Paper and Referee

Paper: C503
Manuscript Title: Finite Element Modeling of Multibody Contact and Its Application to Active Faults
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Referee recommendations: Accepted provided changes suggested are made

Referee Comments (For Editor Only)

The manuscript describes a methodology to simulate static or quasi-static frictional contact between multi-elasto-plastic bodies using a general nonlinear friction law. The approach uses a "node-to-point" contact element strategy in order to overcome convergence problems existing in other methodologies. Interesting results are obtained with the approach which shows that the model can be successfully applied to active faults. Therefore I recommand the manuscript for publication, however a major revision is required. The manuscript describes the approach adequately but fails to demonstrate the efficiency and stability of the approach.

Referee Comments (For Author(s) and Editor)

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Minor problems with the manuscript are:

- "in our laboratory" should be replaced by the institution name.
- The introduction states that the model aims to "further predict earthquake occurence". I suggest removing this statement or rephrasing it into a more general statement such as "the approach may permit study of earthquake prediction".
- References to other methodologies are required for the statement "it is also well known that it is quite time consuming and also difficult for dynamic-explicit FEM to predict the stress distribution with a high accuracy".
- Eq. (1) states that when contact occurs the normal contact velocity is null (ie. $\dot{g}_n = 0$) this would require explanation since it would appear that for a contact to occur the normal contact velocity must not be zero.
- Eq. (2) states that $f^\alpha.n^\alpha < 0$ when a contact occurs, whereas Figure 1 shows otherwise ($f^\alpha.n^\alpha > 0$).

- Eq. (3) assumes that $g_n < 0$ because the two bodies are in contact, this should be explicitly stated in the text.
- Eq. (5) f_m is not defined in the text, and the term $\sqrt{f_m f_m}$ is used in the equation. Do the author(s) mean $|f_m|$?
- Eq. (7) needs more explanation.
- Figure 6 shows units in mm. Do the author(s) mean m? The dimensions of model also appears to be wrong ($20038 \times 51 \times 600$ does not appear to correspond to the dimensions of the model shown in Figure 6).

Major problems with the manuscript are:

- Section 5: as stated in the manuscript, one of the goals of this paper is to show the efficiency, stability and usefulness of the proposed algorithm. However the manuscript failed to demonstrate the efficiency and stability of the algorithm. The algorithm utilizes a parallel sparse solver which is the only parallel part of the algorithm (cf. section 5, the contact search and stiffness matrix assembly computations are serial). The only performance estimate is given by Figure 5 which shows computational time vs. numbers of contact nodes. To demonstrate efficiency, a speed-up plot with number of processors, estimate of flops vs. model size, and/or comparison with other algorithms would be required. The stability of the algorithm is not demonstrated in the manuscript. The rate of convergence (number of iterations required) for various problems should be stated and eventually compared with other methodologies to demonstrate stability and efficiency.
- Section 6: References to the actual analysis and description of the numerical experiment or a more detail analysis is required. Only a few input parameters are given in the text. Enough details should be given so that the experiment may be reproduced.

Presentation Changes

- Figure 6b showing a 3D view of the mesh is not necessary and should be removed.