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Solid Earth Discussions

Interactive comment on "Optical method for measuring bed topography and flow depth in an experimental flume" *by* A. Limare et al.

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General comments : This is an interesting methodological paper presenting the concepts and existing methods of surface digitization based on a moire approach, and illustrates how this method could be used to measure mm-scale water depth and channel bathymetry at high precision and fast acquisition rate in micro-scale flumes. It will certainly sparks interest amongst geomorphologists interested in experiments, and as such this paper deserve publication. Yet, I think it could be significantly improved in order to better convey its message to its targeted audience. First, it is important to emphasize that there is no new software or algorithm development in this paper. The first generation of 'simple' moire approach used by this team has been presented in earlier work (Lancien et al. 2005, Meunier, 2004), and the data presented in this work have

been obtained with a commercially available software (that I'm also using). Hence, the real novelty (and a very important one) is the demonstration that this method can be used to measure mm-scale water depth and topography/bathymetry within a few minutes. Yet, the manuscript lacks a proper analysis of the precision and resolution of the method for both the topographic measurement and water depth measurement (see specific comments). In the end, this is all that matters for experimental geomorphologists, not the details of the moire mathematics (that can be found in existing material).

Specific comments :

+ I find the presentation of existing methods interesting and relatively complete. I note that our group has ceased to use laser systems since 2003, and have used another commercially available moire system (GOM), much more precise than Light3D (surface noise < 0.1 mm) and able to deal with extremely large slope (it is a full 3D system), but also 10 times more expensive that Light3D ! Example of papers using this system (Turowski, Lague et al., 2006; Bonnet 2009). Also, we have recently published a paper in which we use underwater moire to document real time bedform dynamics (Dreano, Valance et al. 2010) which is to my knowledge the first published work in geomorphology using the Light3d package.

+ I find the paper completely unbalanced between a very long presentation of the moire method in which there is strictly nothing new, and its application in the context of micro-scale flume modelling and the capacity to resolve water depth and topography measurement. Simply put, I find p.191 to 195 almost completely useless with respect to the objective of the paper. It's nicely written (and could maybe, if condensed kept as an appendix in which proper references are given to original work), but there is a big risk that it will rebuke non-mathematically wary readers to go on to the important stuff that arrives only on p 197 (influence of water) and then experimental results.

+ The most important aspect missing (but easily corrected) is the lack of a proper evaluation of the precision and resolution of the method. Light3d is not completely

perfect and there's is always some level of banding present in the digitized data (it can be seen in fig 4b for instance, and would probably appear if a channel profile was presented). This corresponds to a structured noise which needs to be properly assessed (and which can be annoying (as noise can be...) when calculating slopes). I suggest :

oo a simple analysis of the distribution of residual noise of a perfectly flat surface (and an assessment of whether it is uniform or not at the scale of the experiment would also be useful).

oo the comparison between detected change and known one (by using displacements of the complete surface by 1 mm steps for instance)

oo the comparison between known water depth and measured ones up to several mm to see how deep the method could be applied before a correction needs to be applied. The presentation of the pdf in fig 6 is not really useful as it is made on a rough surface. I note that in our use of light3d in (Dreano, Valance et al. 2010) under 3 cm of water, we use a (conservative) 1 mm std deviation for noise.

+ The presentation of the actual setup should not be in the experimental results (part 3), but in a specific part in which the above accuracy analysis could be performed as well as general comments on the speed of the acquisition process with typical interval times.

+ A proper discussion-conclusion of the advantage and downside of your method for water depth and topographic calculation should be introduced in particular with respect to recent work by Huang et al. (2010).

Minor comments :

p190,#7-10 : 3D moire system GOM has been used by the Rennes group since 2004 (see first comment above).

p190,#17-20 : (Dreano, Valance et al. 2010)

p198 : Experimental results : the setup description should not be here but in its own section.

p199,#1 : tank tank

p199,#26 :in is -> it is

p200,#19 : I don't exactly see how the pdf adds more than the dem and the water depth map (given that there's a scale on it). Choose different line thickness or style as in BW the curves cannot be distinguished.

p200,#23 : this approach is too coarse to get a proper estimate of the uncertainty in water depth measurement. You need to use water tanks with known water depth to demonstrate that you can resolve water depth, and to give an idea of the uncertainty in this measurement.

p201 #23 : mm scale features : without knowing the actual measurement noise, it is hard to tell if it's noise or true geomorphic features.

p201 #26 : can inform -> can improve

Good luck for the revisions.

references :

Bonnet, S. (2009). "Shrinking and splitting of drainage basins in orogenic landscapes from the migration of the main drainage divide." Nature Geosci 2(11): 766-771.

Dreano, J., A. Valance, et al. (2010). "Experimental study of sediment flux controls on transient and steady-state dynamics of bedforms in supply-limited conditions." Earth Surface Processes and Landforms.

Turowski, J., D. Lague, et al. (2006). "Experimental Channel Response to Tectonic Uplift." Journal of Geophysical Research 111.

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