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Geoscientific Instrumentation Methods and Data Systems Discussions

Interactive comment on "Automatic detection of calving events from time-lapse imagery at Tunabreen, Svalbard" *by* Dorothée Vallot et al.

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a) In machine vision, a camera should be always calibrated unless it is unfeasible. In this situation, I would strongly recommend calibrating the camera to identify the intrinsic camera parameters such as focal length, principle point and lens distortions. By failing to due so the results can have significant different results when used for sizing. Camera calibration is a standard method available in many software packages like matlab, opencv, etc.

This work has been done for the camera used in 2015. The intrinsic focal length is the one used in the article. The images have though not been corrected for distortion because the effect of lens distortion error on size calculation is neglectable as written

in the text: "Lens distortions are neglected here. Given the radial distortion coefficients of the lens, the focal length and the pixel size, the distortion error for the front pixel situated the farthest from the camera was smaller than 0.2 In 2014, this work has not been done and it would be difficult to proceed as the checkerboard pattern should be placed in the distance equal to the distance of the actual observed object. The distance between the camera and the glacier front is estimated from satellite imagery with low resolution. The error is already large compared to the calibration error.

However, this is an important step that we are adding to the text: "Calibration is an important step, particularly when working with sizing, that permits to retrieve intrinsic parameters of the camera. This work has been done in 2015 but not in 2014 and should be systematically used in the future."

b) Image registration works best if the camera is calibrated and lens distortions were removed from the images. Otherwise, the affine transformation must consume the lens distortion with its free parameters resulting to less accurate registrations.

See answer to question (a).

c) For the sizing it is important to find a virtual plane which approximates the surface in question as accurate as possible. Here, it might be useful to have several sections like in Figure 10 and approximate one plane for each of this sections. If the plane parameters are known precise sizing can be performed independently of the camera orientation by back projection (Homography). At the moment there are several assumptions about the orientation of the camera in respect to the calving front which are not always maintained.

This is true that the calving front orientation has an important influence on the calving size calculation. We believe this is taken into consideration when the front delineation and the projection of image pixels into this front is done. The real pixel area is the product of the projected length of the pixel in the horizontal direction, d_X^i, and the projected length of the pixel in the vertical direction, d_Z^i. We add this sentence: "We need to determine the size of the projected pixel on the front in the horizontal direction, d_X^i, which depends on the orientation of the front, and the size in the vertical direction, d_Z^i, which depends on the camera position height, assuming that the front is vertical. "

Outlook: Deep learning is nowadays major enough to be used as a engineering tool for labelling tasks using images (matlab / opencv etc). This requires large labeled datasets for training but it seems they are available for this particular use case. This would improve the segmentation of the calving front. Here, the network can also learn how to deal with different weather conditions and remove unknown objects (birds ...).

Deep learning is a potential method to segment glacier front from other regions. However, we found some potential issue with that method. It is relatively easy to separate glacier front from other regions, such as rock, soil, water etc. But, separating the front from the top part of the glacier is not easy since both parts look similar, visually and texturally. An experiment with some classifiers to segment glacier front didn't show satisfying results. All methods failed to separate glacier front and top, especially around the boundary of those regions. It would also require a powerful machine (and powerful graphic card) and resource. Nevertheless, the idea should not be abandoned and could be the subject to further improvements. We could also imagine to determine cases where each method works best.

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