Referee: 1  
  
Comments to the Author

The authors presented a hybrid numerical model to capture the soil-fluid-structure interaction. The Material Point Method and Implicit Continuous-fluid Eulerian framework are adopted for large deformations in porous media and complex fluid flows, respectively. The theoretical formulation and numerical implementations are sound. The model feasibility is demonstrated through comparison with analytical and experimental results. The application to earthquake-induced submarine landslides is particularly interesting.

Some specific comments are given below.

1. Please double-check Equations (3) (the definition of Terzaghi's effective stress), (12), and (13) for oversights.

The sign is correct and different from Terzaghi’s equation is because Terzaghi assumed that the water pressure is positive under the compression. We on the other hand assumed that the water pressure is positive under the extension.  
2. Numerous Typos are detected, for instance,  
a) page 11, the paragraph before Eqn. (11), ("stretch" instead of "sketch");  
b) page 12, the paragraph before Eqn. (17) ("model" instead of "mode");  
 the paragraph before Eqn. (20), (contact law instead of "contactlaw");  
c) page 19, the paragraph below Eqn. (39) ("the" instead of "he") and the phrasing before the same equation;  
d) page 33, the last paragraph ("shaking" table instead of "skaing" table, can "occur" instead of "occured").  
f) page 35, the paragraph below Figure 17 ("pressure" instead of "ressure").

The typos are checked and fixed accordingly.

3. What is the value taken for the Smagorinsky constant Cs for the numerical examples? Please specify.

Cs = 0.1  
  
4. On pages 13-14, it is not clear how the expression of the hydraulic conductivity is obtained from Eqns. (25) and (28). Please double-check.  
Explanation on how to obtain the hydraulic conductivity is provided.

5. On page 15, the momentum exchange coefficient is 1E5 (in the text) or 1E15 (in Fig.3)?  
There are two values of the momentum exchange coefficient. Momentum exchange coefficient between structure and air is 1E15 and between water and air is 1E5. I update the manuscript to make it clearer.

Referee: 2

Comments to the Author

The manuscript presents an extended version of the MPMICE algorithm to account for porous media using an implicit formulation. The overall framework is presented and validated using two analytical solutions. Two more benchmarks are presented, and results are compared with FEM solution and experimental data. Finally, the framework is used to demonstrate the ability of the model to capture the whole deformation forces of earthquake-induced submarine landslides. The topic is relevant for the Geotech and Offshore communities. However, I have a few comments and suggestions that need to be addressed before this manuscript can be accepted.  
- The title and abstract bring high expectations in terms of the ability of the model to deal with earthquake motions. Although the final application shows a landslide triggered by shaking (which is well appreciated by the reviewer), the model does not capture filed earthquake field conditions. The numerical algorithm is not particularly validated for this type of application (e.g., no validation of site response, boundary conditions are not well explained). The formulation is dynamic, but this does not imply that it is ready to deal with these types of applications accurately.

-Introduction is well-written, and the motivation and objectives are clear. The authors also highlight the new contributions of this work compared to those already published. The organization of the paper is also clear. However, the writing of the rest of the document (including Appendices) needs a thorough review. There is a number of issues with the English quality, many grammar mistakes and typos, some sentences feel incomplete (e.g., “Solving the linear equation below to obtain the increment of velocity with i,j = 1 : N as”), and excessive repetition (pg. 26, 27, 28).

The typos are checked and fixed accordingly.

- The numerical implementation section is slightly tricky to follow, in part because the notation is not always consistent or well presented (e.g., check the notation in Figure 5, what is the difference between FC (capital) with fc (lower caption)?). I highly recommend that the authors include a Figure with a diagram summarizing the computational scheme.

Figure is included.

- Pg 18: Can you better explain what you mean by “extra momentum from contact forces”? Do you mean ffric? I also don’t understand the context of “The nodal velocity and nodal temperature are applied boundary conditions”.

-Pg 19: What is the meaning of “faced-centered” or “face-centered”? The value calculated at the center of the cell? Please, clarify.

-Pg 25: Can you provide the details of the GitHub repository?

-Pg 30: Provide reference after “Unlike other computational models based on total stress analysis,…”

-Pg 31: “The saturated debris flow … turbulent flow as grains are separated from each other and exhibit no contact forces between grains”. Add a new figure comparing the evolution of effective stress in both scenarios. We should see effective stress going down to zero in the submerged model.

-Pg 33: “In the final example, we perform numerical analysis of the earthquake-induced submarine landslides”,“The earthquake of this magnitude can occur typically for the earthquake of magnitude of more than 6” (??). This is not similar to an earthquake loading. Boundary conditions are not realistic. Please, rephrase this explanation. Also, refer to the first comment.  
-Pg 34: Do you mean Rowe's stress-dilatancy theory? Please, correct and add a reference.  
-Pg 34: “On all boundary faces, the symmetric boundary condition is imposed” I do not understand the meaning of this sentence.

-Pg 39: Why is drag force in a summation form?

-Pg 41: What is the difference between superscripts C and FC? Please, clarify.

~~Final note: In the future, please consider providing the line numbers in the draft manuscript to ease the reviewers’ work.~~