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Evaluation of acoustic Doppler velocimetry (ADV) performance under various probe configurations

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Acoustic Doppler velocimetry (ADV) is widely used as one of the most versatile and robust flow diagnostics tools for both laboratory and field studies across a range of research and applied themes spanning engineering eco-hydraulics and geomorphology. A range of specific ADV probes with varying specifications, are readily available for use by professionals and researchers. However, in practice using certain ADV equipment under certain default configurations can easily result in obtaining flow diagnostics that are non-representative of the real flow conditions. This appears to be true for most probes but even more those with which higher temporal resolution can be achieved - which many times is desired for assessing turbulence levels, amongst others.
A preliminary examination revealed that there is a varying level of dependency on a number of the probes' configuration parameters, which even though detailed in the user manual, a definite guide for the user is lacking. Subsequently users of this equipment may end up underutilizing or using it in a manner that returns inaccurate results. There are little, if any, resources in obtaining a better understanding on how to use the probe effectively.
To this goal a series of laboratory experiments are conducted, under the same open channel flow conditions, using a profiler (ADCP VectrinoII from Nortek®) aiming to cover the full range of probe configuration combinations that can be used in practice. For each experiment, single or multiple point measurements are taken to reconstruct velocity and turbulence intensity profiles. These are conducted at the same location (mid-channel) under the same flow conditions (referring to steady uniform flow and fully developed turbulence) for all probe configurations. In particular, the effect of tested parameters (including Range length, Range to fist cell, Sampling rate, Ping algorithm, Transmit pulse size and Cell size) on the sensitivity and accuracy of the obtained results is assessed. The signal to noise ratio (SNR) and the correlation of the measurement are used in evaluating the data quality, while a qualitative comparison of the resulting profiles for flow diagnostics is enabled using reference profiles obtained via a VectrinoI ADV (from Nortek®) and MicroADV (from Sontek®) respectively under the exactly same flow condition at the same location. These observations are important to identify its best configuration for a given probe towards improving the data quality and accuracy.