

Response to Referee 2

Dear Dimitri Lague

Thank you very much for reviewing our paper and for your very interesting remarks. Please find enclosed the response to your comments.

On behalf of all authors,

Angela Limare

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- Your comments are italicized and addressed.

First, it is important to emphasize that there is no new software or algorithm development in this paper.

It is true, but this paper was meant to be a "method" paper, since the software used (Light3D) is not an "out of the box" method, mainly for water depth measurement.

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).

Details about the resolution and precision are added (See figures 1 and 2).

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 than 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.

ATOS scanner does not belong to the class of moire methods, since it does not use structured light. Nevertheless its resolution is impressive as well as its price. The

advantage of using structured light is that one can also have access to water depth, which we do not think it is the case for stereo camera systems such as ATOS from GOM.

Thank you for bringing to our attention the paper of Dreano et al, 2010 that shows the first results obtained with this 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 is nicely written (and could maybe, if condensed kept as an appendix in which proper references are given to original work)...

Both Steve Cochard and the first referee suggested that more details should be added to this part contradictory to your statement. We indeed feel that a simple, accurate introduction to the method should be available to an audience that will not read specialised books. But if the editor decides, we will put this part into an appendix, and modify the paper accordingly.

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 is always some level of banding present in the digitized data ...

You are perfectly right: the residual modulation always exist and can be estimated as it is shown below:

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).

In order to obtain a perfectly flat surface we use milk, that has the advantage of being opaque and of white colour. Figure 1 shows the results obtained as a difference of 2 levels of milk. One can also see the bubbles that existed on the first surface (black marks) and on the second surface (white marks). Except for the bubbles zone, the surface was perfectly flat, and the "residual" modulation still visible. The milk depth

level measured on the flat zone has a value of 2.42 mm with a standard deviation of 0.02 mm.

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

Figure 2a shows the relief obtained with our reference scale. One can also notice the shadow zone behind the object, and the black zones on the top of it where a slopometer is mounted on. The first stair is 10mm high and the 5 others are 2 mm high. A cross section passing through the well demodulated part is shown in Fig 2b. As one can notice the stairs are well resolved. The noise measured on each stair and on the flume board is about 0.1mm.

+ 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.

Since this was already suggested by both Steve Cochard and referee 1, a subsection describing the software and the calibration procedure was introduced at the beginning of the Experimental results section. The two figures shown below and their description will be added to this part to show the capabilities of the method.

+ 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).

We agree that the only comparable study is the one of Huang et al 2010 and we will insist on the comparison with their experimental approach. The resolution on both topography and bathymetry are similar to ours', but these two types of information do not come from the same type of method and they have to be spatially synchronized, which is not trivial.

+ 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

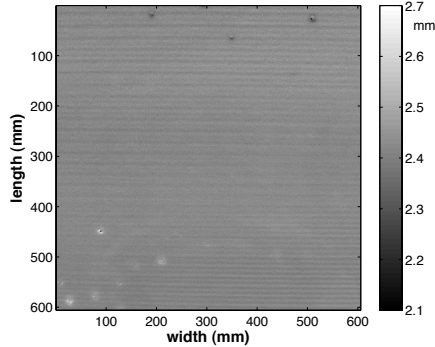


Fig. 1. Relative topography between two milk level surfaces

measurement.

We do not agree with this comment, since the uncertainty on the water level is the same as on the topography, provided that water refraction is taken into consideration properly (eq. 12 in the original submitted paper). This is facilitated in our case by the fact that our experiments are conducted under laminar conditions and the slopes are small without steep variations, so that water free surface can be considered uniform and parallel to bed surface at the scale of moire fringe.

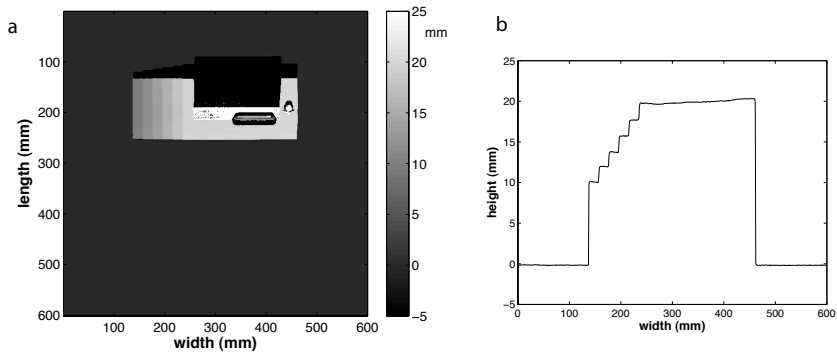


Fig. 2. Topography of a stairs object (a). Cross-section through the object obtained at a length=230mm (b)