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Application of the entropic approach to estimate the mean velocity: analysis in laboratory flumes for different planimetric configurations

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The entropy model developed by Chiu (1988) allows to correlate the mean velocity, um, and the maximum velocity, umax by means of a linear relationship, um, = Φ (M) umax, which depends on the entropy parameter, M, characteristic of the fluvial section. This formulation was tested on several natural streams with different hydraulic and geometric characteristics (Ammari et al. 2010, Moramarco et al., 2004; Moramarco and Termini, 2015). In this paper, attention is focused on the verification of the entropic relationship between the mean velocity and maximum velocity for different planimetric channel configurations (rectilinear and curvilinear) and in the presence of forcing elements such as the curvature of the channel and the bed deformation. The analysis is conducted with the aid of experimental data collected in laboratory channels produced at the Department DICAM University of Palermo.
The results have shown that the linear relationship between the mean velocity and the maximum velocity, defined by the entropy model, remains valid in high curvature channel in which the effect of the secondary circulation is significant. In particular, only as the effect of the channel's curvature (i.e. in absence of the bed deformation) the value of Φ(M) is similar to that obtained in straight channels, for different conditions of roughness of channel's walls. In deformed-bed condition, the Φ(M) assumes a value lower than that obtained in flat-bed condition. This could be due to the fact that the bed topography enhances the convective pattern of flow, determines an increase of the bed roughness and the change of the vertical profile of the longitudinal velocity.

References

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