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2D non-intrusive measurements of dam-break waves in channels with movable bed and width variations

Sergio Martínez-Aranda, Adrian Navas-Montilla, Ignacio García-Palacín, and Pilar García-Navarro
University of Zaragoza, LIFTEC-CSIC, Spain (sermar@unizar.es)

Dam-break waves cause important morphological changes in channels with erodible bed as a consequence of the high velocity of the fluid and the resulting sediment transport process. These morphological changes have been experimentally studied mostly for the case of prismatic rectangular cross-section channels [1,2]. However, in nature, channel width variations are ubiquitous and two-dimensional effects play a key role on the dam-break wave propagation and the erosion-deposition patterns developed on the mobile bed. Understanding the effects of both channel geometry variations and erodible beds on the dam-break wave advance can help to design more efficient response tools for real flood events.

In this work, a recently proposed experimental technique [3] has been used to characterize the temporal evolution of the 2D water free-surface of dam-break waves over an erodible bed made of non-cohesive uniform sand, propagating along a laboratory channel with different width variations. A RGB-D sensor (Kinect, Microsoft, 2010) performed instantaneous two-dimensional measurements of the transient water surface height distribution during the wave propagation. This device records the distance to the water free-surface using an infrared light projection technique with 30 Hz acquisition rate, 1.4 mm spatial resolution and 1-2 mm precision approximately. An ad-hoc C++ code allowed us to reconstruct the transient 2D water surface level evolution. For each channel geometry tested in this work, three consecutive dam-break waves were measured, starting from a flat bed condition. After each wave, the bed surface distribution was also recorded using the same RGB-D sensor in order to determine the morphodynamical substrate evolution. Results for both the free-surface and the bed evolution have also been compared with those obtained for rigid bed conditions with the same channel geometry. We found that the channel width variations play a key role on the erosion-deposition patterns developed due to the dam-break wave propagation.

References

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