Review Report, Esurf-2017-41

Journal: Earth Surf. Dynamic. Discuss.

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Title: Identification of stable areas in unreferenced laser scans for automated geomorphometric monitoring

Summary

For the purpose of topographic monitoring of dynamic sites, the authors propose a method that identifies stable areas and quantifies changes elsewhere. The method takes unorganized point cloud data as input, as is for example obtained by terrestrial laser scanning. The method builds on a well-known existing method, the so called Iterative Closest Point (ICP) approach. The authors do not apply this method globally over the full area of interest, but divides the area over many small blocks and identify changes by finding those blocs where the local results deviate. The method is demonstrated on three different study areas, all three with different deformation phenomena, one normal glacier, one rock glacier and a landslide area.

Advice

Major revision. The approach the author proposes is appropriate and promising for the type of dynamics considered. The storyline and the discussion should be improved in my opinion before the manuscript is a clear read. Notably the authors should:

- Make the text more concise: often parts of sentences can be skipped without affecting the contents, and often the order of presented material is not optimal. Some suggestions are given below.
- Reorder some of the material and notably present Ch 2 as related/exiting work
- Check the influence of some parameters on the results: thinned point clouds and various voxel sizes.

Remarks

1. Overall: can you characterize in which cases ICProx works better? E.g. when deformation is all scattered over the scene (rock fall?), or when it is more focused, e.g. when considering a glacier that flows between stable rock beds. Related: could you characterize the different movement related/expected for the three geomorphological processes you consider?
2. Overall: (maybe for discussion): what would be a strategy in case of more than two epochs?
3. Overall: could the method be improved by making it iterative (smaller voxels) to better detect the boundaries of deforming areas?

4. Overall: or alternatively: could it be extended by a testing step, that after application of optimal transformation parameters, detect which difference can be considered change, given the quality of the data?
5. Overall: how should the voxel size be chosen given the point density and the expected change?
6. Abstract: -> “E.g. terrestrial laser scanners capture a region of interest in a quasi-laminar …”
7. Abtstract: you mention a central problem, but do not state it explicitly, please do so. “The central problem considered in this work is…” To me this seems to be target free registration in areas where it is not clear where stable subareas are.
8. Abstract: -> “For every case, two epochs… is 70 % on average”. Also mention here the reference data
9. Intro: -> “Monitoring surface changes…”
10. Intro, r24: “occurrences”, of what? Please specify.
11. P2r5: “congruence model”? Either explain or omit it here.
12. P3r15: explain in 1-2 lines what *radiometric features* are and why these can be used for registration; Same, explain what is meant by *direct georeferencing.*
13. P3r31: -> “A substantial advantage of the last strategy is the actual use of the information present in the point cloud”.
14. P4r2: -> “In order to obtain a satisfactory..or pre-alignment algorithms” (skip point clouds)
15. P4r16-r20 and r 22-24: double information: avoid repetitions
16. P4r17-> “and identification of deformation..”
17. P14r18: again *congruent* is mentioned but not explained.
18. Ch 2 + Ch 2.1 (p3) could be called “Existing approaches” as this reviews literature. Your methodology basically starts at Ch 2.2, please make this clear.
19. P4r29: “The first one automatically….data. For this purpose the 4PCS-algorithm is…
20. P4, last paragraph: what is the third step of Phase 1?
21. P5r4: -> “that occurred between scan acquisitions”
22. P5r13-r14: “to clarify…object’s surface”: this I don’t get, please clarify.
23. P5r15: how are these “stable regions” obtained?
24. P5r17: -> “deformation estimation” (not measurement)
25. P5r20: -> “is to identify”
26. P5r21: I would not call this “segmentation” but “decomposition” or “voxelization”
27. Table 1: make separate columns for GSD and scanning increment
28. P7r5: “…at an elevation…and is ~ 900 m long and ~350 m wide”
29. P7r11: “and has reported to have a slower upper part…”
30. P7: last paragraph: this is discussing existing work and fits better in a Ch 2 “Existing approaches”
31. Fig.3, caption I see a white circle, not a red circle?
32. P8r9: -> “in the Central part of the Austrian Alps”
33. P8r15: -> “The current retreat of.. glacier has been observed using TLS since 2001… while 6.3m vertical loss was detected…”
34. P9r11: “computed transformation parameters” computed by who?
35. P10: “nunatak mountains”??? Please explain

36. Ch 4: p11: this page contains more general info, (like classification problem). This kind of info should be presented earlier, chapter 1, or chapter 3. Here just present and analyze the results.
37. Also here you could mention once how the reference data is obtained; Later in the discussion: what is the effect of the location of the selected stable areas? If this location is rather small or badly covering the full extent of the ROI, this could affect the validation
38. Ch4: what do you mean by “inspection map”? Is there not a more descriptive name for these images? Is this not just a “change map”?
39. P14 r14: -> “in orange corresponding to large and detected geometric changes”
40. P14r24: can you quantify these “margin of detectability”?
41. P18: could you do and add some experiments with different resamplings (thinning of the data set)?