Morphological Mapping of 13 August 2017 Kotropi Landslide using Images and Videos from Drone and Structure from Motion

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Abstract

Landslides exhibit complex geomorphological features, which are difficult to monitor and map the changes. Photogrammetric methods have emerged as promising tools to overcome such problems due to 3D reconstruction from overlapping images without disturbing the surface. This study presents the structure from motion (SfM) technique for three-dimensional reconstruction using video and images of a large landslide which occurred on 13 August 2017 at Kotropi, Himachal Pradesh, India. In this study, we have used an Unmanned Aerial Vehicle (UAV) – DJI Phantom 3 Advanced to collect high-resolution images and video of landslide. A total of 98 images and 9 videos of 12:18 minutes duration were captured during the drone flight on 23 March 2019 covering the whole landslide and surrounding areas. The images were collected in unorganized manner for covering the whole landslide in the limited amount of time. We have used videos for coarse reconstruction and high-resolution images for fine reconstruction of landslide. The whole model was developed in two parts using MeshRoom and later merged using co-registration in CloudCompare. Based on feature detection technique, scale invariant feature transform (SIFT), image features were automatically detected, described, and matched between photos. A bundle block adjustment is performed on the matched features to identify the 3D position and orientation of the cameras, and the XYZ location of each feature in the photographs resulting in a sparse 3D point cloud. Finally, meshing is carried out using 3D Delaunay tetrahedralization. For visualization and analysis of final 3D model, open source software CloudCompare/MeshLab was used. The morphological parameters such as length, width, height, perimeter, area and volume were computed from the 3D model. From field observations and image analysis we will show that UAV-based image in combination with 3D scene reconstruction algorithms provide a flexible and effective tool to map and monitor large landslides such as Kotropi landslide of Himachal Pradesh.

Morphological Mapping of Landslides using Images and Videos from Drones and SfM

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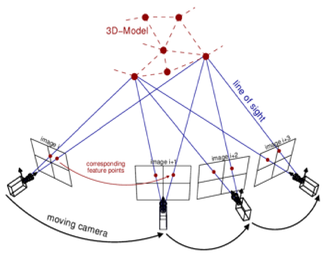
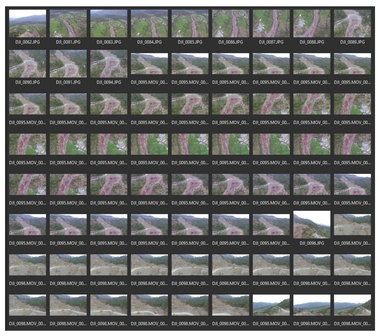
INTRODUCTION

- Large landslides and complex geomorphology
- Difficult to estimate volume/area/perimeter from traditional instruments.
- SfM for 3D reconstruction using drone videos and images .
- Videos for coarse reconstruction and high-resolution images for fine reconstruction.

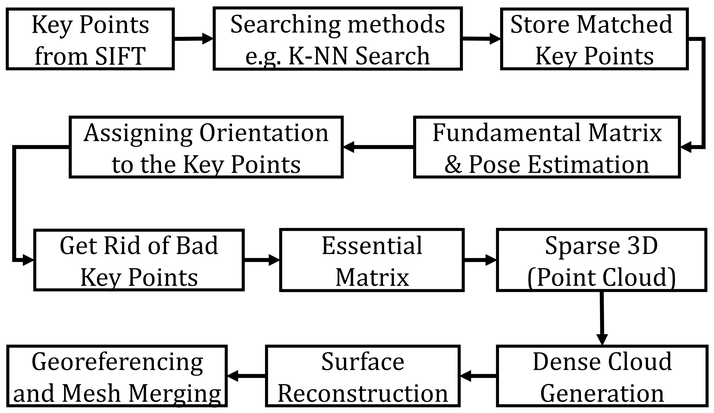
METHODS & TOOLS

- Photos + Videos
- Structure from Motion
- Meshroom, AGI Metashapes
- MeshLab/CloudCompare
- Global Mapper

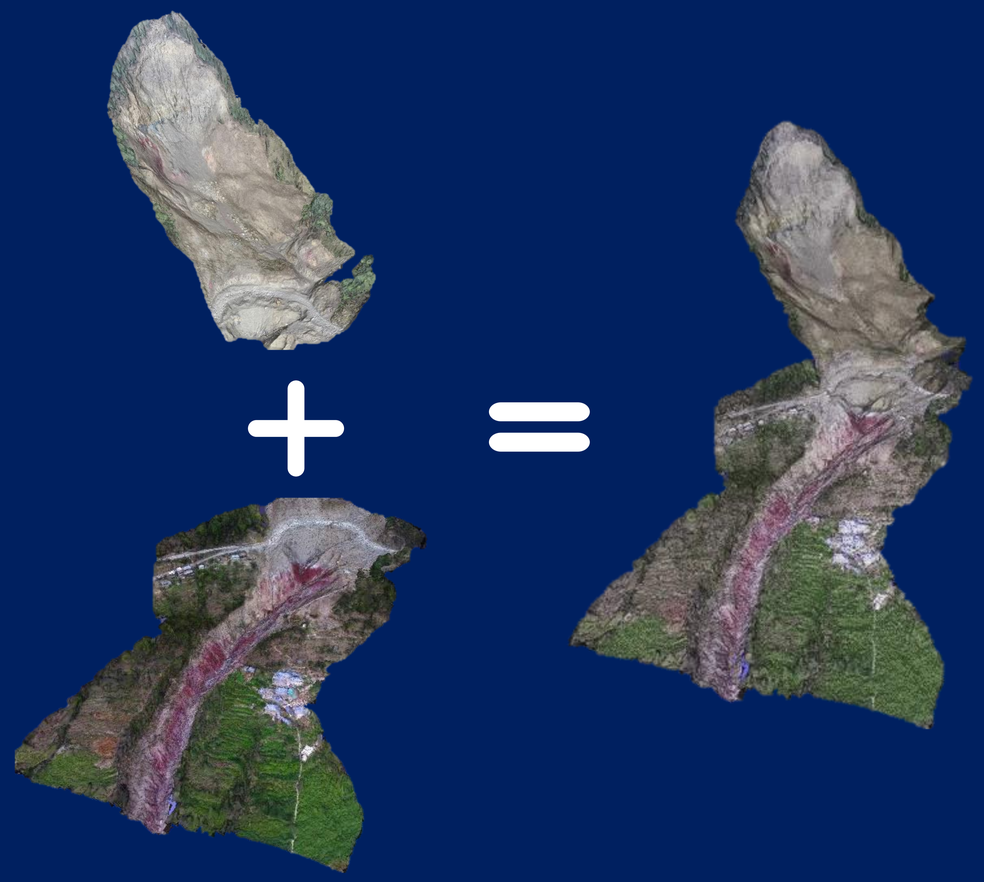




- **Drone Photos = ~100**
- **Video Frames = ~600**



UAV images in combination with SfM provide a flexible and effective tool to map and monitor large landslides.



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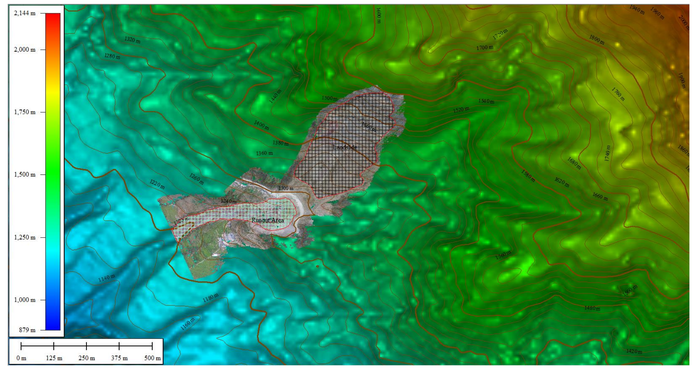
FIELD VISIT

RESULTS

	Volume (cu. m)	Enclosed Area (sq. m)	Perimeter (m)
Part above road	-4,00,986.39	77,300	1173.00
Part below road	-2,88,002.49	28,100	994.37



CONCLUSIONS

- A very large landslide such as Kotrupi, cannot be measured in the field using traditional instruments and hence UAV's and SfM can be very effective in mapping and monitoring such landslides.

FUTURE SCOPE

- 3D Slope stability analysis requires the geometric surface of an area. The surface generated using current analysis could be applied for local stability analysis within the landslide area.

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