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Robust Assessment of Acoustic Doppler velocimetry Profiler Configuration Parameters

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ADVPs can enable profile measurements of flow velocity with a good sampling rate. It recently has been becoming a widely used tool in flow diagnostics, however the probe's configuration parameters are not well explained in the technical references offered by the probe manufacture nor any guidance exists to aid the user set these properly. Recent studies from Rusello [2012] and Thomas et al. [2017], indicate that there are a range of issues over the way such probes can be used, sometimes leading to erroneous results. The study carried herein, demonstrates that under exactly the same reference flow conditions, the results obtained using the ADVP probe under various probe configurations, can differ dramatically. Thus, a methodological approach to assess the performance of virtually the whole range of possible probe configuration combinations on the measured flow quantities is performed. This is conducted using certain performance indicators and suitable criteria (including from obtained time series characteristics to whole velocity profiles and estimated flow quantities such as boundary shear stresses) towards identifying the optimal probe configuration. It is found that results can vary significantly; specifically, the variation of the time averaged velocity result can be more than 50%, and the turbulent kinetic energy can vary up to 6 times for the same flow conditions. It is recommended that users of ADVP avoid using the default configuration without a search of the configuration parameters for the various flows they examine. The proposed framework offered here, along with the suggested performance metrics, can be followed to this goal, so at to allow identifying the near optimal probe configuration and offer reliable results with greater certainty.

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Thomas R., L. Schindfessel, S. McLelland and S. Creele (2017), Bias in mean velocities and noise in variances and covariances measured using a multistatic acoustic profiler: the Nortek Vectrino Profiler, Measurement Science and Technology, 28(7), 075302 (25pp), doi:10.1088/1361-6501/aa7273