MEASUREMENT OF FISH ACTIVITY USING ACOUSTIC DOPPLER VELOCIMETRY TECHNIQUES

I. Masaló[1], M. Revuelta, M. Ginovart, J. Oca

[1]Departament d'Enginyeria Agroalimentària i Biotecnologia, Universitat Politècnica de Catalunya, Urgell 187, 08036 Barcelona, Spain. E-mail: ingrid.masalo@upc.es

Introduction

The Acoustic Doppler Velocimeter (ADV) has been used in many studies of turbulence analysis (Voulgaris and Trowbridge, 1998; Nikora and Goring, 2000) due to its capacity to measure all three components of velocity vector in laboratory and field environments, furthermore permits to obtain precise and quick measurements.
Dispersion of velocity values in a specific point of a tank can be an indicator of fish activity. The knowledge of the fish activity is an important tool for the study of fish behaviour and its influence in the dynamics of sediments.
The purpose of this work is to explore the capability of ADV to be used for measurement of fish activity, and to set the conditions for data acquisition and data processing together with the parameters to be used as indicators of fish activity level.

Materials and methods

The work was developed with a 78x30x40 cm^3 aquarium. Two anti-turbulence screens were placed in each extreme of the aquarium allowing a working volume of 58x30x30 cm^3 with a flow rate of 59.3 $cm^3\ s^{-1}$. The fishes were goldfish (*Carassius aurata*). The experiments were carried out with the absence and the presence of the fish within the tank. The density of fish was 4.9 kg m^{-3}.
Different experiments were made, measuring the variance of velocities in different experimental conditions: i) sampling volume depth (3, 12 and 21 cm), ii) type of tank bottom (glass or sand), iii) data acquisition frequency (2 and 25 Hz).
The sampling volume and velocity range were always 9 mm and 3 cm s^{-1}, respectively, according to De Medina *et al* (2002). The variance of velocities in every axis was the statistical parameter used to compare different experiments.
The post-processing of the raw data was made using the software WinADV32 (Wahl, 2002) to filter the data. The correlation filter (COR) and signal-to-noise ratio filter (SNR) were applied as a quality parameter for the velocity data; ideally, COR should have values between 70 and 100, and SNR above 5 (Nortek AS, 2000). In the experiments with fishes the *Phase-space threshold despiking* filter developed by Goring and Nikora (2000) was applied to remove spikes, produced by the momentary positioning of any fish between the probe and the sampling volume.

Results and discussion

The sand in the tank bottom improves the results, decreasing the percent of data filtered by COR and SNR filters.
The utilization of the COR, SNR and *Despiking* filter allows to remove the spikes generated by the emplacement of fish between the probe and the sampling volume.
Detection of fish is achieved with an adequate configuration of the ADV. Variances of velocities in experiments with fishes were between 2 and 25 times the variances in experiments without fishes (Table 1), being observed the higher ratios in the vertical component of the velocity (Z).

Table I. Variances of velocity (V) in X, Y and Z-axis, with and without fishes. Experiments developed using sandy bottom, with frequencies 2 and 25 Hz and distances H between the sampling volume and bottom.

2 Hz

Axis	X			Y			Z		
H (cm)	21	12	3	21	12	3	21	12	3
V with	0.127	0.172	0.156	0.132	0.213	0.194	0.087	0.134	0.049
V without	0.059	0.010	0.012	0.035	0.022	0.016	0.012	0.007	0.004

25 Hz

Axis	X			Y			Z		
H (cm)	21	12	3	21	12	3	21	12	3
V with	0.377	0.431	0.546	0.458	0.402	0.635	0.226	0.152	0.122
V without	0.080	0.105	0.206	0.058	0.209	0.188	0.009	0.006	0.08

References

De Medina, V., Bateman, A., Velasco, D. (2002) Estudio detallado de los parametros de configuracion de un velocimetro acustico de alta frecuencia (ADV, acoustic doppler velocimeter). XX Congreso Latinoamericano de hidráulica-La Habana, 1-5 Octubre de 2002

Goring, D.G., Nikora, V.I. (2002) Despiking Acoustic Doppler Velocimeter data. Journal of Hydraulic Engineering 128 (1), pp 117-126

Nikora, V., Goring, D. (2000) Flow turbulence over fixed and weakly mobile gravel beds. Journal of hydraulic engineering 126 (9), pp 679-690

Nortek AS (2000). Operations Manual Nortek 10MHz Velocimeter.

Voulgaris, G., Trowbridge, J. H. (1998) Evaluation of the Accoustic Doppler Velocimeter (ADV) for turbulence measurements. Journal of Atmospheric and Oceanic Technology 15 (1), pp 272-289

Wahl, T. L. (2000) Analyzing ADV data using WinADV. Joint Conference on Water Resources Planning & Management; July 30-August 2, 2000-Minneapolis, Minnesota