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River Hydraulics and Sediment Transport

# Apply Smartphone apps to real time 3D Modeling of Sediment-Related Disasters

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## INTRODUCTION

- During typhoons and heavy rainfall events, sediment-related disasters frequently occur on hill slopes, among which debris flows pose the most significant threat. It is imperative to swiftly collect pertinent disaster data to facilitate disaster mitigation and response initiatives.
- In recent years, remote sensing imagery and unmanned aerial vehicles (UAVs) have been increasingly employed for large-scale data collection and investigation of disaster sites. This methodology markedly enhances efficiency in comparison to traditional manual field surveys. Although both techniques offer insights into the geographical features of extensive areas, they face challenges in promptly capturing precise details of smaller zones.
- This study employs smartphones for on-site disaster surveys, utilizing 360-degree panoramas, LIDAR scanning, and photogrammetry. This approach is utilized to investigate disaster areas where remote sensing imagery and UAVs fail to capture.

## Research material and Method

### Site condition

**Debris-flow torrent (DF013)**

1. **Type of disaster** ：Debris flow
2. **Occurrence date :** 2023-08-04
3. **Location** ：Nanfeng Village, Ren'ai Township, Nantou County, Taiwan
4. **Coordinate** **:** 258756.894, 2655371.996 (TWD 97)
5. **Investigation date:** 2023-08-14(After disaster) 2024-04-09(8 months later)

### Research material

Smartphone
iPhone 14 Pro

### Application

| LIDAR scanning application | | | |
|---|---|---|---|
| Item | | | |
| Application | Scaniverse | 3d Scanner App | ConstLiDAR Lite |
| Operating system | IOS | | |
| Compatibility (up to 2024/3) | iPhone 12, 13,14, and 15 Pro or higher 、iPad 11" (2nd generation) or higher 、iPad Pro " (4nd generation) or higher | | |
| Export Format | LAS 、PLY 、USDZ 、OBJ 、DAE... | | Real-time display onsite |
| Functionality | 1.3D model construction 2. Length and perimeter measurement | 1.3D model construction 2. volume measurement 3.AR 、VR 、Walking mode | Horizontal, vertical, and slant distance measurement |

| Photogrammetry application | | |
|---|---|---|
| Item | | |
| Application | polycam | Luma AI |
| Operating system | IOS/android | IOS |
| Compatibility (up to 2024/3) | (Photo) iPhone 11 or higher android 8.0 or higher (LIDAR) iPhone 12 or higher | (Photo) iPhone X or higher |
| Export Format | LAS 、PLY 、USDZ 、OBJ 、DAE... | |
| Functionality | 1.360 panoramic mode 2. Length and perimeter measurement | 1.3D model construction 2. Gaussian Splatting mode 3. Presenting plant and rock detail features |

### Research method

360-degree Panorama

Presenting panoramic images of the surrounding environment of potential debris-flow torrent in each river section

3D model Construction & Rapid 3D measurement

Presenting 3D models of key locations in potential debris-flow torrent in each river section, for quickly understanding the 3D dimensions of disaster locations.

3D quantification analysis & Visualization mode presentation

Performing comprehensive dimensional measurements and volume calculations for all locations along potential debris-flow torrent in each river section.

## RESULTS AND DISCUSSIONS

### The 360-degree panoramic and 3D model in stream

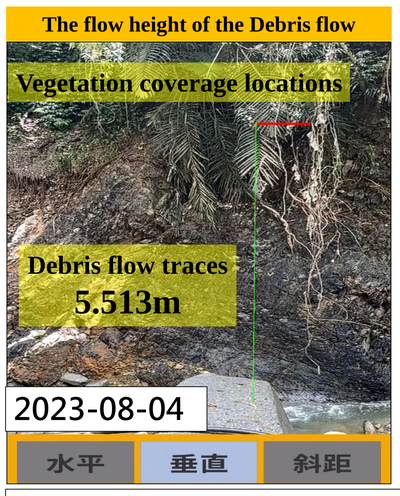
#### (1) 360-degree Panorama

**After the debris flow, vegetation still densely covers this area.**

**After 8 months, the continuous outflow of debris and sediment persists.**

#### (2) 3D model Construction & Rapid 3D measurement

**The flow height of the Debris flow**

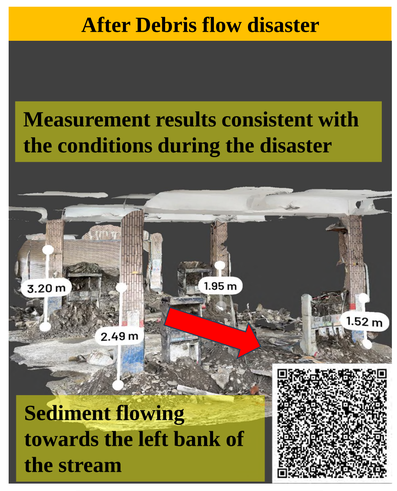



**3D model-Ground sill**

2023-08-14　　2024-04-09

**Debris flow disaster**

**After Debris flow disaster**

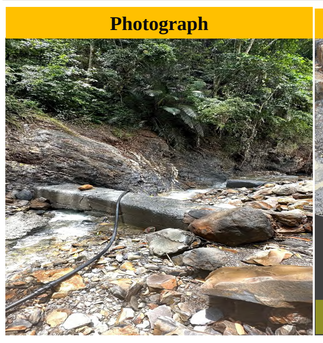



**Now situation**

2023-08-04　　2023-08-14　　2024-04-09

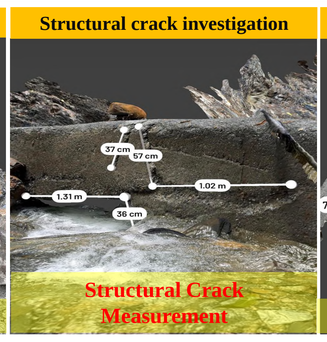
#### (3) 3D quantification analysis & Visualization mode presentation

**Photograph**

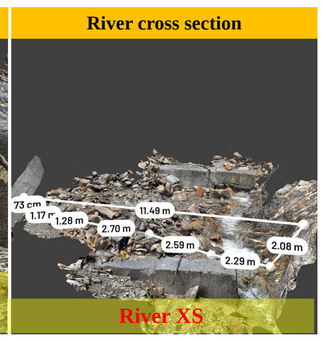


**Diameter of Stream bed material**

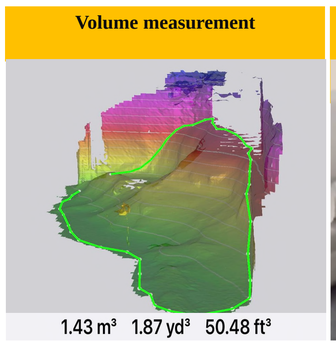
**Structural crack investigation**



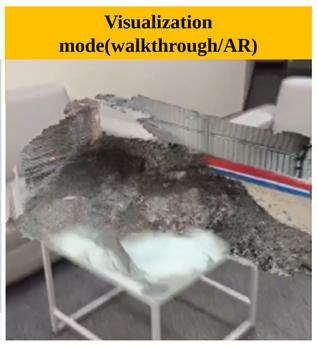

**River cross section**



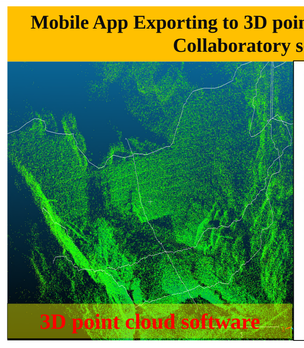

**Volume measurement**

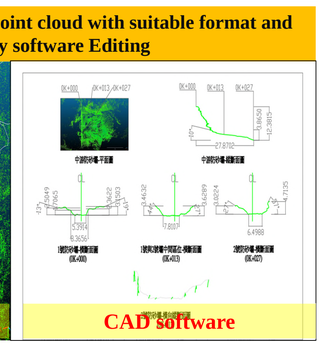



**Visualization mode(walkthrough/AR)**



**Mobile App Exporting to 3D point cloud with suitable format and Collaboratory software Editing**




### The 360-degree panoramic and 3D model in gas station