Interactive comment on "PyTrx: A Python toolbox for deriving velocities, surface areas and line measurements from oblique imagery in glacial environments" *by* Penelope How et al.

Anonymous Referee #1

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The authors describe a toolbox for terrestrial photographs directed towards tidewater glacier outlets. It is a combination of personal best practices of the authors, combining different procedures to extract products from these data. Their targeted audiences seem to be students interested in glaciers, without prior knowledge of computer vision nor photogrammetry.

In the wake of open source movements, and the quest for reproducible results the objective of this paper is clear. However, the implementation seems incomplete.

If the intended audiences are students, the implementation has serious limitations. Processing of data can be done with PyTrx, but understanding of the limitations might

not be gained. For example, the velocity estimation is based upon optical flow. This technique (especially the Lucas-Kanade implementation) is highly sensitive to intensity changes. When no movement is present, it can still produce velocities due to overcasting. The weakness in this work is that the authors apply histogram equalization, hereafter optical flow is computed.

If the intended audiences are peers, and the toolbox should be seen as a benchmark to build upon, its structure is limited. In such a case one should expect a modular framework where different methodologies can be interchanged. Now, the processing pipelines of the authors are the only pathway, which might not work for other datasets. For example, the supra glacial lake detection is very simple, while more advanced methods already exist (Koschitzki et al. 2014).

Furthermore, a camera calibration procedure is missing in the toolbox, which makes the toolbox appear incomplete. The paper is similar to (Messerli & Grinstad, 2015), therefor the question arises why the authors do not build upon this effort, and instead a new toolbox is introduced. Furthermore, the presented workflow is based upon methodologies used by the authors for other publications. These methodologies are around for quite some time, and thus the presented work does not advance the field nor does it provide new insights.

Another design issue might puzzle the reader, as the objective of the authors is a toolbox for the glaciological community. However, the implementation is very algorithmic based; the authors implement a sparse point cloud. This will result in a scattered data collection of different locations in space and time. While for modelling a fixed coordinate system would be more sufficient, as in (Ahn & Box, 2010). Also an error budget for the 3D transformation is missing, which in the terrestrial setup this scales with distance, see for example (Schwalbe & Maas 2017).

Lastly, there is a strong tendency towards referencing to Szeliski, which is a book of references, and a Python image processing book of Solem. Off coarse the authors

describe known methodology, but it might have been a bit more specific.

If the former points are implemented it might be a worthwhile contribution. However, this is substantial and asks for a complete restructuring of the toolbox.

minor comments:

p1 l19 "More toolboxes are therefor needed", I disagree with this argument. It is more worthwhile to extent on previous efforts; open codes are available for Imgraft as well as, photogrammetric libraries such as Ames SP and MicMac.

p2 l4 "measurements from photographs" too vague

p2 l5 "photogrammetry" or do you mean signal processing?

p2 l17 "efficient photgrammetry software", to what extent is PyTrx efficient, there is no emphasis placed in the text about it (batch, multithread,...)

p2 l29 maybe change title to put also an emphasis on monoscopic.

p10 l7 "Matlab Computer Vision toolbox", why is camera calibration not included into PyTrx?

p12 l9 Why do the authors not use simple functions, this will increase the versatility of the toolbox.

p14 l2 Why is there manual inspection? Typically, a dataset has a training and a testing set. Hence, why does PyTrx have not the ability to make a "ground truth" and then different methodologies can be tested. This reduces the subjectiveness of manual inspection.

p14 l11 Why not use the HSV space?

p15 l6 the advantage of Shi-Tomasi is its computational efficiency: the determinant does not have to be calculated

p15 l17 Why are sparse point clouds used, and why if (Szeliski) is cited consteantly,

his adaptive region based selection isn't used? Also, I think most products are more helpful if consistent data points are used, then scattered features, seen throughout a scene.

p17 l5 This is by no means new, the authors might have missed to include (Scambos et al. 1992) & (Jeong et al. 2017).

p22 l2 "proves to be robust" loose claim, see testing/training comment above

p22 l11 this backtracking is a relative error. The authors talk about the alternative approach, as implemented by the other toolboxes. These use Monte-Carlo which is an efficient way to grasp propagations of errors, especially in this non-linear system. Thus the authors know of this technique, but implement an inferior method. Why is this done?

p22 l25 "toolboxes to choose from", I don't think it is very efficient as a field to have several implementations. All implementing their own best practice, how do the authors see this as a pro?

Schwalbe & Maas. 2017. The determination of high-resolution spatio-temporal glacier motion fields from time-lapse sequences

Jeong et al. 2017. Improved multiple matching method for observing glacier motion with repeat image feature tracking

Messerli & Grinstad. 2015. Image georectification and feature tracking toolbox: ImGRAFT

Koschitzki et al. 2014. An autonomous image based approach for detecting glacial lake outburst floods.

Ahn & Box. 2010. Glacier velocities from time-lapse photos: technique development and first results from the Extreme Ice Survey (EIS) in Greenland

Scambos et al. 1992. Application of image cross-correlation to the measurement of

glacier velocity using satellite image data.

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