Earth Surface Dynamics Discussions

Earth Surf. Dynam. Discuss., referee comment RC2
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Comment on esurf-2021-104

Anonymous Referee #2

Referee comment on "Time-Of-Flight monitoring reveals higher sediment redistribution rates related to burrowing animals than previously assumed" by Paulina Grigusova et al., Earth Surf. Dynam. Discuss., https://doi.org/10.5194/esurf-2021-104-RC2, 2022

The study illustrates an interesting application of time-of-flight cameras in geomorphology. Furthermore, it very well highlights the potential of custom build sensor systems with simple components (i.e. Pi) with full automatic/autonomous capabilities. The manuscript is well structured and easy to follow. I agree with the first reviewer that the already captured data entails enough novel information to present in ESurf. However, some issues regarding the methods should be addressed in more detail, which are displayed in detail below:

Chapter 1: What is actually a low-cost ToF? No prices (or at least rough estimates) are mentioned and therefore the statement low-cost is not possible to assess. The authors discuss the drawback of laserscanning, as being a lot more expensive. However, laserscanning also reaches a lot farther compared to the ToF cameras. Therefore, the types of studies that can be performed are not relatable due to the different observation scales. The authors miss mentioning time-lapse photogrammetry as another already applied low-cost (as even track-cameras might be used) topographic monitoring technique that can be applied at different observation distances and thus scales (e.g. James et al., 2014 and Galland et al., 2016 – volcanology, Eltner et al., 2017 – soil erosion, Mallalieu et al., 2017 – glacier, Kromer et al., 2019 and Blanch et al., 2021 – rock falls).

Line 162-165: I find the explanation of the pulsed ToF principle confusing. It should be added that the receiver is opening the first window simultaneously and synchronised with the pulse emission, i.e. the receiver opening the window with the same delta t as the emitted pulse. And then the second window is opened, for the same duration delta t, synchronised with the closing of the first window. Thus, the captured photon number (i.e. measured by electrical charge) in both windows can be related according to equation 1 (the higher g1 the shorter the distance) to solve for the distance, which can also be considered as solving for the phase shift and thus solving the ToF. Maybe, the authors can also shortly mention that in general the ToF cameras rely on the principle of measuring the phase shift and that there are different options to modulate the light source to be able

to measure a phase shift, e.g. the camera in this study using pulsed modulation.

Line 172-173: The spatial resolution also depends on the orientation of the camera. The more oblique the perspective, the more the variation.

Line 174-175: The point cloud can be both binary and encoded. The authors are actually describing a cloud stored in a binary format being transformed into an ASCII (?) encoded data format.

Line 176-179: As I understand this, the centre of the camera sensor defines the origin of the local, 3D Cartesian coordinate system?

Equation 2: What is actually wrong with the original Z-value? Are the authors aiming to transform the measurements to a local coordinate system, where the X-Y-axes are parallel to the soil surface (for the subsequent transformation of Z-values to a 2.5D dataset)? If yes, would a simple rigid body transformation not be enough? Furthermore, why is the distance of a distance, i.e. distance(y_1-y_i), calculated? Do you mean solely (y_1-y_i)? Also, if the authors refer to the distance of the origin, thus the radius, I would suggest to use r_{xy} (sqrt(sqr(x_1-x_i)+sqr(y_1-y_i))) instead of y. This causes confusion, as y is already explained as the y-coordinate. How did the authors calculate the angles and with what accuracies? This seems to be tricky in the field.

Equation 3: Why did the authors choose the scaling of 1 standard deviation and not e.g. 1,5 or 2?

Chapter 3.3: Why did the authors not compare the ToF data in the lab experiment with SfM (sub-mm accuracy at that close range possible) or a triangulation based LiDAR (µm accuracy possible)? Such references allow the assessment of spatially distributed errors or potential spatially correlated errors. If the authors use SfM they could have also done an accuracy assessment outside under the actual observation conditions.

Line 209-211: I understand that the authors average the data from several subsequent scans to reduce the noise, assuming a random (Gaussian distributed) error. However, in regard of the accuracy estimation, I would suggest to display the standard deviation, also spatially distributed, to get a better grasp on the variation of each scan.

Line 211-212: How did the author assure a smooth surface? What was the surface made of? I suggest, instead of using the standard-deviation of the Z-coordinate as error estimate (which will be overestimated if the surface is tilted), to fit a plane into the point cloud and calculate the distance to that surface to get the variation in the distance

measurements.

Line 223: Please, also display the standard deviation to assess the random error and potentially display a boxplot to better illustrate the inherent variability in your method as you have 45 measurements allowing for such a display.

Chapter 3.5: The choice of the parameters to derive the entrance or mound seem arbitrary. The motivation and reasoning for the choices as well as the defined thresholds should be explained in more detail.

Line 266-267: What is the spatial resolution of the DSM?

Line 274: Why 16 squares and what was their size?

Line 297-298: What is the standard deviation of the five scans? This could also be used to assess the accuracy of the measurements?

Line 323: Why five scans? Did the authors test that at this number, accuracy does not increase much more after averaging? Or is this due to storage or power consumption?

Chapter 3.7: How did the author ensure that there is no mixture/overlap of different processes, e.g. erosion due to rainfall happening shortly after digging?

Line 337: What machine learning algorithm was used? After checking the cited paper, I understood that an in the other study trained random forest was used again in this study. I would suggest to add this information; thus others can follow the manuscript without needing to check the references.

Equation 7: What is M? Did you mean Vol?

Equation 7-10: The authors observed the sites solely for 7 months and upscale then to yearly changes. Can this be done so easily. For instance, at the Mediterranean site at least a full year should be observed to capture all the seasons. For the desert site the observation period would need to be even longer.

Chapter 3.8: Did the authors perform any validation of their up-scaled data, e.g. by leaving out some samples for testing?

Figure 4: Please, also state the standard deviation because it looks high according to the scatterplot.

Line 590-592: Why would more sporadic measurements be less reliable? The cumulative signal can be more significant than the more frequent measurements with smaller signal to noise ratio.

References

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