FEDS

Case Study

Mountain Corridor Survey for the World's Longest Zipline

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Overview

"Drone survey offers its unique capability in surveying field, especially in mountainous regions where it is difficult and dangerous to access. With our tried and tested procedures and expertise, we could produce data that could rival the accuracy of data obtained from advanced manual surveying techniques. Furthermore, the point cloud generated in drone survey is much higher and denser, which can give a more accurate landform representation."

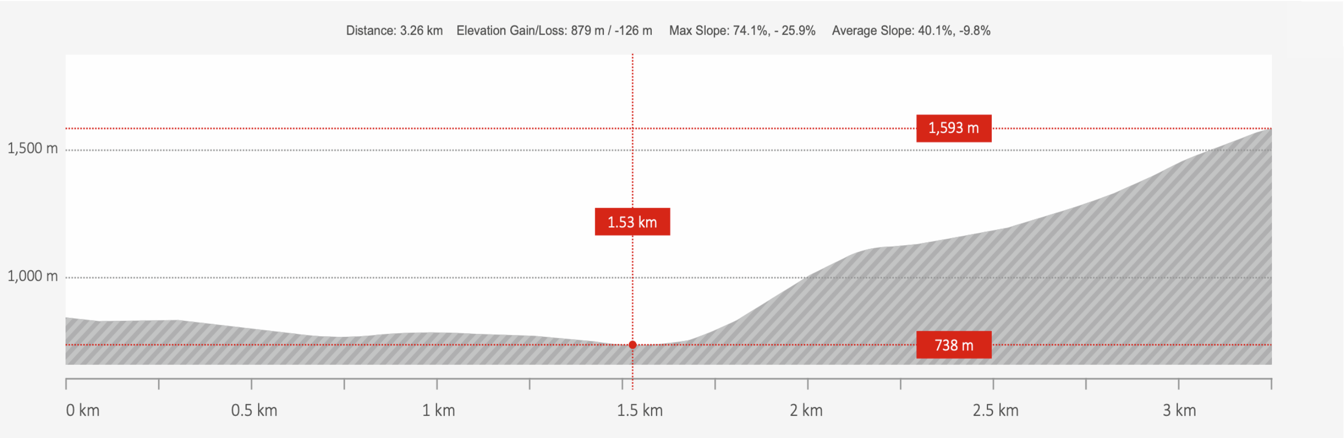
Ting Wen Ong, Project Manager – FEDS

On the first of February 2018, the "Jebel Jais Flight: The World's Longest Zipline" was announced by Ras Al Khaimah Tourism Development Authority. Falcon Eye Drones (FEDS), is proud to be a part of this project back in early 2017.

The world's longest zip line, measuring 2.83 km, is located in the mountainous region of Jebel Jais. Home to the tallest mountain in the UAE, the peak is 1,934 m with an abundance of hiking and mountain biking trails. When the project was initially proposed, there was a huge question of how can the surveyor acquire topography data of the area.

Fixed-wing or Multirotor?

Usually, in a mountainous area, the multirotor drone is more suitable to operate, as it carries less risk for take-off and landing. With the corridor length of 3 km, the multirotor could do two passes (a total of 6 km flight distance) along the corridor, which is not enough to cover the corridor with the required ground sampling distance (GSD). To do a proper corridor survey, a more consistent GSD is required. That's why we chose a fixed-wing drone for this mission, where it can quickly cover more than 60 km in total distance in a single flight.



Corridor survey elevation profile

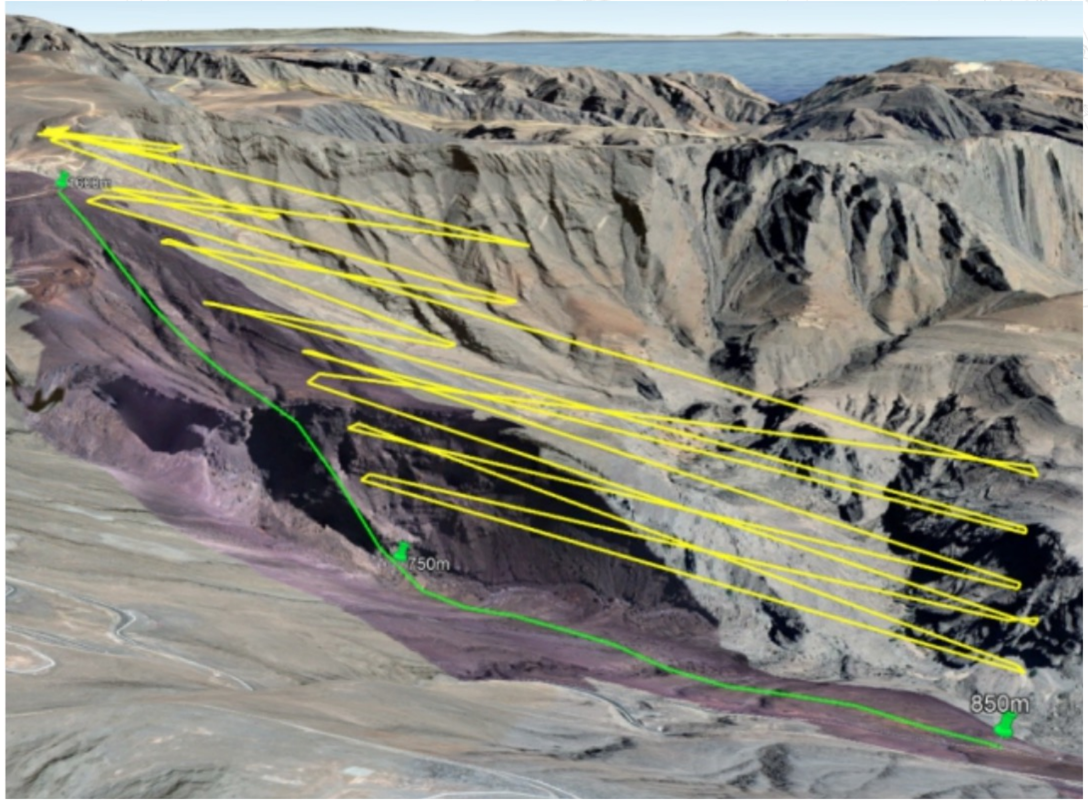
An example of functional and technical differences between deploying traditional survey methods, multirotor drones and fixed-wing drones for surveys.

Flight Planning: The Ultimate Challenge

The most challenging part of this mission is the flight planning. Usually, during a drone survey mission, a flight plan could be generated automatically by mission planning software, and it's planned according to ground elevation data so that the aerial images have a more consistent GSD. With the elevation difference of 1,000 m, the flight planning software could not generate a proper flight plan. When using the usual corridor survey planning, it is impossible for the drone to climb or descend to reach a consistent GSD.

One of the most challenging situations is when there is a change in the corridor. All the mission characteristics including waypoints, distance in between flight lines, and altitude are all calculated manually. If there are any changes in the mission design, it might take a day to modify the flight plan.

We use the “zig-zag” approach to allow the drone to reach its designated altitude. The total flight distance is more than 35 km, and It takes more than 10 passes to cover the whole corridor. The “zig-zag” approach allows us to maintain the GSD between 3.5- 7.5 cm.



Zig-zag flight Plan to ensure efficiency

Ground Truth: Adding ground Control Points

Most of the UAVs are equipped with commercial-grade GNSS receivers, accurate to a few meters. It is essential to add the ground control points to tie all the aerial images to accurate ground points. Ground targets were carefully placed and distributed at the accessible locations along the corridor, particularly at the beginning point and the end point of the zip line. All the ground targets are measured using RTK GNSS equipment with better than 3 cm precision.

Ground target from aerial images

Closing the safest take-off & Landing Spot

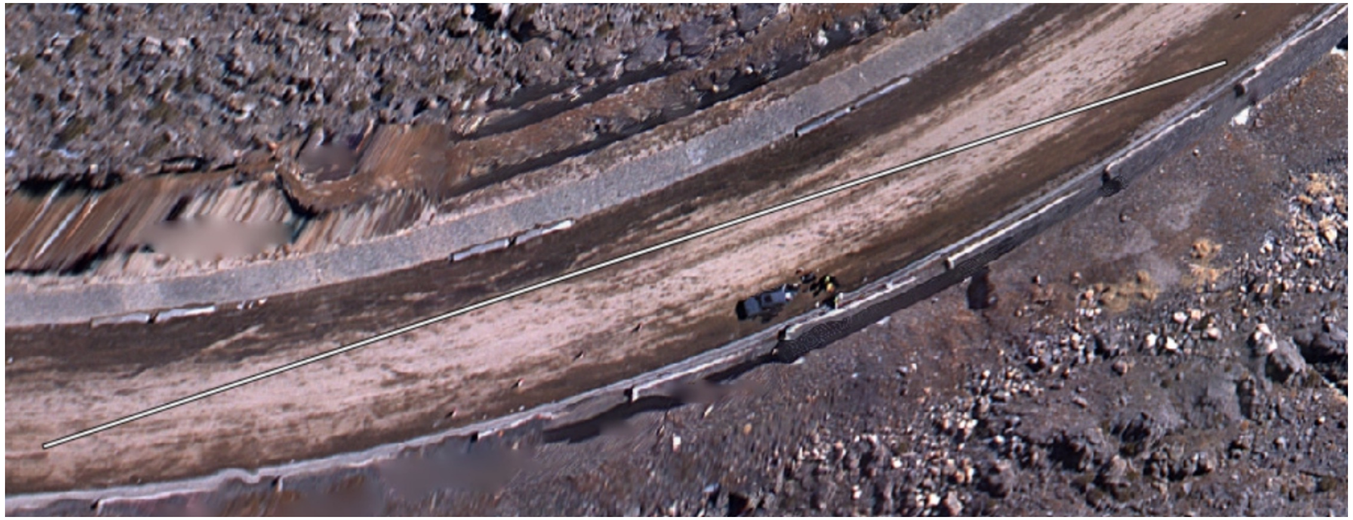
Safety is always our priority in a mission. Our chosen take-off and landing site is on the road under construction. The size of the landing strip measured around a length of 130m and a width of 12 m. One side of the road is a mountain wall, while another side of the road is a cliff; making the cliff side the opening for a go-around. The landing proved to be a challenge for us, it took three go-arounds and required a change in approaching direction for us to land the UAV successfully.

To increase the safety measures of the mission, we deployed 2 additional assistants to monitor the traffic along the road, especially when the UAV was approaching the strip so that the external pilot could focus on the UAV, and the internal pilot could focus on the ground control station. Operating at an elevation of 1,600 m, the UAV flew below our ground station for most of the time!

Data Accuracy

In a photogrammetric project, we use checkpoints to evaluate the accuracy of the data. Checkpoints are the ground control points that are not used during automatic aerial triangulation (AAT) and bundle block adjustment (BBA). Usually, for any photogrammetric project, the accuracy in Z is around 1-3 GSD. Surprisingly, all the checkpoints in this project are accurate within 1 GSD! Some of the factors that contribute to this achievement are:

- Moderate temperature: The camera is relatively stable when there are no big fluctuations in temperature.
- Light wind: The altitude of the UAV was stable throughout the flight, most of the aerial images are in near nadir.
- Camera settings: Sun condition changes throughout the flight, and camera settings were changed to produce well-exposed images.



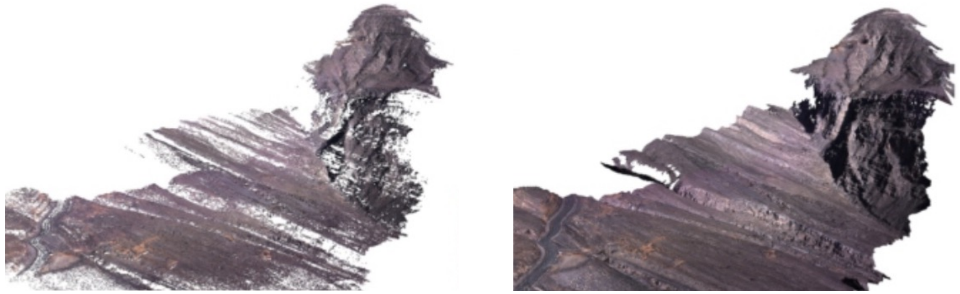
Landing Strip: Length 130 m, Width 12 m

Resolution
3 cm

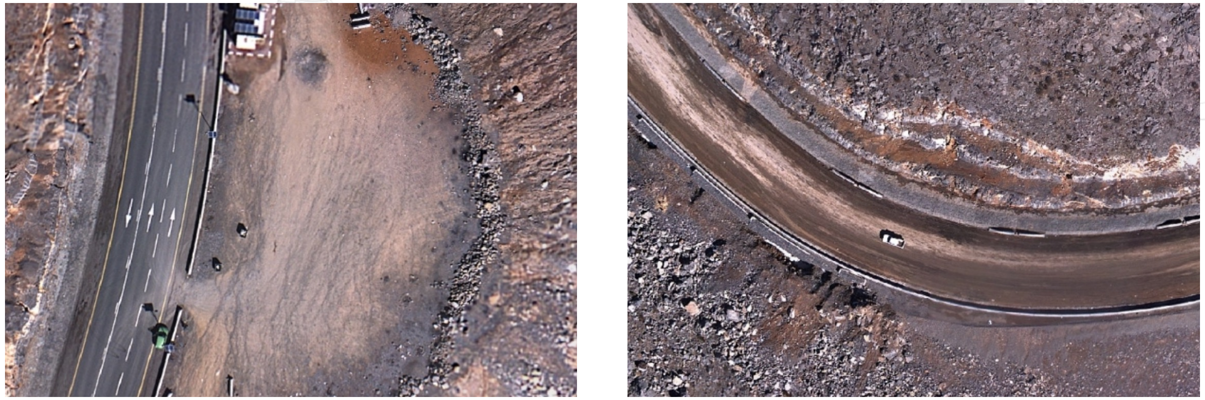
Accuracy
3 cm / 8 cm

Deliverables

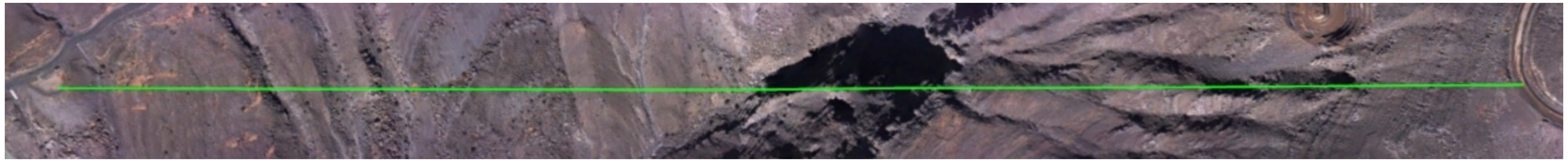
The 3D points generated are more than 5 points within a square meter. Furthermore, to have better data visualisation, the 3D points are interpolated to a densified point cloud. One of the advantages of drone surveys is the generation of orthomosaic, where you could have an overall view of the site.



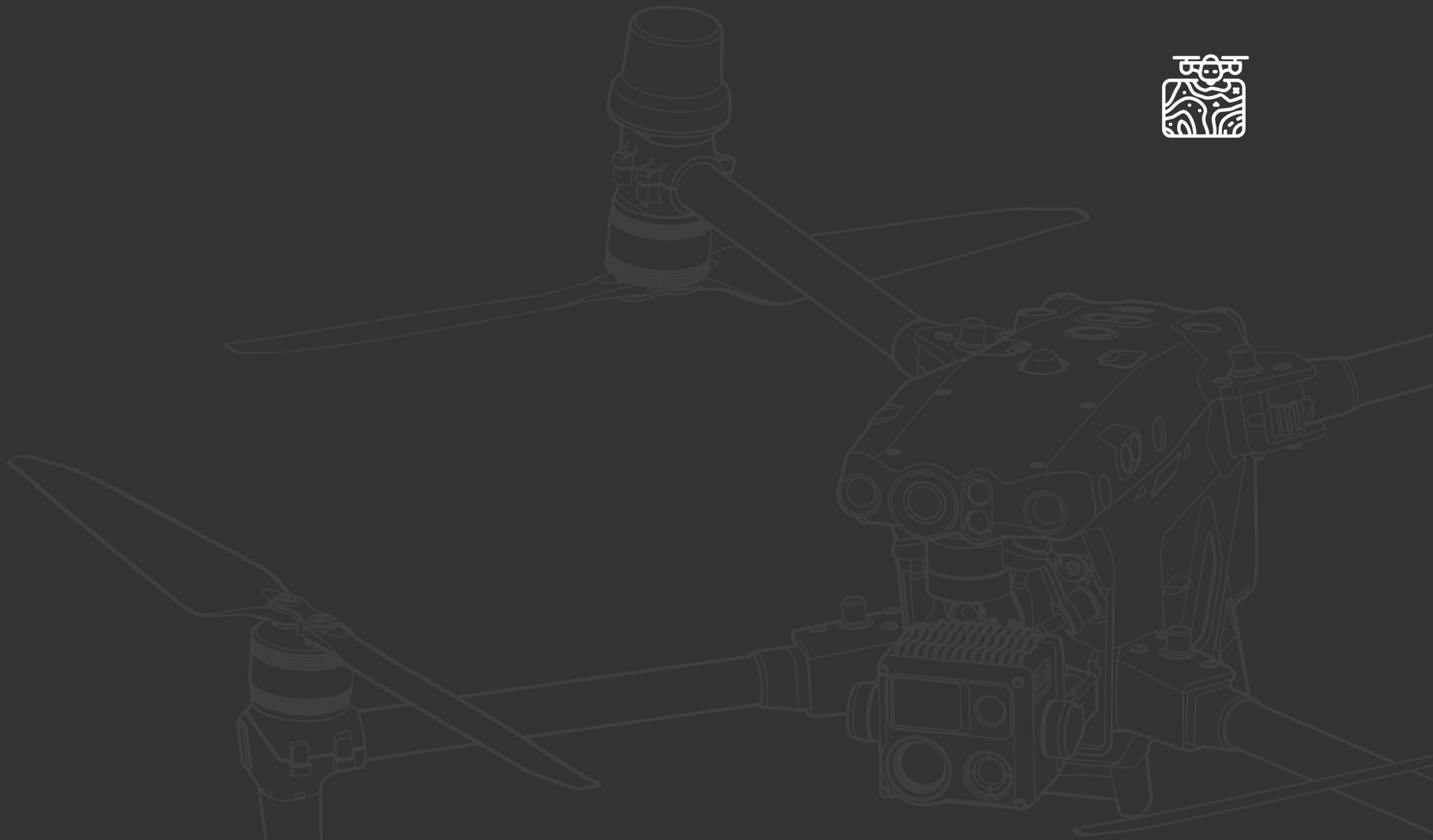
Point Cloud, before and after interpolation



High resolution aerial images



Orthomosaic



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