Earth Surf. Dynam. Discuss.,
https://doi.org/10.5194/esurf-2018-45-RC2, 2018

Earth Surface Dynamics Discussions

Interactive comment on "Short Communication: Challenges and Applications of Structure-from-Motion Photogrammetry in a Physical Model of a Braided River" *by* P. Leduc et al.

Anonymous Referee #2

Received and published: 3 August 2018

In this short communication, the authors detail Structure-from-Motion photogrammetry methods related to topographic measurements in a braided river flume experiment. The authors utilize automated batch processing to expedite creation of digital elevation models (DEMs) and provide a sampling of potential further analyses including the calculation of erosion and deposition using DEMs of difference (DoDs) and estimation of water depths. This study extends previous research on using Structure-from-Motion photogrammetry in laboratory flume settings and provides important insight that is relevant for researchers involved in similar physical experiments. The paper is straightfor-

ward, logically organized, and easy to read. However, there are a few issues that need clarification or addressing.

My primary concern is with the "error quantification" in Section 3.1. In subsection 3.1.1 DEMs derived from duplicate photosets of the same surface are compared to "estimate the mean and standard deviation of the vertical error" (P4, L7), while the comparisons of non-changing areas in subsection 3.1.2 are used to "estimate vertical precision" (P4, L15). I would consider the former to be a measure of precision also, rather than "error." The use of the term "error" conveys the idea of comparison to a standard, or a measure of "trueness", while these comparisons are between two surfaces of unknown accuracy. Subsection 3.1.3 does provide potential for actual error estimation, but the reported accuracy of the hand-held laser is not stated. A rewording of the parameters being estimated and quantified by the authors could strengthen section 3.1. I have more comments related to this section that will be included below.

Other comments:

P2, L13: Please also include the geometric standard deviation of the grain size distribution.

P3, L6: The guidance I have seen suggests having stationary lighting sources rather than one that moves with the camera (e.g., the camera flash). This does not seem to have negatively affected your results, but it is counter to general guidelines.

P3, L18: Was there general consistency in the density of the SfM point clouds? How did the point spacing compare to the DEM cell size and what was the interpolation method used to generate the DEMs?

P4, L6: Please clarify, were the two photosets each made up of $\sim$ 100 photos (mentioned in P2, L24)?

P4, L9: Was there a spatial pattern to the differences in the DoD maps (e.g., greater differences in areas with more complex topography)?

P4, L12: Were there any steps taken to ensure that the comparison to the DEM from the previous time did not include an area where geomorphic change may have taken place?

P4, L18: The analysis in section 3.1.1 seems to be a better estimation of the "overall DEM noise" as the entire DEMs were used (< 1 mm, Table 1). Section 3.1.2 is a more localized analysis of DEM noise, where the greater variability ($\sim$1 mm, Table 2) may be attributable to the featureless nature of the areas in the images used to generate the elevations of those "non moving, flat areas". The analysis is this section does nicely highlight the effect of data collection improvement by the reduction in mean differences in Table 2.

P4, L21: What is the manufacturer/model of the laser scanner? What is its reported accuracy?

P4, L22: How were the scanner data oriented in real world coordinates? How did the point density from the laser scanner compare with SfM point density?

P5, L1: Was there any spatial pattern to the differences in the DEMs? What was the nature of the 30 cm x 39 cm area scanned (e.g., with or without channels/complex topography)?

P6, L5: What were Photoscan's estimates for target errors? Were they consistent through time, or did they also improve?

P6, L14: The combining of DEMs described in subsection 3.1.1 is not derived from a single set of images. I'm not sure the last sentence of this paragraph is necessary or meaningful for how the data were processed.

P6, L17: What are the specs of the machine used for processing (e.g., CPU, RAM)?

P7, L13: I suggest citing Wheaton et al. (2010a) and/or Wheaton et al. (2010b) in reference to Geomorphic Change Detection.

P8, L6: Here you say images were collected in final minute of each experiment, but earlier (P6, L16) you say it took 15 minutes to collect the imagery?

P8, L10: How did derived depth maps compare with visual observations? Figure 7 looks like a single-thread channel. Was that the condition of the flume, or were there many other threads below the threshold of detection?

P8, L11: Possibly make a recommendation or two for future development to improve your method.

P9, Figure 8B: Consider presenting the grain size data as a semi-log plot.

P12, L3: Please consider making your processing scripts (Python and Scilab) available also. You may be interested in also creating an entry on your methods/setup/equipment on Sediment Experimentalist Network (SEN) Knowledge Base (http://sedexp.net/).

Editorial comments:

P1, L22: "recent reports show the SfM techniques. . ." should read "recent reports show that SfM techniques. . ."

P2, L12: "2.71 s-1" should be "2.71 m3s-1"

P4, Table 1 caption: "duplicates DEM" should be "duplicate DEMs"

P5, Table 2 caption: I think "Vertical precision" would be a more accurate description than "vertical error"

P5, L7: "Table 1" should be "Table 2"

P6, L12: "the focus as improved" should be "the focus was improved"

P9, L17: "different grain size" should be "different grain sizes"

P11, L5: "precision of the order" should be "precision on the order"

References:

Wheaton, J. M., J. Brasington, S. E. Darby, and D. A. Sear (2010a), Accounting for uncertainty in DEMs from repeat topographic surveys: improved sediment budgets, Earth Surface Processes and Landforms, 35 (2), 136-156, doi:10.1002/esp.1886.

Wheaton, J. M., J. Brasington, S. E. Darby, J. Merz, G. B. Pasternack, D. Sear, and D. Vericat (2010b), Linking geomorphic changes to salmonid habitat at a scale relevant to fish, River Research and Applications, 26 (4), 469-486, doi:10.1002/rra.1305.

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