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Interactive comment on "Reconstruction of three-dimensional rockfall trajectories using remote sensing and rock-based accelerometers and gyroscopes" *by* Andrin Caviezel et al.

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Dear referee,

We thank for the positive conception of our submission and your suggestions for improvements. We deliberately focused on the experimental methodology and its implementation in order to write a compact publication. An in-detail analysis of the experimental results and their possible implications to constitutive models and calibration routines is on-going work.

Please find below the response on your remaining criticisms:

1. Rockfall trajectography is one of the most popular topics in the geohazards community, with numerous publications. Very few references are actually given in this paper. I would suggest the authors to introduce shortly how their experiment compares with previous experiments (not only those of the authors' group).

In order blend our work into the past and ongoing research of rockfall trajectography, we extended the introductory part (Introduction, paragraph 2) by numerous references, focusing especially on published experimental work. As already adked for in RC1, the overall manuscript has been extended with more references to relevant work. Slight rephrasing of the given paragraph, emphasizes the distinction of latest research (Saroglou et al., 2018, Ushiro et al., 2006; Hibert et al., 2017; Salo et al., 2018, our work) on an experimental reconstruction methodology aiming for a full-slope trajectographic reconstruction. The revised introductory paragraph and phrasings are marked in blue in the attachment.

2. I would appreciate to have a figure with a picture of one of the impact point and the corresponding point cloud after impact. That would help to understand the quality of the data and the type of information available.

We ammended Figure 4, especially panel (b) and the overal caption such that the quality and type of data of the DCR reconstruction workflow is more easily understandable. Panel (a) depicts a visualization of superimposed reconstructed point clouds of one upper trajectory sector. The pink rock is well distinguishable in most of the image pairs. That is, this figure is a direct visualization of data quality. Inset (b) has been redesigned and labelled such that the extracted point clouds of the rock is emphasised. It shows the residual points of the rock and its centre of mass extraction after colour-filtered extraction of the rock at four subsequent positions and is the direct visualization of the type of data obtained by the described workflow. The reliability of the DCR extraction can be judged by the density of pink rocks in panel (a). The revised caption of Figure 4 is marked in blue in the attachment.

3. I don't think that the few observations made in this experiment (only 5 runs with a wheel-like block) can be generalized to support the conclusions on jump height and mitigation measures dimensioning (p12, l8). Some extra cautions have to be taken before jumping to these conclusions.

We only present 5 runs in order to facilitate visualization and presentation of the experimental methodology, as this paper focuses on the 4D reconstruction. The entire data set comprises more than those 5 runs and ongoing analysis corroborates the made claims. We deliberately decided against the inclusion of further data analysis, in order to keep the presented paper in a concise and compact manner. We agree, however, that the presentation of the conclusion seems premature and thus rephrased the statement, pointing towards the ongoing in-depth analysis. As the overestimation of jump heights is a key issue for most simulations programs, we advocate in favour of leaving the statement in, being aware of its implications. The amended sections in the conclusions are marked in blue in the attachment.

4. It's a Rolls-Royce experiment, involving a heavy logistics (even a helicopter). Such experiments are definitively useful, but the number of runs is naturally low and may be a limitation when studying stochastic processes. Do you think it would be possible to downscale this kind of experiment, keeping the same monitoring techniques?

Here, we face the major conflict when it comes to real-scale rockfall experiments: Generating a statistically relevant data set without generating enormous costs. The experimental evolution in our group started with small boulders (40-80 kg) which we could carry up the slope. Major criticism has always been that the considered energies are not of practical relevance. Thus, we are currently predominantly aiming for an up-scaling rather than a down-scaling. Now we strive towards a maximum cost efficiency for such large-scale experiments, where the use of a helicopter is not necessarily more expensive than a lengthy installation of a logging ropeway or lending of other heavy machinery such as excavators, cranes, etc. With our approach, we aim for maximal repeatability dealing with rock masses of interest for hazard engineers. We believe, that the amount of deposition points will allow certain conclusions with respect to stochastic processes, but we are fully aware of its limitations.

However, we are also pursuing the ideas of donwscaling the described experiment to laboratory size, with easier control on ground specifications, etc. There, the further development of the videogrammetric reconstruction can be pursued with less expenditure.

In short, yes, we strongly believe that the proposed techniques are applicable in a down-scaled environment, yielding valuable data.

We would like to thank the referee for evaluating our manuscript and strongly believe that the publication was enhanced by the made changes.

On behalf of the authors, yours sincerely, Andrin Caviezel

Please also note the supplement to this comment:
https://www.earth-surf-dynam-discuss.net/esurf-2018-74/esurf-2018-74-AC2-supplement.pdf

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