



EGUsphere, referee comment RC2
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Comment on egusphere-2022-75

Anonymous Referee #2

Referee comment on "Size, shape and orientation matter: fast and semi-automatic measurement of grain geometries from 3D point clouds" by Philippe Steer et al., EGU sphere, <https://doi.org/10.5194/egusphere-2022-75-RC2>, 2022

This study proposed an approach to segment grains in 3D point clouds. Based on bare-terrain point clouds that only include grains and topographic flats, the authors initially utilized a watershed method to roughly segment grains. The initial segmentation sometimes resulted in an over-segmentation problem where some grains were falsely split to multiple parts. Therefore, they conducted three criteria to merge grains. Several operations cleaned noise points and detected topographic flats in point clouds. Two methods approximated ellipsoids from the segmented grains. They also presented histograms of geometric characteristics of the approximated ellipsoids. The first experiment examined the 3D grain segmentation method in synthetic data. They also tested their method at three field sites and compared the results with the Wolman method. The 3D grain segmentation method from this study is interesting and straightforward. Based on the two major assumptions mentioned in the paper, the method seems effective and novel. However, English writing is one of the biggest concerns of publishing this paper on ESurf. The paper is full of ambiguous verbs and redundant sentences such that the reviewer has to guess what the authors intend to convey. There are also many transition words misused in the paper.

This paper also does not provide enough research on the previous work about granulometry such as traditional granulometry and recent optical granulometry based on machine learning. Reviewing these studies and comparing them with the proposed method are important to illustrate the novelty or advantages of this study. Unfortunately, the literature review is limited. For example, watershed has already been widely applied to 2D grain segmentation in Bulter et al., 2001. Also, Garbonneau et al. (2018) and Langhammer et al. (2017) are recent machine learning based approaches for optical granulometry. The review of these important studies is missing in this paper.

One criticism of the proposed method is that it requires a trial-and-error step to decide the parameters, and the rubric of such exploration is unclear. This is another biggest concern of this study, because it is unknown when to stop such a trial-and-error step to get the best results. If the exploration is just based on visual results, the effectiveness and accuracy of the proposed method is doubtful. Additionally, if the proposed method needs to manually explore and test parameters, it should belong to semi-automatic methods. The authors should clarify these points.

This is an interesting and promising paper. The reviewer suggests the authors address the comments, rewrite the paper with formal, scientific language, and resubmit it.

The reviewer also has the detailed comments, concerns, and suggestions as follows.

Page 1 line 5-10: Please rewrite the sentence: "The grain-scale morphology of sediments and their size distribution inform on their transport history, are important factors controlling the efficiency of erosion and transport and control the quality of aquatic ecosystems."

Page 1 line 5-10: This is a redundant sentence: "In turn, constraining the spatial evolution of the size and shape of grains can offer deep insights on the dynamics of erosion and sediment transport 10 in coastal, hillslope and fluvial environments."

Page 1 line 20: in-situ is a misused word.

Page 1 line 25: it should be polygonal instead of polyhedral

Page 2 line 0-5: this sentence is confusing. Please clarify or rewrite it. "The size and shape distribution of grains in various natural environments can therefore be represented as an initial size or shape distribution, informing on fragmentation, weathering processes and on the structure of the rock mass (e.g., fracture density and orientation, mineral size)"

Page 2 line 20: untrue statement: "the 3D geometry of grains and their statistical distributions in natural environments remain poorly known." Either 3D geometry of grains or grain distributions have been researched. The authors should do more research on this.

Page 2 line 25-30: recent grain segmentation based on machine learning and UAS has been applied to a large scale (hundreds of meters).

Page 3. Please include more literature reviews as mentioned above.

Page 3 line 15-20: segmenting grains from airborne lidar is doubtful. Airborne lidar only has resolution of meters, which is much worse than SfM.

Page 3 line 25: actually what this study has obtained is histograms instead of distributions.

Page 4 line 0-5: it's good the authors mention the assumptions. However, another assumption is that there are no vertically stacked rocks.

Page 4 line 15-20: what is the context of "local minimum"? Because local minimum is used in optimization problems, the authors should clarify its usage or metrics here.

Page 4 line 20: missing introduction to the FastScape algorithm. E.g. How does it work? In the same sentence, "order" is an ambiguous word.

Page 5 line 1: as long as the neighborhood nodes of each node are known. Plural

Page 5 line 1: the 3D distance used in the method is unspecified. E.g. Is it Euclidean distance, Manhattan distance, or anything else?

Page 5 line 5-10: support or evidence is lacking to state "each grain is theoretically identified by a single watershed"

Page line 10: please specify the laptop configuration used in the study. E.g. processors, RAM, etc.

Page 6 line 1: the 3D angle is unspecified. Is it angle in degrees or radians, Euler angle, dot product, quaternion, or anything else?

Figure 2: the review suggests to include a detailed, zoom-in figure to demonstrate the merging results.

Page 6 line 15: not scientific writing: "If this initial segmentation is deemed satisfactory at first order, some minor flaws can lead to an inaccurate description of the geometry of grains and their size distributions."

Page 6 line 20: point cleaning process is conducted to remove segments with a few points. However, the abstract states the method is only limited to segmenting grains greater than one 3D point. These two are contradictory.

Page 6 line 25-30: please provide intuitive explanation of "a minimum or an intermediate singular value divided by its maximum singular value"

Page 8 line 25: If the constraint has not been considered in the fitting, then the fitting should be called quadrics fitting instead of ellipsoid fitting.

Page 8 line 25-30: support or evidence is lacking to state "Other ellipsoidal fitting algorithms exist, but this direct least-square approach was found to lead to the best solution."

Page 10 3 Result. The paper states the method can be applied to various point cloud sources including lidar. However, they haven't conducted any experiments on lidar. For example, airborne lidar has lower resolution. It is doubtful that their method can be applied to airborne lidar.

Page 12 line 5: It is unclear why the cuboids are used as ground truth.

Page 13 Figure 5 b) and c): the study sites for Wolman method and SfM are not the same. If the data sources are different, how can the authors guarantee it is meaningful to compare the grain segmentation results? Please clarify this point or consider the same area for the experiment.

Page 15 line 5: please explain more details about the Wolman sampling method. Is it a manual or automated method? Is it 2D or 3D?

Page 15 Figure 6: why are the results from Herault missing?

Page 17 line 5-10: another important reason to use "patch-scale" areas is that the proposed method is not effective for high-frequency terrains.

Page 17 line 5-10: It is doubtful that G3Point can be applied to large areas greater than 100 meter squares. There are many reasons. For example, the method is limited by the computer's RAM capacity. It is unclear how efficient the watershed algorithm is to segment 3D points. Its time complexity is unknown. Also, searching neighborhoods is also time consuming.

Page 17 20-25: untrue statement: "Point clouds obtained with LiDAR data provide better accuracy than SfM but can be associated to varying resolution, while the ones obtained by SfM provide uniform resolution but can lead to some inaccuracies." Only terrestrial lidar can have higher accuracy than SfM. UAS lidar or airborne lidar have worse local accuracy than SfM

Page 18 4.3. The comparison between previous 2D grain segmentation and the G3Point 3D grain segmentation is missing.

References

Butler, J. B., Lane, S. N., & Chandler, J. H. (2001). Automated extraction of grain-size data from gravel surfaces using digital image processing. *Journal of Hydraulic Research*, 39(5), 519–529. <https://doi.org/10.1080/00221686.2001.9628276>

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