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Earth Surface Dynamics Discussions

Interactive comment on "Shallow landslides modeling using a particle finite element model with emphasis on landslide evolution" *by* Liang Wang et al.

Anonymous Referee #1

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GENERAL COMMENTS

The Authors present the numerical simulation of shallow landslides using a PFEM formulation already presented and published in other works of one of the Authors.

The PFEM is a widely used numerical strategy for the analysis of large-deformations problems. Originally, the method was proposed for free-surface fluid dynamics analysis (e.g. see works of S. Idelsohn, E. Oñate and co-workers), and then extended to other applications still involving large variations of topology of computational domains, such as in phase change problems, particulate-flow, and geotechnical applications, including also landslides simulation (e.g. see works of M. Cremonesi, F. Salazar, A. Larese, X.

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Discussion paper

Zhang and co-workers).

In this sense, the proposed method cannot be considered innovative either for the type of application (landslide simulation) or for the used numerical strategy (it bases on the work of Zhang, 2015).

From the analysis of the main case of the work, the Cà Mengoni landslide, it is hard to assess the accuracy of the numerical results. This is mainly due to the nature of the considered landslide event, whose large duration (around two days) and evolving external conditions are difficult to reproduce numerically. This explains the large differences between the numerical results and the observation, also after the calibration of the reduction factor. Furthermore, the Authors model a 3D problem with a 2D method without justifying/proving the validity of this approximation.

On the other hand, the first numerical test is quite simple and the deformations suffered from the computational domain are so small that the utility of the PFEM massive remeshing is questionable.

Apart from these important issues, the article lacks details of the used numerical method. In particular, the PFEM description is not clear and the method appears hard to understand for people not familiar with the method. Furthermore, some parts of the article are not clear or not properly justified, and the overall quality of pictures and graphs is low (see the following sections).

According to these considerations, although the method has surely a strong potential for landslides simulations (as already shown in other publications), I think that the paper cannot be published as it is. The lack of novelty of the work could be compensated by presenting the application (and validation) of the method against a real landslide event, preferably in three dimensions. In this sense, the second test cannot play this role for the reasons previously exposed. Furthermore, an extended revision of the work according to the following indications is suggested.

SPECIFIC COMMENTS

Section 1 – The authors should explain more clearly which are the novelties of the work and why the work is worth to be published.

Section 1 – The works of Salazar (2016) and Cremonesi (2011) on landslides simulation with the PFEM should be referenced.

Section 1 – Re-mapping operations are used in the PFEM only when historical variables are used and stored at nodes. This is not done in the classical (and most used) PFEM approach, which is generally used for fluid dynamics problem. Indeed, the PFEM for solid mechanics has been used only in a few works (J.M Carbonell, X. Zhang, W. Zhang and co-workers). This is not a weak point of the method at all, but it should be mentioned in the introduction.

Section 2 – The description of the PFEM is poor. It is not even mentioned how tessellation is built (I guess Delaunay Triangulation as in the standard PFEM). In this sense, Figure 2 is not clear and does not help to understand the method (the initial mesh is identical to the discretization after remeshing, so why remeshing?).

Section 2 – The explanation of remapping operations is not clear, and, again, Figure 2 does not help the understanding. Furthermore, from the picture, it seems that three integration points are used in the first mesh, and only one in the new one. Which elements are used? Linear or quadratic? This choice should be also motivated.

Section 2 – Some considerations about the effect of remeshing over stresses accuracy should be included.

Section 3 – Why are the Authors using different mesh sizes for Cases 1 and 2?

Section 3 – Why Case 1 is not compared to other numerical results? If a validation of Case 1 cannot be done, the test can be removed as it does not add any new information to the work.

Section 4 – All the section is a bit confusing and it is hard to follow and understand the motivation of the several tests done by the Authors. Furthermore, as already said previously, the accuracy of the numerical results cannot be clearly assessed.

TECHNICAL CORRECTIONS AND TYPOS

Section 1 - Please, define the anagrams SPH, MPM, PFEM and FEM

Section 2 – Please, find a more appropriate title for the section.

Section 2 – Please, rephrase the sentence 'PFEM is the particle extension of the classical FEM method' which is very vague.

Section 2 – Please, rephrase lines 11-13.

Section 3 - Please, do not make reference to Whang 2019 if the work has not already accepted.

Section 3 – Please, define the mesh size as a length and not as an area.

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