An End-to-End Framework for Landslide Erosion Analysis

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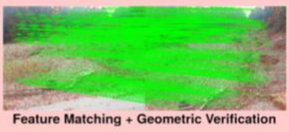
3D Reconstruction

Structure From Motion

Series of 2D images taken with smart phone

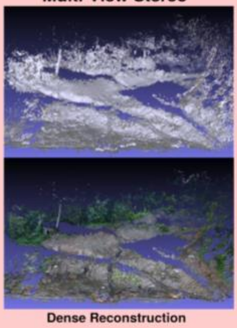
Feature Extraction using SIFT



Feature Matching + Geometric Verification

Sparse Reconstruction

Multi-View Stereo

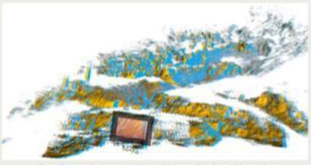


Dense Reconstruction

Structure From Motion and Multiview Stereo produces a 3D model from a series of static 2D images accompanied by local motion.

COLMAP's implementation of Structure From Motion and Multi-view Stereo are used to handle 3D Reconstruction from a series of RGB images[1].

Point Cloud Comparison



Registration used to Align Point Clouds

Before Heavy Rain

After Heavy Rain

Open3D library is used for Point Cloud Registration and Segmentation[2].

Local and Global Registration algorithms are used to align and scale point clouds. Once aligned, a segmented region of the two point clouds can be compared.

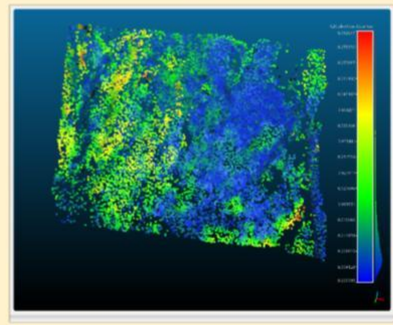
Introduction

- Traditional Landslide response methods are time consuming and capture critical information. However, Computational Analysis of Landslides is inaccessible and expensive.
- **Research goal is to build an end-to-end Landslide Reconstruction and Change Detection Framework**

Geometric Change Detection

Hausdorff Distance

$$d_{\mathrm{H}}(X,Y) = \max\{d(X,Y), d(Y,X)\}.$$



Heatmap of calculated distance difference between point clouds

Before Heavy Rain

After Heavy Rain

Conclusion & Future Work

Our framework utilizes recent advances in open source libraries and algorithms to provide landslide responders with a single application that handles every step in the 3D reconstruction and change detection process.

- Further incorporate more robust algorithms and UI tools
- Extend framework to use learning based method for subsecptibility prediction

References

[1] Johannes L. Schonberger and Jan-Michael Frahm. "Structure-from-Motion Revisited". In: 2016 IEEE Conference on Computer Vision and Pattern Recognition (CVPR).
[2] Qian-Yi Zhou, Jaesik Park, and Vladlen Koltun. "Open3D: A Modern Library for 3DData Processing". In: (2018). arXiv: 1801 .09847.

Acknowledgements

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