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Solid Earth
Discussions
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Interactive comment on "2-D finite displacements and finite strain from PIV analysis of plane-strain tectonic analogue models" *by* David Boutelier et al.

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Review of manuscript se-2019-67

The manuscript documents methodological developments and synthetic benchmarks of an open source software for digital image correlation (or particle image velocimetry, PIV) tailored to applications in analogue tectonic modelling (TecPIV by Boutelier (2016)). The developments include multipass processing with decreasing window size and window deformation and the derivation of various incremental and finite strain components in Eulerian and Lagrangian reference systems. Especially summing up incremental strain in a Lagrangian reference frame meets the demands of the commu-

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nity, as this is the reference frame of geoscientists' observations at long time scales at which material and structures are advected. These developments make TecPIV competitive with respect to commercial software packages (e.g. LaVision Davis Strainmaster). In my opinion it is a laudable effort by the authors to develop, improve and maintain TecPIV and the paper is a highly appreciated contribution to be published in SE. I enjoyed reading the manuscript which is at a very mature stage and needs to my opinion only minor (mainly technical) revisions before publication.

General comments:

Structure and language:

The paper is straight forwardly structured and very well written at a level of detail that allows appreciating the mathematics behind the typically "colourful" results.

Mathematics:

I have to admit not having checked all formulas for their correctness by myself (I would not be able to do it) but from what I could verify I have the impression of things being correctly documented.

Figures:

Figures are all usefull, required and generally well designed.

Specific comments:

Title:

In the title you constrict the use to applications for plane strain. I probably understand your motivation to do so because the method is 2D but in contrast to the synthetic benchmarks (which are truly 2D) any real analogue model (free) surface will deviate at least locally from plane strain. Also because in the main text you never recall the issue of plane strain (not before the conclusions), so I suggest to delete "plane strain" from the title and instead discuss the limitations of 2D analysis shortly elsewhere.

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Terms and definitions:

"PIV": "PIV" is an essential acronym which should be defined earlier (title or abstract) than it is currently done (where you define it in the third paragraph of the intro). You may also quickly clarify the use of the term “PIV” in parallel to the emerging preference of the term “DIC” (digital image correlation) for applications outside the fluid dynamic context. In understand you stick to “PIV” because the software has this name and you may not want to change it. Even if this would be the only reason, it should be spoken out frankly.

“TecPIV” first (and only) appears in the conclusions although it is what the paper is about. It should be introduced in the introduction and abstract (if not in the title).

Page 2 Line 3ff:

The reasoning for not using PIV cameras is (my perception) nowadays mainly the costs, not the resolution. I therefore suggest to update the sentence on “relatively low-resolution”. You say that PIV cameras have low resolution (<10 MPx), which is strictly valid only for imaging frequencies beyond what is typically used in analogue modelling of tectonic processes and for cameras with a color depth beyond 14 bit. There now exist also higher resolution (up to 29 MPx, 14 bit) PIV cameras which run at frequencies up to a few Hz and I assume with a time lag of a few years they will keep pace with DSLR camera developments in term of spatial resolution. The sensitivity of PIV cameras might indeed be of minor importance for the tectonic analogue modelling community, unless you work with pulsed light or under low light conditions. A short sentence clarifying the role of a proper dynamic range (preferentially at least 12 bit) for image correlation accuracy could be helpful in this context. Lastly, analogue “seismo-tectonic” models, where high rates are an issue, requires imaging frequencies beyond what is possible with consumer-grade cameras at a decent level of image quality.

Technical comments:

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Figures:

A) Increase font size in all panels showing the velocity fields (numbers on axes and color bars).

B) Figure 3 & 5: The grey background is not well suited to appreciate the velocity field, especially the low levels. A white zero-level (as actually the color bar indicates) is better. The undeformed areas of the masks are not really visible, maybe add some space outside the frame, make the lines thicker etc.

Criteria:

Does the paper address relevant scientific questions within the scope of SE? YES

Does the paper present novel concepts, ideas, tools, or data? YES

Are substantial conclusions reached? YES (technique-wise)

Are the scientific methods and assumptions valid and clearly outlined? YES

Are the results sufficient to support the interpretations and conclusions? YES

Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)? YES

Do the authors give proper credit to related work and clearly indicate their own new/original contribution? YES

Does the title clearly reflect the contents of the paper? Maybe not (see comments above)

Does the abstract provide a concise and complete summary? YES

Is the overall presentation well structured and clear? YES

Is the language fluent and precise? YES

Are mathematical formulae, symbols, abbreviations, and units correctly defined and

used? YES

Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated? NO

Are the number and quality of references appropriate? YES

Is the amount and quality of supplementary material appropriate? n.a.

_____ Matthias Rosenau

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