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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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Dear Members,

Please, let me share some thoughts on the article Optical method for measuring bed topography and flow depth in an experimental flume. The technique used in this article is interesting and represents an improvement of the setup proposed by Huang et al. (2010). Instead of using a laser line to scan the bed topography, the authors used a 2d pattern projection technique (referred as a Moiré projection in the paper).

To be complete the paper, to my opinion, should include the following elements;

- A description of the Moiré interferometery is given in section 2.1, but it is far from

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clear if it is the technique used to create the fringe pattern projected onto the surface;

  - If the fringe pattern is created by a Moiré interferometry technique, why using a projector instead of a strong light source, such as a laser? If a digital projector is used, as mentioned in Figure 1, why not directly projects a cosine fringe pattern instead of trying to create a Moiré pattern?
  - If the projector projects a cosine fringe pattern, why describing the Moiré technique?

- Equ 1 is usually written as: $I(x,y) = r_k(x,y) \cdot [a(x,y) + b(x,y) \cdot \cos(\theta)]$ where r is the surface reflectivity.
- The last paragraph of Section 2.1 describes the projection as a grating of parallel lines' which is in contradiction with what is described at the beginning of the same section.
- Section 2.2 should be renamed 'Fourier Phase Profilometry' (FPP) (Takeda et al. (1982)).
- Section 2.2. One of the major drawback of the FPP, used with the describe setup, is the change of frequency of the projected pattern along the projected plane. If the projected phase is not corrected to produce a constant recorded phase by the camera, the Inverse Fourier Transform only give an approximation of the phase and therefore of the height to be measured. The frequency of the carrier phase should be at least one order of magnitude higher than the frequency of the object to measure. On a more general note, and as mentioned by the authors, the FPP should only be used in real time application where speed is more important than accuracy. It is not clear how Breque's method (Berque, 2004) overcomes this problem.

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- A much more efficient way to retrieve the phase from one image than the FPP is to use a Local Wave Retrieval method (Liebling, 2004). This technique is extremely robust to any change of the carrier frequency.
- Section 2.3. It is truly disappointing that the work done by Ghiglia et al. (1998) on phase unwrapping is not recognised and mentioned. Phase unwrapping is usually more complicated than just adding plus or minus 2 pi at every discontinuity. As singularities arise with noise of shadow, the unwrapping process becomes complex.
- The last paragraph of page 194 describes a technique developed by Huntley et al (1997) and usually referred as 'Temporal Phase Unwrapping'.
- The reasons behind the choice of algorithms selected to retrieve the phase and to unwrap it are not discussed.
- Section 2.7. The hypothesis that the free surface is parallel to the bed can/should be discussed. Wouldn't it be preferable to used the same apparatus than Huang (2010) to estimate the fluid height and therefore compute the water height, which would in turn allow the free surface and the reflection to be computed, and then compute the bed topography ?

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2. M. Takeda, H. Ina, and S. Kobayashi. Fourier-transform method of fringe-pattern analysis for computer-based topography and interferometry. Journal of the Optical Society of America, 72(1):156 - 160, 1982.

3. D. C. Ghiglia and M. P. Pritt. Two-dimensional phase unwrapping: theory, algorithms, and software. Wiley-Interscience. Wiley, cop., 1998. ISBN 0-471-24935-1.

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Best regards,

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