



Measuring the Bed Load velocity in Laboratory flumes using ADCP and Digital Cameras

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Measuring the transport rate and apparent velocity of the bedload is notoriously hard and there is not a certain technique that would obtain continuous data. There are many empirical models, based on the estimation of the shear stress, but only few involve direct measurement of the bed load velocity.

The bottom tracking (BT) mode of an acoustic Doppler current profiler (ADCP) has been used many times to estimate the apparent velocity of the bed load. Herein is the basic idea, to exploit the bias of the BT signal towards the bed load movement and to calibrate this signal with traditional measuring techniques. These measurements are quite scarce and seldom reliable since they are not taken in controlled conditions. So far, no clear confirmation has been conducted in laboratory-controlled conditions that would attest the assumptions made in the estimation of the apparent bed load velocity, nor in the calibration of the empirical equations.

Therefore, this study explores several experiments under stationary conditions, where the signal of the ADCP BT mode is recorded and compared to the bed load motion recorded by digital camera videography. The experiments have been performed in the hydraulic laboratories of Ottawa and Bologna, using two different ADCPs and two different high resolution cameras. In total, more than 30 experiments were performed for different sediment mixtures and different hydraulic conditions.

In general, a good match is documented between the apparent bed load velocity measured by the ADCP and the videography. The slight deviation in single experiments can be explained by gravel particles inhomogeneity, difficulty in reproducing the same hydro-sedimentological conditions and the randomness of the backscattering strength.