Spatial Frontier

PRESENTATION

Presented at the FIG Working Week 2025 ,
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GIS AND DRONE PHOTOGRAMMETRY: TRANSFORMING SPATIAL ANALYSIS AND MAPPING INTO DIGITAL REALITY

Iam Dammawan

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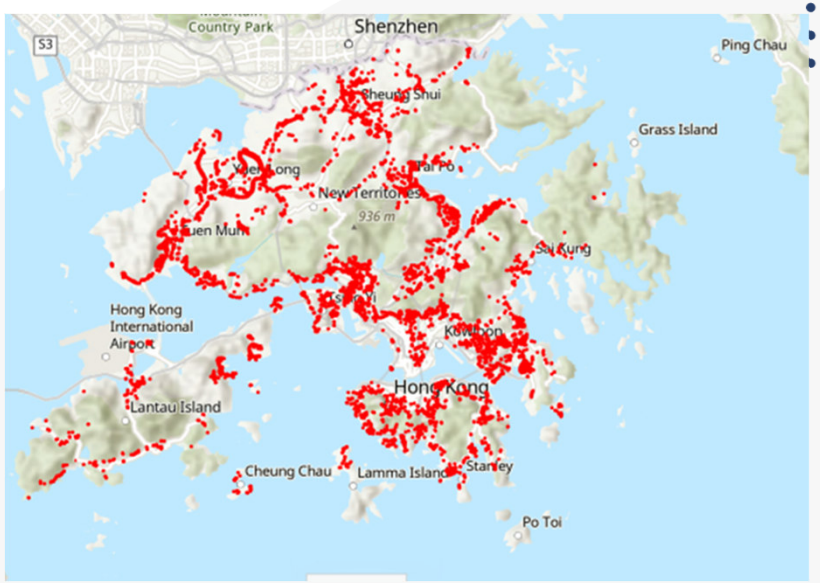
INTRODUCTION

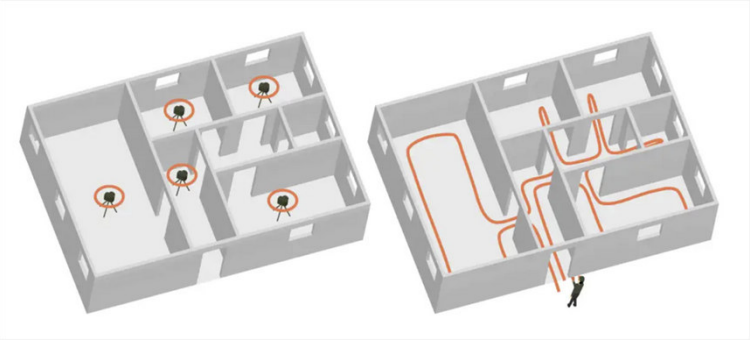
- Using data of different sources is important when it comes to sustainable planning
- Urban planning challenges include efficiency, managing population growth
- We can use photogrammetry to identify vacant slopes for recreational purposes



HONG KONG CASE STUDY

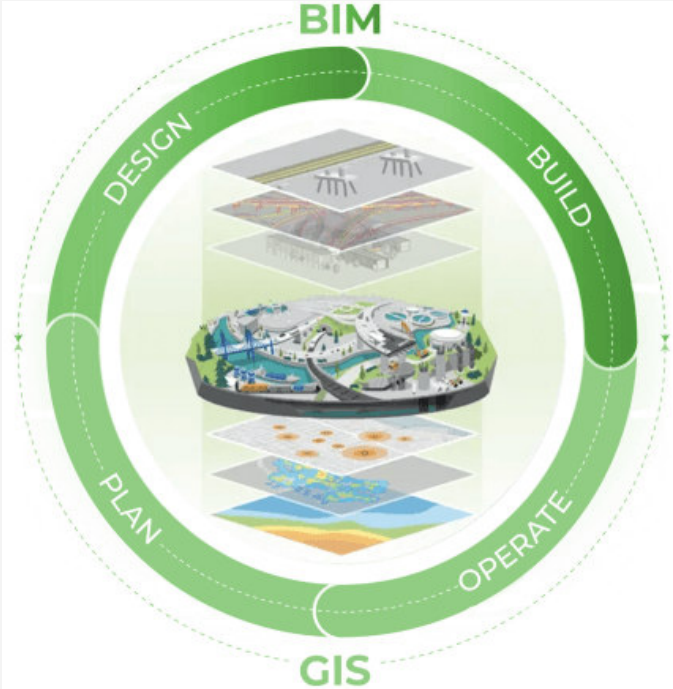
The portion of slope next to Nam Cheong Street in Shek Kip Mei is how we could leverage underutilised slopes which are accessible and could potentially be used as recreational spaces for people living nearby the area

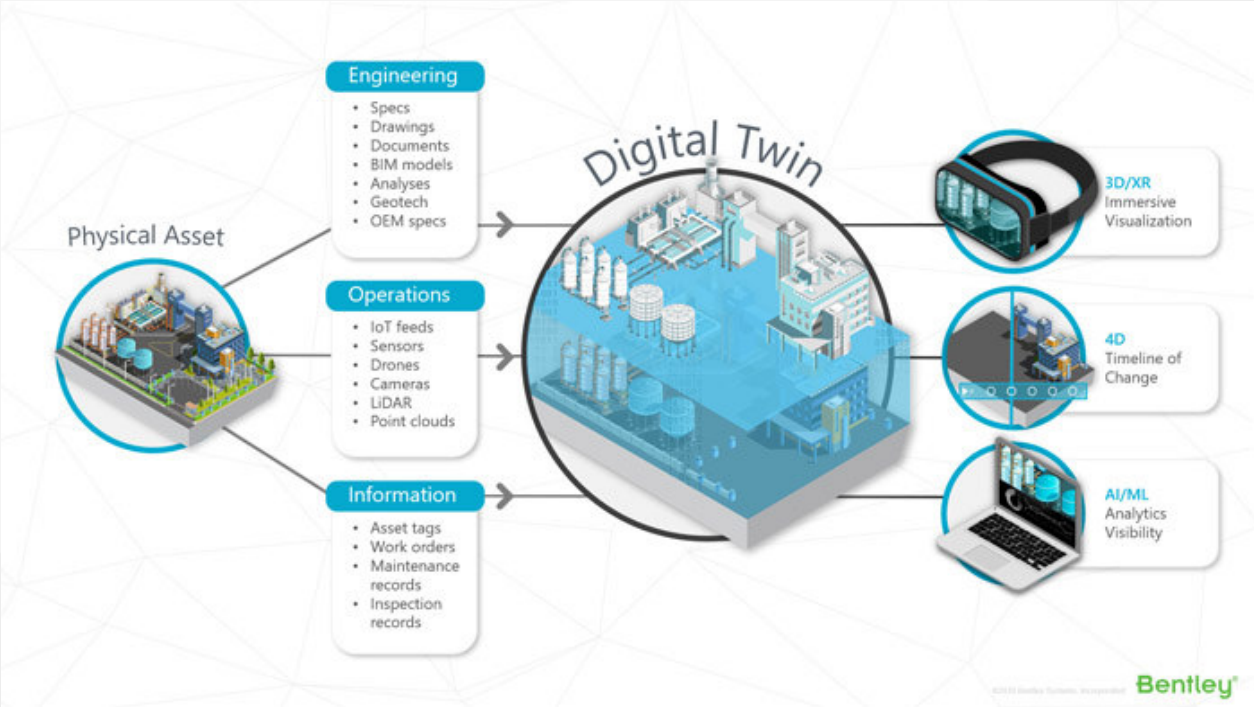
SLAM + GIS + DRONES



COMPREHENSIVE DATA IN SHORT TIME
+
10X QUICKER THAN TRADITIONAL METHODS

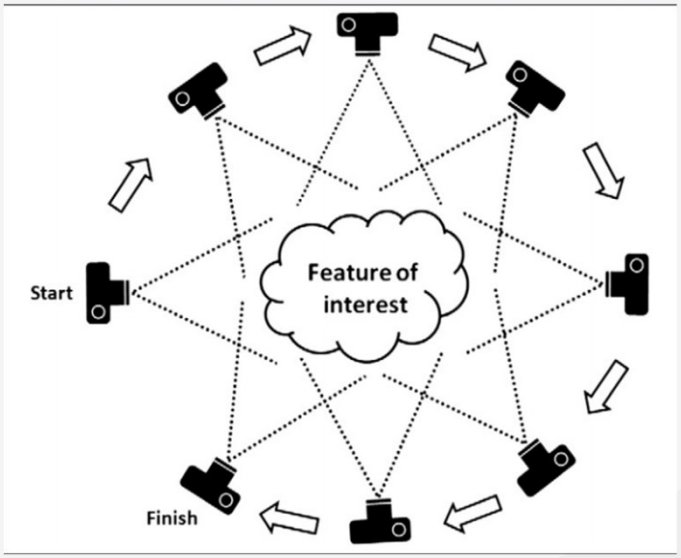
GIS + BIM

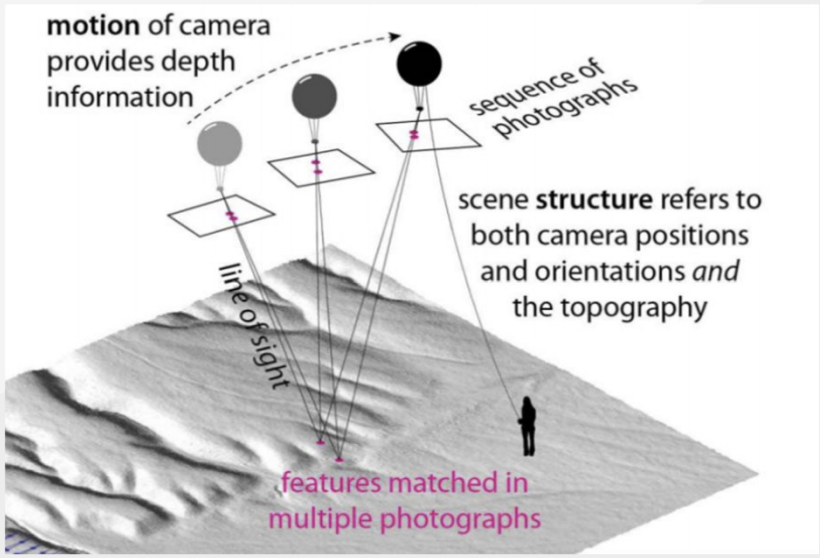




Drones should be combined with GIS and BIM to generate digital twins

STRUCTURE FROM MOTION





Structure from Motion utilises several, overlapping aerial photographs in order to create 3D reconstruction models and extraction.

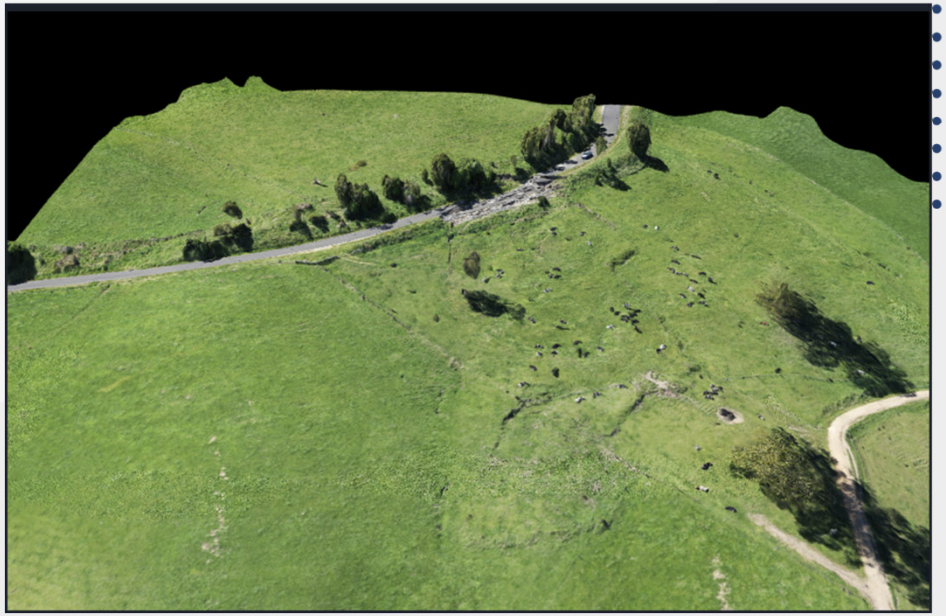
ADVANTAGES OF STRUCTURE FROM MOTION

- Accurate reconstruction of image in 3D space
- Uses triangulation to roughly determine the 3D positions
- Completely automated method from keypoint extraction to accurate reconstruction
- Therefore minimises the need for manual identification of photo control before processing occurs
- Create high density point clouds

(Westoby et al., 2012)

BACKGROUND

- Photogrammetry was retrieved by combining the images together from the drone
- In this situation, an area in South East Victoria had a landslide failure which was deterioriating rapidly from one year to the next



PRESENTATION STRUCTURE

Overall processes of Structure from Motion

Introduction to case study

Field Data Acquisition

SfM Computation/Processing

Post Processing (outputs)

Other case studies

STRUCTURE FROM MOTION PROCESS

Phase 1: Field Data Acquisition

- Flight plan type suited for particular terrain or object
- Photo resolution (GSD) and overlap needed for type of terrain or object
- Generate ground control points network
- Drone enabled optical data acquisition (nadir/oblique photos/video)

Phase 2: SfM Computation/Processing

- Automatically identifies matching points in several photos
- Bundle adjustment and step-by-step 3D scene regeneration
- Ground Control Point initialisation to optimise internal and external parameters of camera

Phase 3: Post Processing (outputs)

- Transformation and Georeferencing
- 3D Point Cloud
  Orthophoto
  Digital Surface Model
  Digital Terrain Model

(Zekkos, 2021)

PROCESS

Phase 1: Field Data Acquisition

Flight plan type suited for particular terrain or object

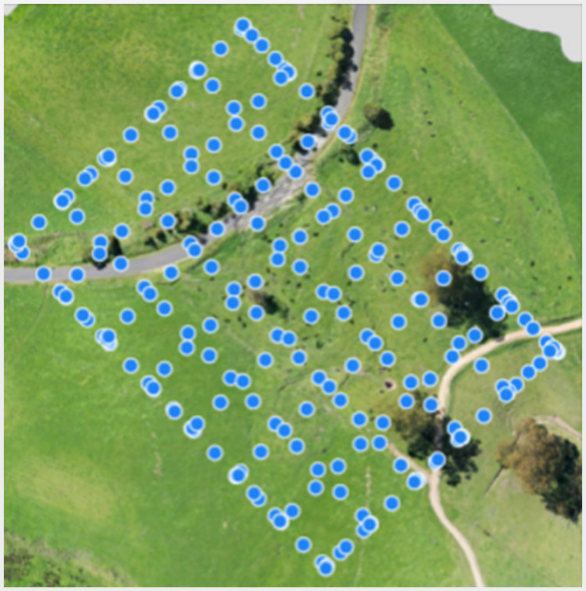
Photo resolution (GSD) and overlap needed for type of terrain or object

Generate ground control points network

Drone enabled optical data acquisition (nadir/oblique photos/video)

FLIGHT PLAN TYPE - AERIAL COVERAGE

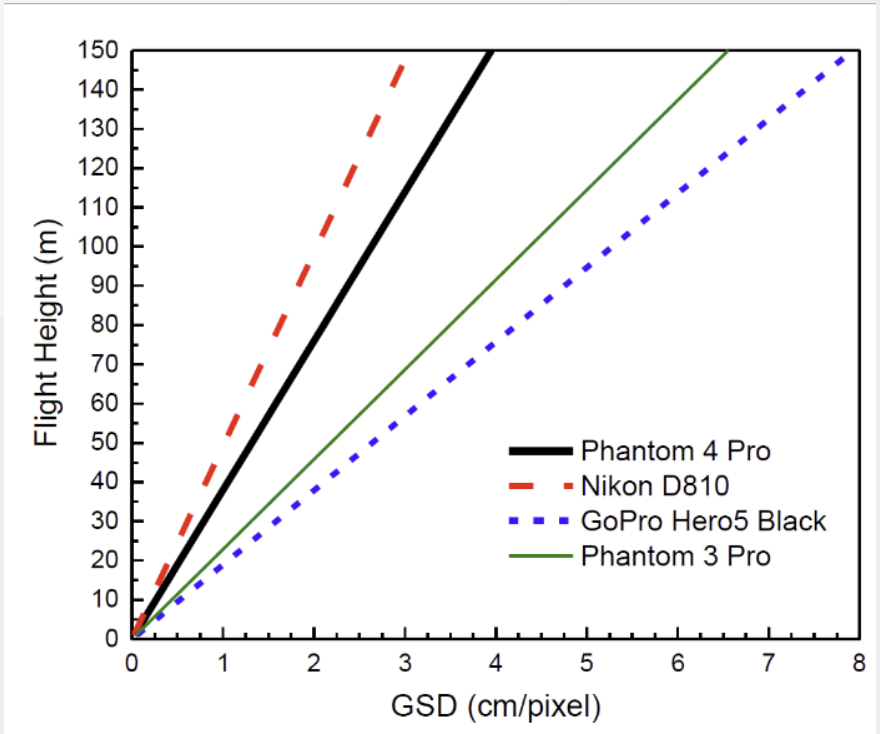
DJI Phantom 4 was used in this mission



Grid plan was used to create a comprehensive 3D model and aerial map

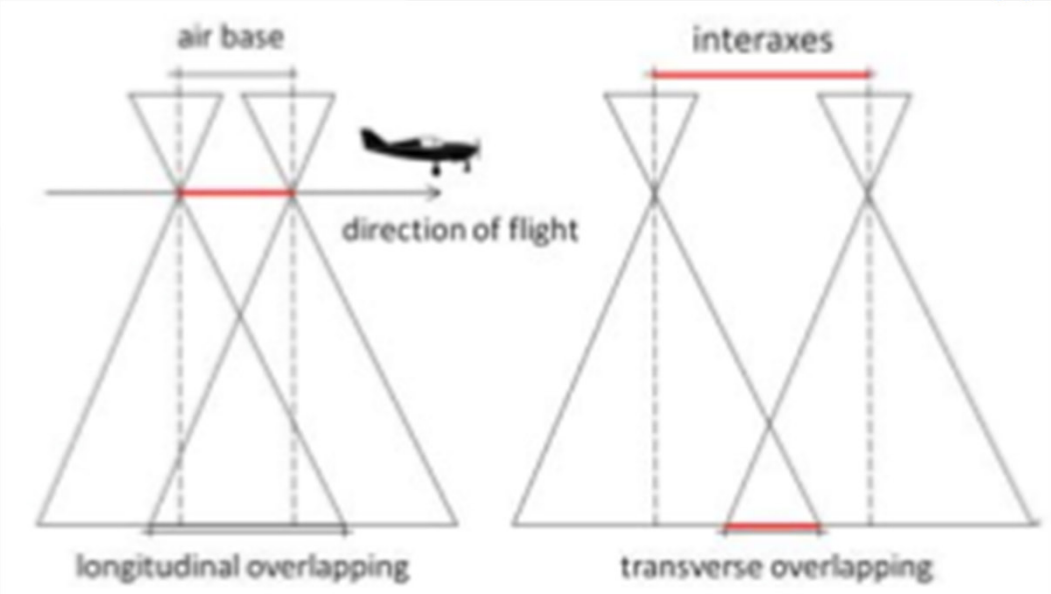
TARGET RESOLUTION

- The GSD will depend on the extent of work you intend to do
- 2 to 10 pixels per dimension are required if you need more specific detail of features



FACTORS FOR DRONE IMAGE QUALITY FOR GOOD MATCHING BETWEEN OVERLAPS

- Decreasing distance between camera and targeted area = increasing spatial resolution of aerial imagery
- Ensure that overlaps are maximised by decreasing the distance between subsequent photo positions



PROCESS

Phase 2: SfM Computation/Processing

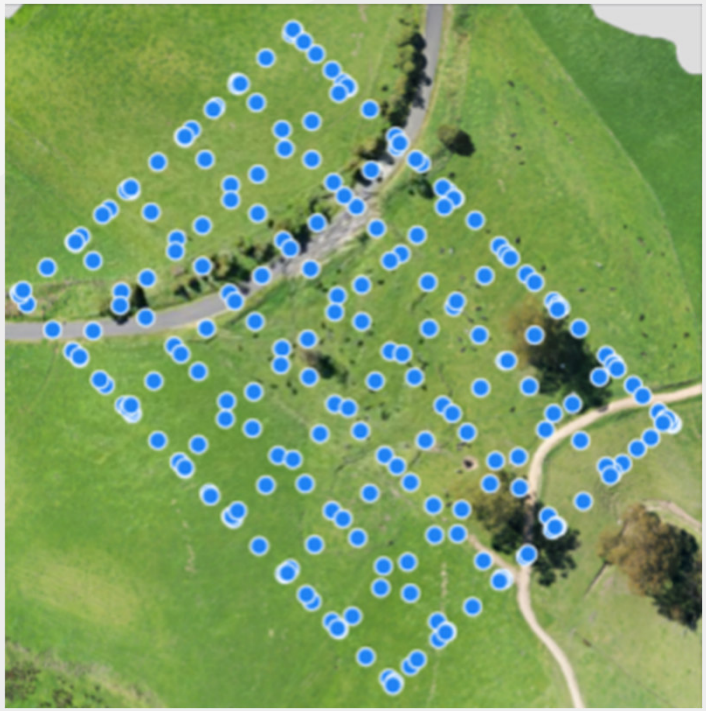
Automatically identifies matching points in several photos

Bundle adjustment and step-by-step 3D scene regeneration

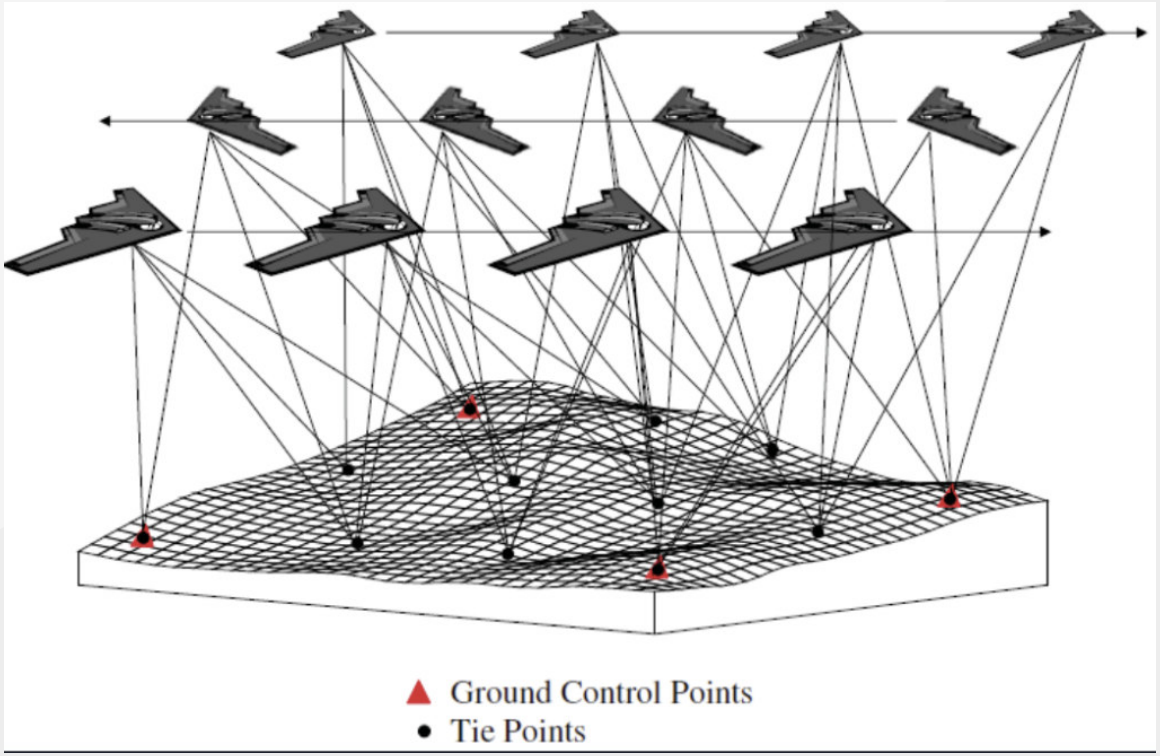
Ground Control Point initialisation to optimise internal and external parameters of camera

STEP 1: MATCH FEATURES FROM SEVERAL PHOTOS

- For good results, you need photo overlap of 70% or more
- Factors affecting results of orthomosaic or 3D model include:
  - Photo resolution
  - Photo overlap
  - Target texture



STEP 2: BUNDLE ADJUSTMENT AND STEP-BY-STEP SCENE RECONSTRUCTION

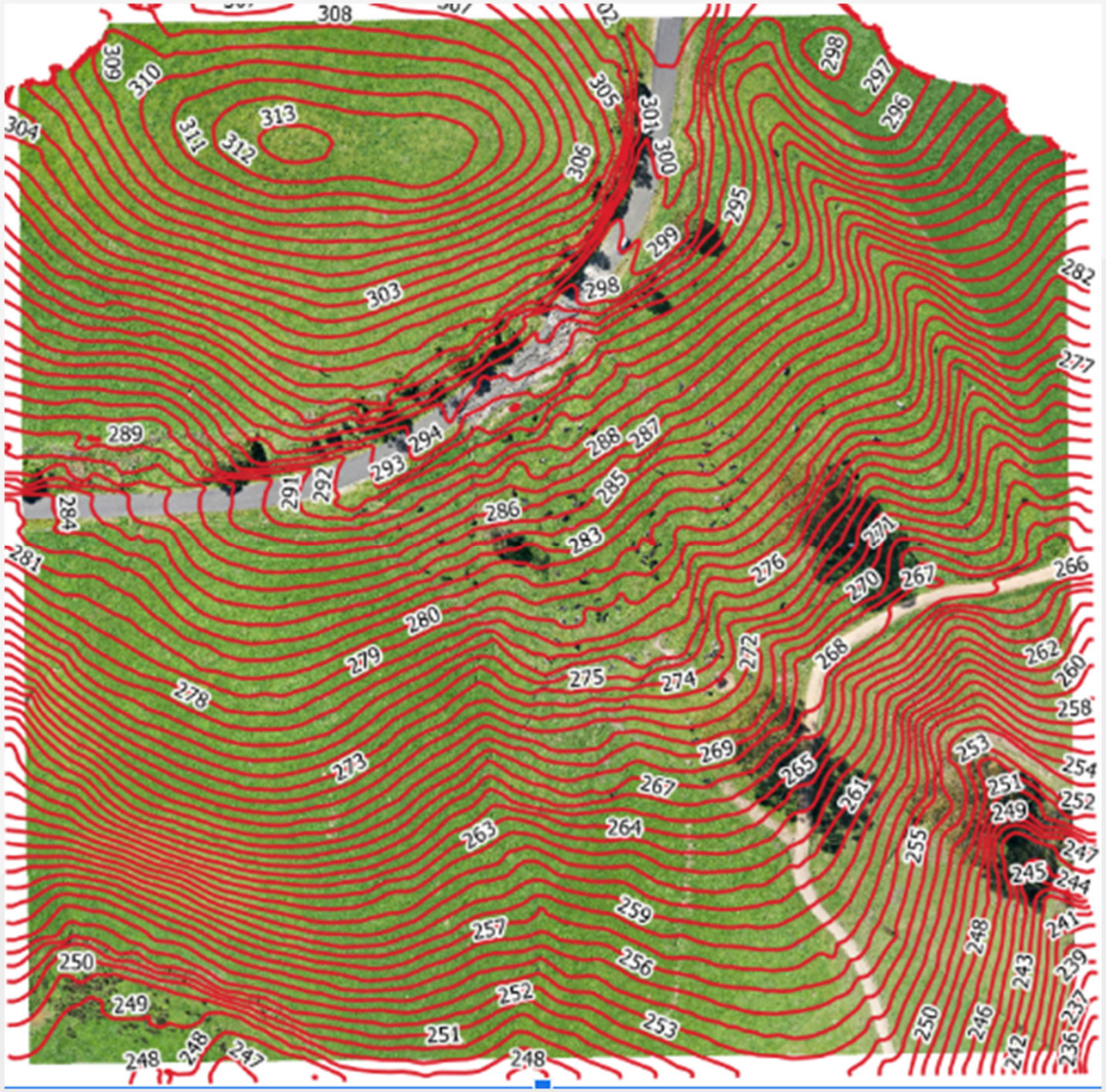


STEP 3: MANUAL TIE POINTS FOR FURTHER IMPROVEMENT OF ACCURACY

- Manual Ground Control Points can be collected from RTK GPS coordinates you have acquired on site
- This will enhance solution processing and georeferencing

STEP 4: POINT CLOUD DENSIFICATION

CASE STUDY 1: CHANGE OF LANDSLIDE BETWEEN 2019 TO 2020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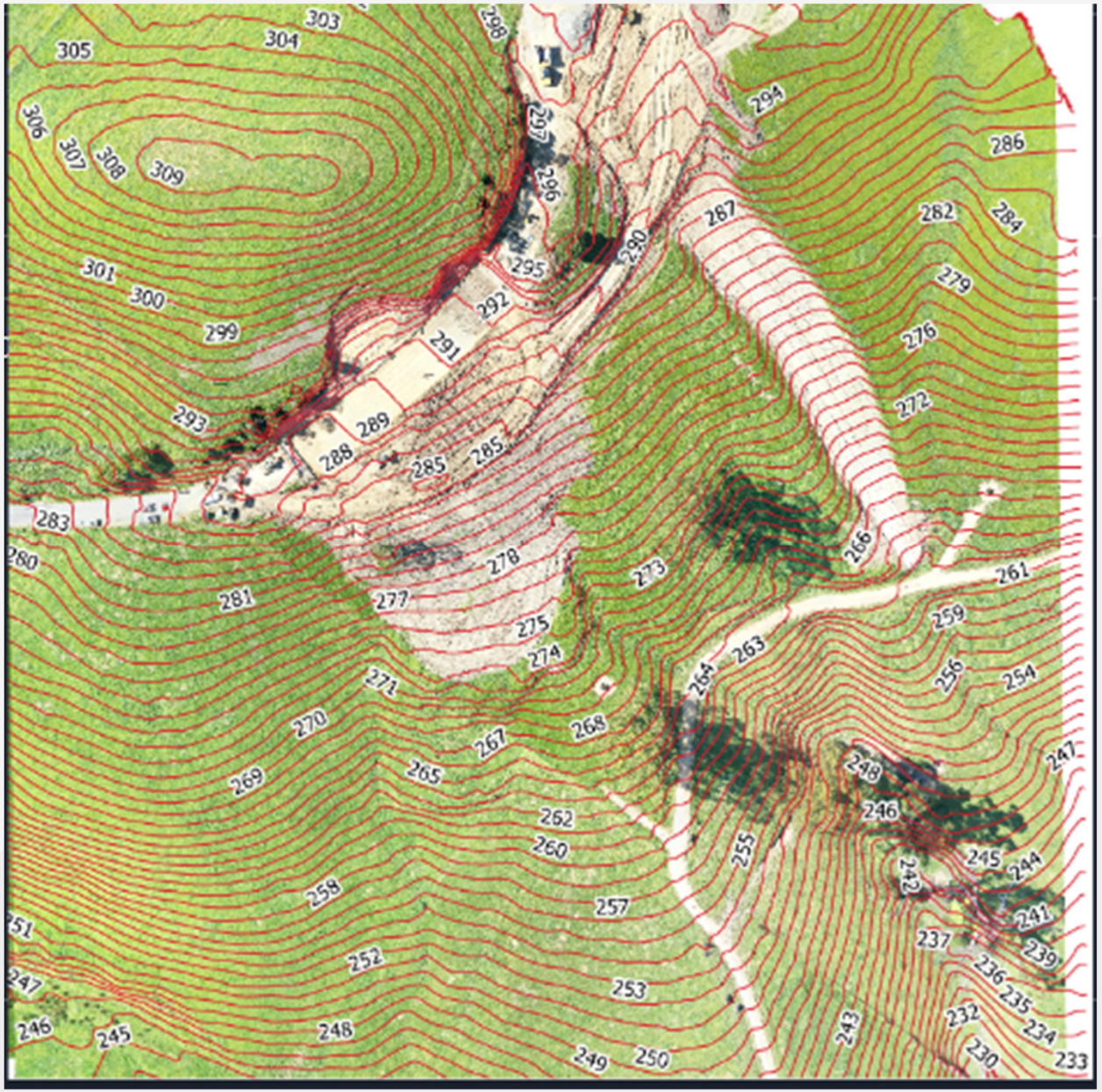
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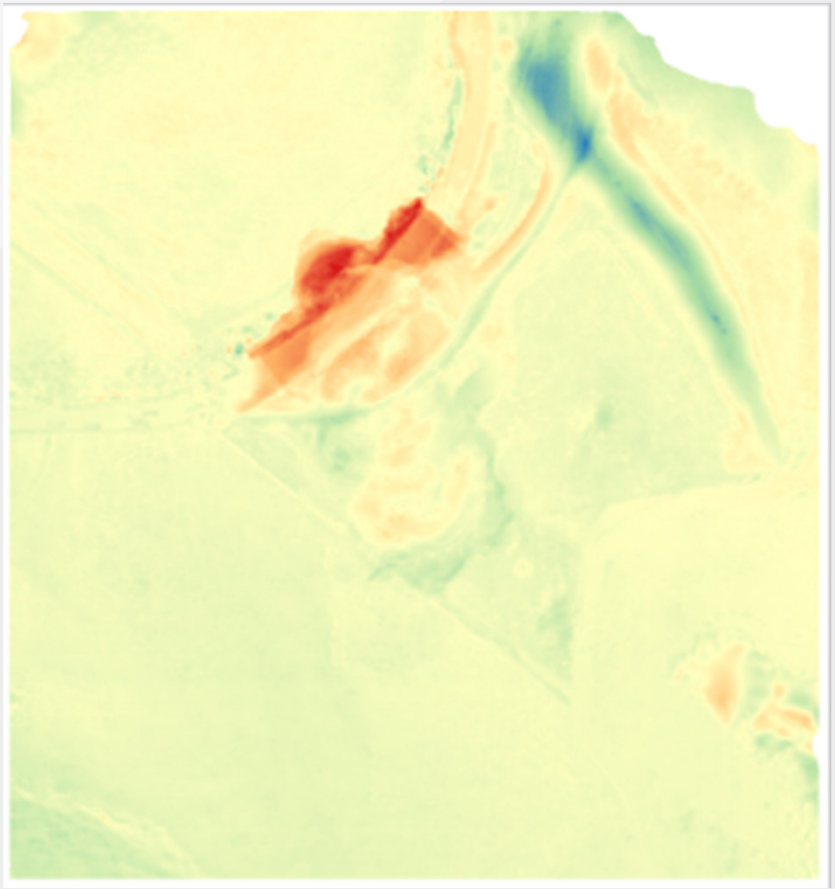
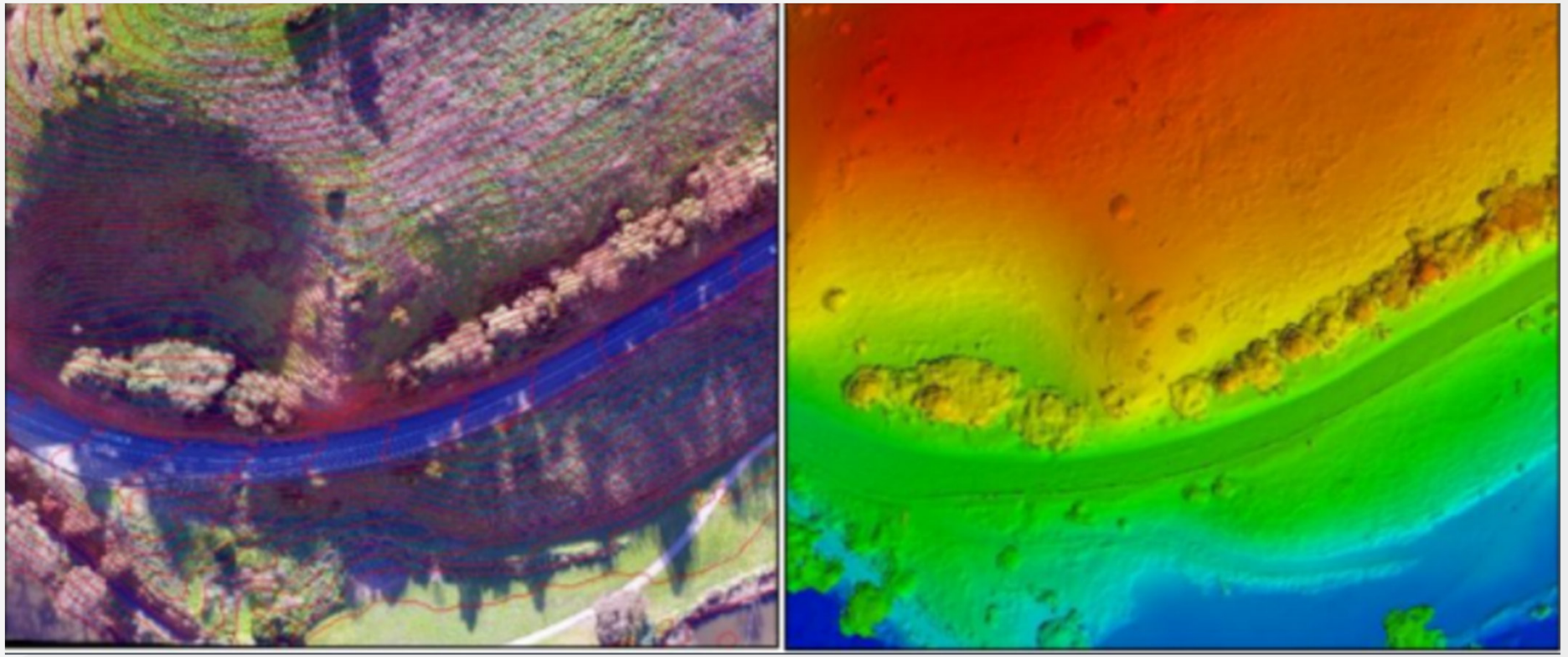
DIFFERENCE IN ELEVATION WITH DTM FOR SEVERITY OF LANDSLIDE

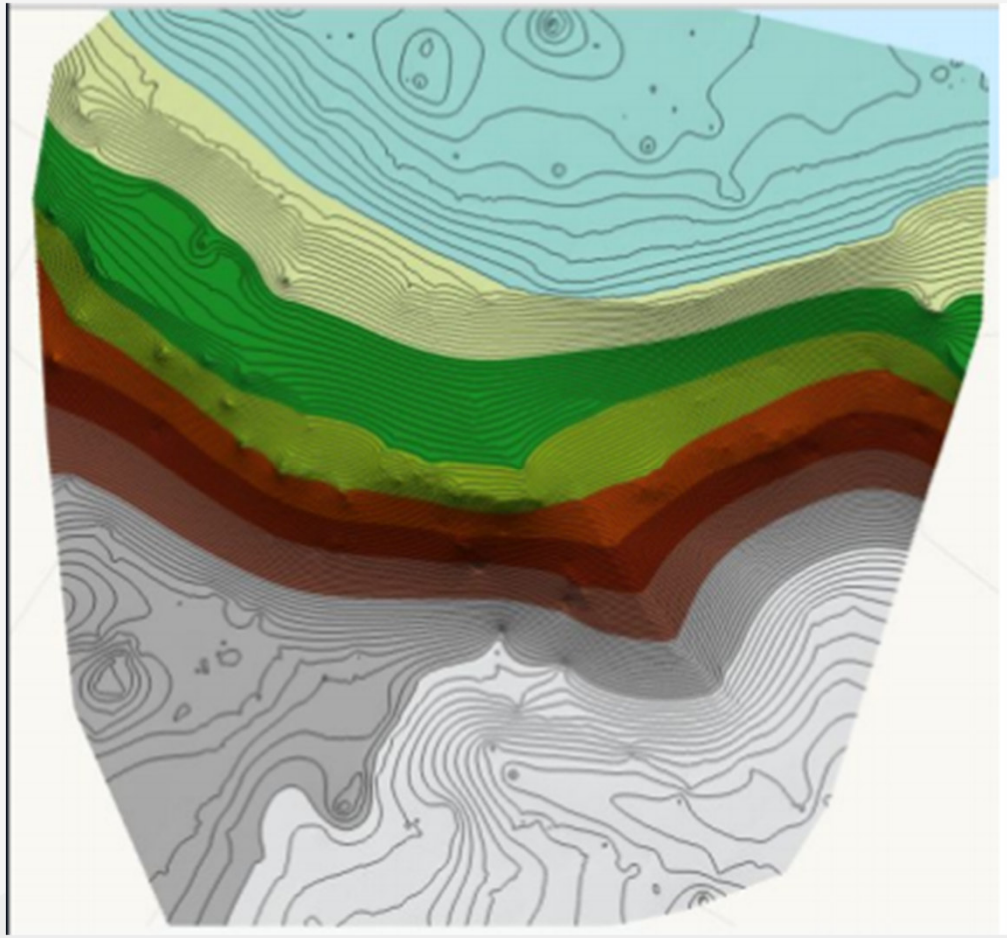
- Subtracted 2019 raster data (less severe) to
- 2020 raster data (more severe)
- The red areas showcase a difference in elevation
- between 1 to 3 metres
- The milder areas indicate that there is no significant change



YOU CAN CREATE DSMS/DTMS



AND YOU CAN CHECK THE SLOPE SEVERITY TO DETERMINE THE SUSCEPTIBILITY OF LANDSLIDE



CASE STUDY #1: EARTHWORKS

December 2023

April 2024

CASE STUDY #2: LANDSLIDE

2019

2020

CASE STUDY #3: ASSET MANAGEMENT

CASE STUDY #3: ASSET MANAGEMENT

Spatial Frontier

Spatial Frontier emphasises creating spatial solutions for businesses, NGOs and government associations for their current needs and their plans by connecting the dots to create a story. We also have plans to distribute surveying and GPS equipment.

To find out more:
www.spatialfrontier.com.au

Ian Darmawan

Founder @ Spatial Frontier | VP, AIYA Victoria | Geospatial Consultant | Stan…

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