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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "UAV-based urban structural damage assessment using object-based image analysis and semantic reasoning" *by* J. Fernandez Galarreta et al.

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Dear Paolo Gamba, thank you very much for your interesting and positive feedback. Below you can find each of your comments addressed independently. We hope our responses answer the concerns and suggestions you had.

- If I may suggest, I would add some additional information about the hardware required and the computational cost for the processing of the UAV images.

Authors response: As it was mentioned on the paper in section 3.1 the hardware required was a hexacopter Aibot X6 V.1 with a canon 600D with a 40mm fixed zoom

Voigtländer lens and a compact camera Canon Power Shot S100 attached to an extensible 8m pole. All the camera settings were set to default. On the computer side, no special requirements were needed, standard laptops were used to proceed with the processing and analysis of the UAV images. Regarding to the processing cost, the time required to create the 3D point-clouds depended on the network connection, since we used the cloud-based service "123Dcatch". With a good (university based) connection it took on average 15min per building. The time required to process with the OBIA damage feature extraction was an average of 30 seconds per image. We will make this clearer in the revised version of the paper.

- What is more difficult for me to understand, as this is not written in the paper is which are the features that allow discriminating between D1-3 and D4-5 damages in 3D point clouds. Besides a list of these features, which is the degree of "fuzziness" that one may tolerate? This decision branch is very early in the procedure and a mistake may be dramatic.

Authors response. In section 3.2 it is mentioned that the features that are taken into account in order to determine whether a building belongs to the D1-D3 group or to the D4-D5 group are: total collapse, collapsed roof, rubble piles and inclined façades. The presence of any of them would classify the entire building as D4-D5.

Regarding to the degree of fuzziness that can be tolerated, building damage assessment as it has been mentioned in this paper, is subjective. This subjectivity effect has implications at every level of the assessment, including the expert assessment of 3D point-clouds and the fuzziness of the features that they have to identify. The degree of fuzziness that an expert can tolerate when he/she is proceeding with the evaluation depends on his/her skills and the context information that they have on the building. Taking the inclination of a façade as an example, it is the expert's judgment the one who has to decide whether a 1 degree inclination is related to the effects triggered by an earthquake of whether it was a pre-existing characteristic. In this paper the degree of fuzziness during the 3D point-cloud assessment was assumed to be an issue that

was self-contained within the expert's judgment and cannot be defined with a threshold. We understand that a more advanced and careful assessment of the 3D point-clouds can be done and that the branching in the methodology can be seen as "too early" . However we always kept in mind the context of this kind of assessment. We prioritize a fast identification of potential D4-D5 building where people can be trapped over more detailed assessments where fuzziness, for instance, can be taken more into account.

- Additionally, at some point it is mentioned that the work was mostly on the 3D data processing than on the 3D interpretation side. I understand this means that the algorithm to extract the cloud is novel, but I do not see it clearly explained, with the stress on its novelty it deserves, anywhere in the paper.'

Authors response. We think that the way we expressed that on the paper was not clear enough. In page 5618 line 5-8 we said : "Nevertheless, our work focused on the 3-D point could processing, with the actual damage detection still requiring manual assessment. Proper characterization of the target features in the detailed 3-D point cloud remains needed to develop more automatic approaches". What we mean is that for the 3D point-cloud assessment we did not focus on the actual data processing and automatic analysis of the datasets because of its expected complexity and novelty. We thus focused on generating the 3D point-clouds using existing approaches, and then proceeded with a visual assessments of the datasets to identify the cited damage features. This statement will be rephrased in the revised document. The research therefore focused more on the OOA-based detection of damage features, and the assessment of their value in expert-based damage assessment.

Again, we appreciate the constructive comments and suggestions made in this review, and trust that we have addressed all questions and comments satisfactorily.

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., 2, 5603, 2014.