists in integrating depths and point velocities through the cross-section. Due to the limited number of point measurements, the quality of the measurement depends mainly on the sampling strategy.

Different methods of uncertainty estimation are available in the literature (ISO 748, Q+ and IVE). The main uncertainty component, noted u_m, is often related to the cross-sectional interpolation errors. However the computation of this term according to these approaches does not evaluate both the sampling strategy and the complexity of the cross-section.

The FLAURE method (FLow Analog UnceRtainty Estimation) includes a new methodology to estimate this term. It is based on the study of high-resolution stream-gaugings (i.e. reference stream-gaugings made with a high number of verticals). The high-resolution measurements are first subsampled by reducing the number of verticals to generate a sample of realistic stream-gaugings. A statistical analysis is performed to estimate the u_m component and then a sampling quality index is defined. For each reference stream-gauging, it leads to a curve of u_m component as a function of the sampling quality index. This set of curves is finally used to compute the u_m component of any routine stream-gauging. Curves are then selected according to the similitude between the routine stream-gauging and reference stream-gaugings. The similitude between the routine stream-gauging and reference stream-gaugings is evaluated thanks to the Nash criteria computed on lateral velocity distribution and bathymetric profile. The main advantage of this new methodology is to take into account both the sampling strategy and the complexity of the cross-section. Its application is adequate for various cross-sectional configurations including complex cross-sections and smooth man-made channels.