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Experimental analysis of turbulence characteristics and flow conveyance effects in a vegetated channel

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Natural rivers are characterized by a strong hydraulic and geomorphic complexity. Many studies conducted in this field (Malthus and Mumby, 2003; Muhar, 1996) show that the accurate estimation both of the river morphological changes and of local hydraulic characteristics of flow (i.e. the local flow velocities and water depths) is necessary for the restoration and protection of biodiversity.
Vegetation is a key factor to analyze the interrelated system of flow, sediment transport, and morphodynamic in rivers (Tsujimoto, 1999; Maione et al., 2000). On one hand, some kind of species of vegetation affect the habitat conditions, being crucial to the maintenance of biodiversity (Larkum et al, 2004); on the other hand, effects of vegetation on flow velocity are significant and are of crucial importance for stabilizing sediments and reducing erosion along the channel. In particular, it has been generally agreed that vegetation increases flow resistance and modifies sediment transport and deposition (Tsujimoto et al., 1996; Yen 2002).
The analysis of the hydrodynamic conditions in vegetated channels is complex because vegetation is flexible in varying degrees and it oscillates in the flow changing position. Furthermore, because of temporal changing of roughness due to natural vegetative growth, the response of vegetation to the flow can change in time. In this paper the flow over real flexible vegetation is experimentally studied. A 2D-ADV (Acoustic Doppler Velocimeter) is used to measure the local flow velocities, for different vegetation concentrations and varying the discharge and the flume slope. The influence of both vegetation concentration and depth/vegetation height ratio on the measured velocity profiles is analyzed. The comparison between the velocity distribution and the turbulence intensity distribution is also presented. The spectral analysis is operated in order to verify the formation of turbulence structures inside the vegetated layer and the flow conveyance effects are also analyzed.