

***Interactive comment on* “The Potential of Smartstone Probes in Landslide Experiments: How to Read Motion Data” by Bastian Dost et al.**

Anonymous Referee #2

Received and published: 29 March 2020

The manuscript entitled "The potential of Smartstone probes in landslide experiments: how to read motion data" reports data and results from a set of laboratory experiments, in which the movement of selected individual tracer stones within a landslide was recorded by means of a "Smartstone probe". The presented technology is interesting, and the manuscript shows the potential of this technology for analyzing the movement of individual grains within a granular flow. However, the manuscript focuses solely on the interpretation of the recordings and one of the main findings is that the technology requires further improvements. For example, the manuscript indicates that the system is not really stable (one sensor out of five did not work appropriately, and another produced false results). Moreover, the statements at L483 and following indicate that the data analyses need to be further improved and that the current analyses are, to

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some extent, premature. What is lacking, in my opinion, is how these data can be used to further develop theories regarding granular flows (the latter have not been reviewed in the manuscript). In this context, it is good to see that the technology advances and that it is shown how digitalization can be helpful to tackle complex problems, but the data needs to be analyzed accordingly so that the manuscript could be published as a research article. I would also like to note that, although the manuscript has been prepared with great care, the manuscript needs to be improved language-wise and stylistically, so that the contents becomes clearer. This becomes obvious from my large amount of detailed comments below. To summarize - the presented material is interesting, but I do not see substantial and original scientific results which warrant publication of the manuscript as a research article. In contrast, the manuscript "reports new developments, significant advances, and novel aspects of experimental and theoretical methods and techniques which are relevant for scientific investigations within the journal scope". This statement has directly been copied from the NHESS-website defining the manuscript type "Brief communication". These aspects are covered by the manuscript and I therefore recommend that the authors shorten the manuscript significantly and resubmit it as a brief communication.

Detailed comments - many of my comments highlight issues regarding the presentation of the material and the language - therefore not all of my comments are of major nature. Note also that I wrote the comments before finally recommending resubmission as a brief communication. Nonetheless, I decided to provide substantiate my above evaluation.

P1, L2: I am not convinced that every reader understands what is meant by external and internal information.

P1, L4: The first "internal" can be deleted.

P1, L6: "artificial laboratory-scale landslide" - artificial may be deleted

P1, L7-10: Is this detailed information really adequate for the abstract?

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P1, L11: I partly disagree with this statement - the movement of individual pebbles was observed with the Smartstone probe, but not the motion of 520 kg of the pebble material...

P1, L12: Which mass is meant - the mass of the pebble-material?

P1, L13-21: This is mainly a description of what has been done - what is lacking is a more generalized description of the results - i.e. the novelty aspect of the study should be better highlighted.

P2, L28: In my opinion the paper would benefit from additional considerations (including a review) on granular flow mechanics and how these can be described using the sensor data.

P2, L32: What is meant by "some depositional features"? A more general description of the landslide processes would be helpful.

P2, L36: What is meant by precess? Is "process" meant? I am also not sure that I understand what is meant here.

P2, L37: Include year for reference Okura et al.

P2, L38: My understanding of the word "collusion" seems to be different from the understanding of the authors. Maybe "collisions" is meant by the authors?

P2, L40: The authors use specific terminology which has not been defined before. As indicated above, a more general description of landslide mechanics and granular flow would be helpful (also for the better understanding of the subsequent passages).

P2, L48: Please specify what kind of 2D section of the body is meant.

P2, L51: This is true - but is the information also relevant for the description of the movement of the granular material?

P2, L57: Replace "got" by "became"

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P2, L58: What is the technical aspect of so called 'smart tracers' for natural transport? These tracers can be helpful to collect data for the description of natural transport processes but have no effect on natural transport... (please try to be specific language wise throughout the manuscript).

P3, L59: What is the significance of this sentence?

P3, L65 and following: This could be more concise.

P3, L75: As already mentioned - the physics of the movement of granular material should be better highlighted. I fully agree with the next statement that the manuscript focuses on sensor application (i.e. on the method), and this is exactly why I see limits regarding the significance and novelty of the scientific findings. Therefore I finally recommended to resubmit the manuscript as a brief communication instead of a research paper.

P3, L79: Please improve the description of the objectives.

P4, L93: Why "mainly"?

P4, L100: Why "available"?

P4, L122: Different dimensions have been mentioned before (L96) which is confusing - I find it also confusing that the dimensions are given only "approximately" - what are the exact dimensions?

P4, L124: What is meant by "lager objects"? Is "larger objects" meant? Please check the language throughout the manuscript (I stop here giving comments on the language).

P5, L125: Sentence starting at L124 - what is the significance of this sentence for the study?

P5, L127: This information could be given in the Acknowledgements or incorporated in the above text. The sentence that further improvements are planned already indicates

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that the presented findings are premature (similar statements are given at the end of the manuscript).

P5, L137: The reference systems could be introduced better... I find the presentation of Figure 1c rather confusing (as the reference system 'f' is only introduced at L150).

P5, L140: Why is 'relative' in italics? I don't think that "donated" is adequate terminology... (throughout the paper)

P5, L143: Why 'probably'?

P5, L151: I don't understand - please improve the description and be more precise (e.g., it is only mentioned below that z follows the direction of gravity).

P5, L153: What is meant by higher-order global system (i.e., why higher-order)?

P5, L154: Why was this not done?

P6, L162: I am not sure that I understand what is meant by (i) as well as (ii and iii).

P6, L163: 'describes' must be 'describe'.

P6, L165: All this remains a black box and could be explained in some more detail. I also find that the 'damaged probe' is mentioned too often...

P6, L170: Some more details would be desirable (or at least references where relevant information can be found). I find this important section rather short.

P6, L178: What is meant by 'various studies'?

P6, L180: A more precise length is given in the figure, which I find confusing (why approx. when the exact length is known?).

P6, L181: I find this difficult to read - please improve language.

P7, L206: Please check language. What was the accuracy of these measurements?

P7, L210: This statement defines the scope of the study - the demonstration of the

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applicability of the sensor to monitor the motion of individual pebbles within a landslide - this calls again for publication as a brief communication instead of a research article.

P7, L211: The information on the date should be presented in Section 2.4 (is this information important)?

P7, L216: As mentioned above, the calibration of the sensor remains partly foggy, and I am not sure that the terminology "calibrated raw data" is adequate - it seems to me that raw data are presented which were obtained by a calibrated sensor?

P7, L217: Could this be measured without activated IMU? If not, the statement in brackets could be deleted.

P7, L217/218: I had first difficulties to understand this sentence when looking at the figure - this could be formulated more clearly.

P8, L222: Why does the time series begin at a 'negative time'? When exactly was the landslide triggered? This should be mentioned/explained more clearly. Also, the statements relate to accelerations along the considered axes, this should be better highlighted in the text (xp and yp show low values - but strictly speaking, these are coordinate axes; the same applies to the statements given in the next sentences).

P8, L223: Why 'seems'? The data show this higher level.

P8, L230: Please improve - this is difficult to read and understand (suggestion: alpha, beta and gamma define the angle between xp, yp and zp and the gravity vector).

P8, L230 - L312: This qualitative presentation of the raw data is difficult to read and understand - it should, in my opinion, be coupled with the derived trajectory.

P8, L231: 'downwards direction' is, in my opinion, a rather confusing terminology.

P8, L234: If the pebble is stationary, it is clear that it cannot rotate...

P8, L234: I guess the landslide was triggered at 0.00 s? This should be mentioned in

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the text. Define 'the change' in the plots more clearly.

P8, L235: The text implies that the z -axis drops, which is not the case (and which is rather confusing). What drops is the acceleration value, and this needs to be described more clearly (also in the following passages).

P8, L238: This could be explained better and the motion characteristics 'free fall' and 'hampered free fall' should be defined more clearly.

P9, L248: This seems to be rather speculative - a statement like 'a conclusion might be...' is very vague...

P9, L251: Note that the values range between 1 g and -1 g (and do not correspond to 1 g and -1 g as presently stated).

P9, L257: However, I can see other spikes which are defined by two data points.

P9, L260: Indicate which axis is analyzed here.

P10, L289: 'Of cause'?

P10, L290: Why?

P10, L290: This is trivial - I would be surprised if the pebble would not change its orientation.

P10, L313: The above qualitative statements regarding the motion mode should be coupled with the considerations of the movement with respect to position and time.

P10, L315: This could be mentioned earlier.

P11, L316: Are these relationships really that simple?

P11, L317: Check language ('calculated after...').

P11, L318: Why were the angles 'received'? How can the accelerations be 'rearranged'? Please check language throughout.

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P11, L320: This is a description of a method which is described in detail in the literature - it could therefore be included into Section 2.

P11, L328: 'srel' is not integrated. It is obtained from integration.

P11, 336: I am not sure that I understand what is meant here. Please improve.

P11, L337 and following: All this could be combined with the qualitative discussion.

P11, L338: I disagree with this statement: a_{zrel} does not increase but decrease from 0 to -9.4. It also does not do this continuously decrease as clearly shown by the fluctuations in the plot.

P11, L339: Why? This should be explained better. I also cannot see in the Figure that the pebble 'swims'. Please improve.

P11, L342: What is the significance of the maximum velocity v_{yrel} ? Why is v_{zrel} decreasing afterwards while it further increased simultaneously? This is confusing.

P11, L343: Why 'covered'?

P11, L345: I disagree again - the plots for the y-axis do not really exhibit a major change. I am also not sure about the relevance of the capture of the high-speed sequence.

P11, L346: Is the 'acceleration curve' really smooth before 0.389 s?

P12, L349: This is difficult to understand and should be explained better.

P12, L351: What is the significance of this observed maximum?

P12, L353: Please explain better - this is hard to see from Figure c.

P12, L355: Figure 4 d shows photographs and not displacement plots?

P12, L355: I do not see these staircases (if plot c was meant).

P12, L372: This was mentioned before.

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P13, L390: I am not sure that I understand what is meant.

P13, L390 and following: This could be combined with the previous analyses.

P14, L432: This sentence is incomplete.

P14, L437: This indicates that further work is required.

P15, L470: This is a drawback for field applications, but not really for laboratory experiments.

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., <https://doi.org/10.5194/nhess-2020-61>, 2020.

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