UNIVERSITY OF TRENTO - Italy
Department of Civil, Environmental and Mechanical Engineering

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Room Red-- Tuesday 12/06/2018

		SM.1 Airborne LiDAR bathymetry: New approaches and their application **Conveners: M. Aufleger; R. Klar; K. Baumgartner.**
11:30	11:45	A review of airborne laser bathymetry sensors. G. Mandlburger.
11:45	12:00	Recent developments in LiDAR bathymetry. H.G. Maas; D. Mader; K. Richter; P. Westfeld.
12:00	12:15	Challenges and opportunities for single wavelength full wave LiDAR bathymetry. R. Schwarz; M. Pfennigbauer.
12:15	12:30	Mapping the riverscape . D. Tonina; J. McKean; W. Wright; R. Benjankar; R. Carmichael.
12:30	12:45	Topobathymetric laser scan of the river Mangfall: Deriving a 2D-CFDmesh from a point cloud with terabyte size. W. Dobler; F. Steinbacher; R. Baran; W. Benger; M. Aufleger.
12:45	13:00	Application of airborne LiDAR bathymetry data – Case study on the Mareit/Mareta, Italy. K. Baumgartner; R. Klar; M. Aufleger; G. Zolezzi; D. Faro.
13:00	14:15	**Lunch**
		FM.3 Hydraulic engineering and biological fluids: a fast expanding research area **Conveners: E. Toro; F. M. Susin.**
14:15	14:30	Introduction by conveners
14:30	14:45	The augmented FSI system for blood flow in compliant vessels. G. Bertaglia; A. Valiani; V. Caleffi.
14:45	15:00	The effect of active and passive dysfunction on right ventricle performance. G. Comunale; M. Padalino; B. Castaldi; P. Peruzzo; F. M. Susin.
15:00	15:15	In-vitro and in-silico modelling of hemodynamics in a deformable aorta. P. Peruzzo; L. Di Micco; S. Bonvini; F.M. Susin.
15:15	15:30	Experimental research on the effects of catheter in the evaluation of urodynamic data. L. Lotti; M. Milanesi; V. Li Marzi; L. Solari; E. Paris; S. Serni.
15:30	15:45	A holistic multi-scale mathematical model of the murine fluid systems: understanding the pathophysiology of idiopathic intracranial hypertension. C. Contarino; E. F. Toro; A. Louveau; S. Da Mesquita; D. Raper; I. Smirnov;J. Kipnis; N. Agarwal
15:45	16:00	Idiopathic intracranial hypertension and transverse sinus stenosis: a study combining in-vivo measurements and mathematical modeling. A. Avezzù; E. F. Toro; C. Contarino; K. C. Liu; T. J. Buell
16:00	16:15	The selfish-brain hypothesis as possible cause of hypertension: a modeling study. M. Celant; E.F. Toro; L.O. Muller; P.J. Blanco.
		Posters
16:15	16:20	Uncertainty Quantification methodology for blood flow in elastic vessels. M. Petrella; S. Tokareva; E.F. Toro.
		Microbial tracer transport as particles with biphasic-decay. A. A. Bakar; R. Ahmadian.
16:20	16:45	**Coffee break**
		FM.4 Turbulence and Interactions in River Hydraulics **Conveners: V. Armenio; V. Nikora; G. Costantinescu.**
16:45	17:00	Turbulent mixing in curved channels. F. Campomaggiore; V. Armenio; S. Lanzoni.
17:00	17:15	Velocity features in ice jammed bridge piers. I. Carnacina.
17:15	17:30	Local scour around long vertical wall abutments and the phenomenology of turbulence. F. Coscarella; C. Manes; R. Gaudio.
17:30	17:45	Physical modelling of flow and geomorphological conditions along an arched bridge with a scoured abutment. G. Gilja; M. Valyrakis; P. Michalis; D. Bekić; N. Kuspilić; E. McKeogh.
17:45	18:00	First results on the effect of particle shape on sediment transport. R. Jain; S. Tschisgale; J. Fröhlich.
18:00	18:15	Internal structure of flow past a bar in a gravel stream. A.M. Ferreira da Silva; M.S. Ahadi; A. Button.
18:15	18:30	Towards a characterization of turbulence structure in hydraulic jumps BIV imaging method. J.T. Garcia; A. Vigueras-Rodríguez; L.G. Castillo; J.M. Carrillo.

Towards a characterization of turbulence structure in hydraulic jumps by BIV imaging method

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ABSTRACT
An experimental campaign based on Bubble Image Velocimetry (BIV) is presented in the highly aerated mixing layer zone of hydraulic jumps with Froude numbers in the range 4.9-8.0. Turbulence dissipation is calculated and being presented the first results.

1 INTRODUCTION

The BIV technique was first introduced by Ryu et al. (2005) to measure velocity field in high aerated flows from backlit images analysis without the need of laser. Bubbly flows are illuminated from behind by a uniform light source while high speed camera captures shadow textures created by gas-liquid interfaces (Muste et al., 2017). The depth of field is limited, so objects appear sharp only in a few centimetres. This technique has been already used to measure the flow structure in hydraulic jumps in aerated zone by Lin et al. (2012). In their study, turbulence intensity, Reynolds stresses autocorrelation function and power density spectra were presented.
Turbulence characteristics of hydraulic jumps have been studied in non-aerated low Froude hydraulic jumps with MicroADV devices by Liu et al. (2004). The dissipative eddy size was calculated by using Kolmogorov theory of local isotropic turbulence.
Turbulence parameters have been studied extensively to understand dissipation process along hydraulic jumps that contributes to a better design of hydraulic structures (Castillo, 1987; Nezu & Nakagawa, 1993). This work presents the first results of the experimental determination through Bubble Image Velocimetry of turbulence structure in the highly aerated mixing layer zone of totally developed hydraulic jumps. Hydraulic jumps analysed have their Froude numbers in the range 4.9-8.0.

2 EXPERIMENTAL SETUP

Tests are carried out in a flume of 12.5 m long and 0.31 m wide. Flow rates are in the range of Q = 11.52-16.66 l/s. The hydraulic jump tested are totally developed. Table 1 summarizes their main characteristics, where h_1 and h_2 are the upstream and downstream water depth, respectively.

Table 1. Details of the experiment campaign

Run	h_1 (mm)	h_2 (mm)	Q (l/s)	Fr (-)
1	23.0	144.5	16.66	4.9
2	13.0	120.0	11.52	8.0
3	17.5	130.0	14.44	6.4

A high-speed camera FASTCAM SA3 Model 120K (Photron Limited) was used with the following setting: a zoom lens with 60 mm focal length by Nikkor, lens aperture f/5.6, 128x128 pixels resolution, 8 bits→255 shades and a horizontal distance from the camera to the hydraulic jump of around 1.50 m.
Illumination of experiment was reached with 8 regular 800 w light bulbs with reflecting mounts in front and back of the flow (Lin et al., 2012). The speed camera used was 1,000 Hz; the pixel dimensions are 0.00017 m/pixel. Frames were taken at several sections of the hydraulic jump and at different flow depths. They were analyzed in consecutive pairs by cross-correlation algorithm in an interrogation area of 64 x 64 pixels with sub-windows of 32 x 32 pixels in a single pass search and overlapping of 50% (Adrian and Westerweel, 2010). No background slide subtraction or noise remove techniques were applied. The PIVlab 1.41 software was used for the cross-correlation. This program is an open-source time-resolved particle image velocimetry tool in MATLAB® (Thielicke and Stamhuis, 2014). Each test was repeated three times. Round 80,000 images were recorded each time.

3 RESULTS AND DISCUSSION

In the different sections measured, similarity law of averaged and longitudinal velocity is calculated. Results are in agreement with Lin et al. (2012). One-dimensional power density spectra of longitudinal velocity component, $S_{uu}(f)$, are calculated in the frequency field. Data tapering and averaging techniques are applied to spectra calculation to reduce bias and variability, respectively (Muste et al., 2017). Then, the spectral power density is approximated by a potential function (Pope, 2001; Vigueras-Rodriguez, 2008). At each measured point, it is studied where the flow remains isotropic and where bubble turbulence is additive to wall turbulence (Michiyoshi et al., 1986; Shawkat et al., 2007). The measured flow characteristics also include statistical quantities such as turbulence intensity, Reynolds stresses, probability distribution function, skewness and flatness factors and autocorrelation function. Figure 1 presents the power density spectra at two measured points.

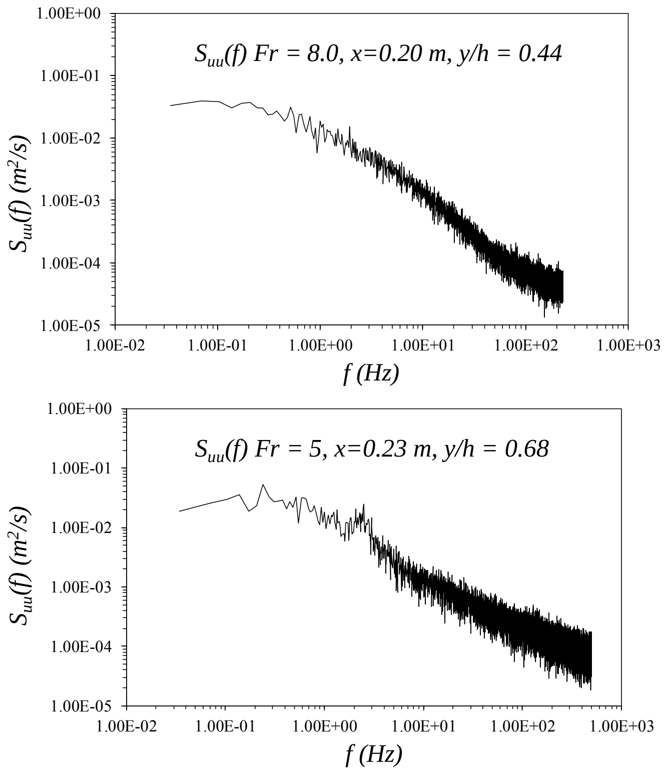

Figure 1. Power density spectrum of the longitudinal component of the velocity in the mixing area.

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