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AND Locate25
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Comparative Accuracy of GNSS, NTRIP, and Base Station UAV Surveys

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The Growth of UAV's within the Surveying Industry

The drone industry is set to grow by 9.6% each year globally and is forecasted to be worth over US $70B by 2029.

Due to the advancement in onboard positioning systems, drone surveys are rapidly replacing traditional survey methods in multiple sectors of the industry.

To replace methods such as a total station, sub-centimetre accuracy is often required.

Reasons for this Study

The baseline precision of the onboard positioning system is often overlooked.

Extensive research into conventional GNSS systems but not NTRIP and RTK base corrections when UAV surveying.

To identify environmental factors that effect each of the positioning systems.

To determine if any of the systems are viable for sub-centimetre accuracy.

Research Methods

The study aimed to identify factors effecting UAV GNSS accuracy through various experiments at rural, urban and coastal sites.

The two specific sites of interest were the Pennines near Manchester due to poor GNSS coverage and the Sports Field at the University as a control site for Total Station comparison.

3 identical surveys were flown at every site producing a data set for each system. All flights were conducted using a DJI Mavic 3E with the RTK module.

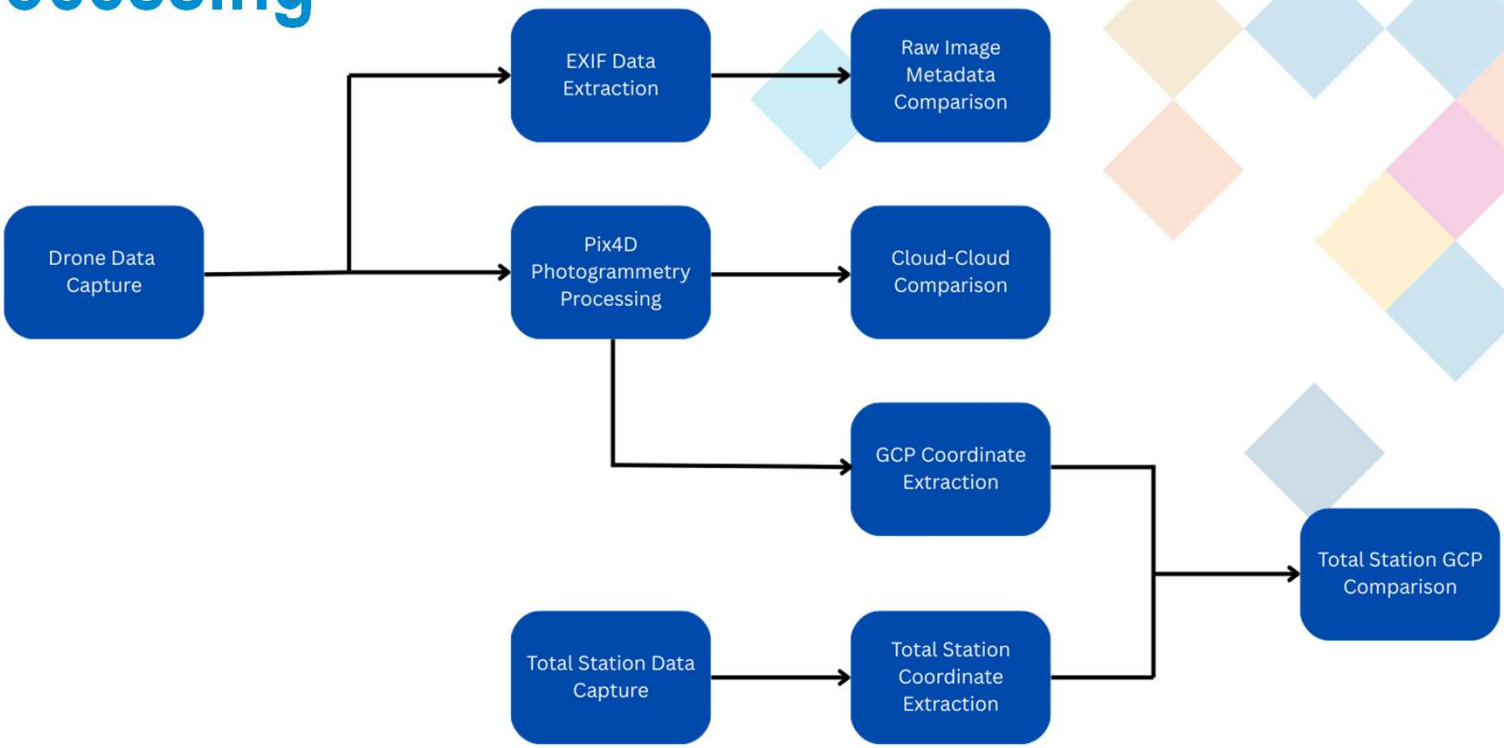
Total Station Data Comparison

9 GCP's were equally spaced on a 3x3 grid at the sports field with a 3 different elevations.

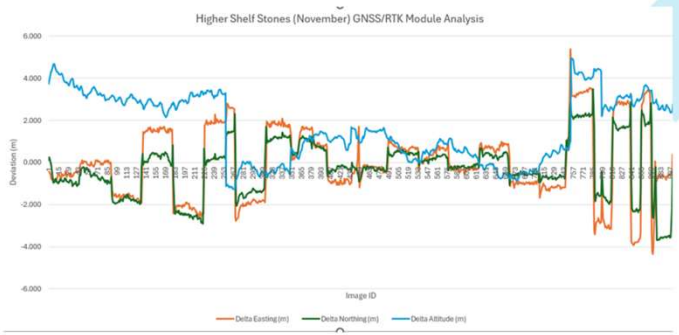
A 0.5" total station measuring to <1mm accuracy calculated the distances and elevations between each point.

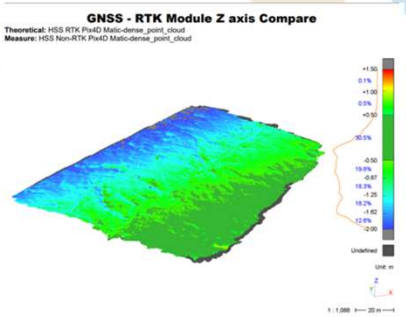
The drone surveyed the grid and the GCP coordinates were extracted from the point cloud.

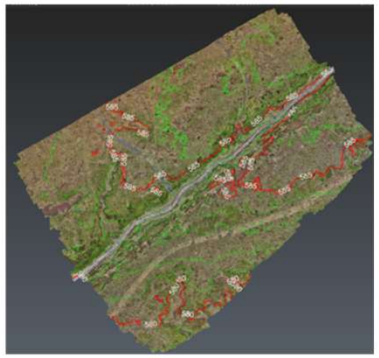
Data Processing

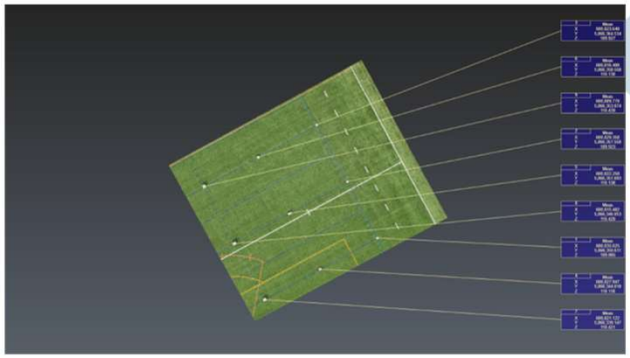


Data Processing









Analysis

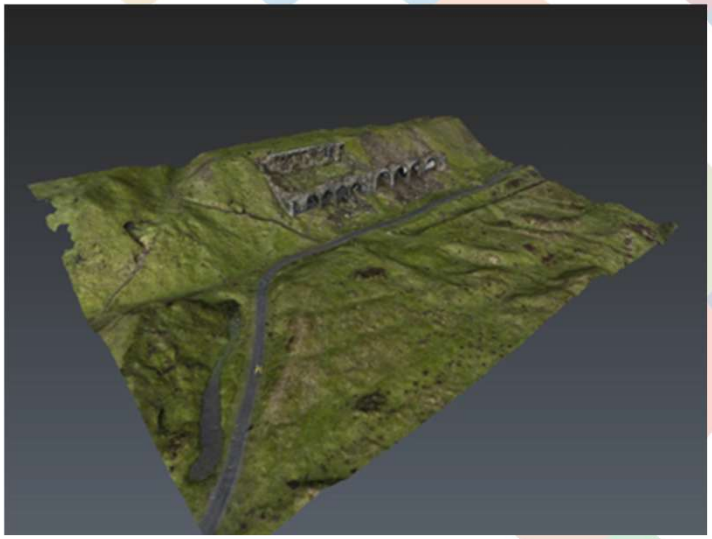
Subject	Details
Altitude Estimation	When GNSS is corrected with RTK, the range in altitude estimation can be reduced by as high as 95% depending on the site conditions. In areas of poor GNSS coverage an onsite base station can significantly improve performance.
Poor turning circle	The raw data indicates that the turning circle of the drone is not consistent with each flight.
Processing interpolation	Cloud-cloud analysis displays significantly lower deviations than the raw data showing the level of photogrammetry interpolation. Could lead to errors.
GCP image overlap	GCP's not captured in the same image display higher point-point deviations, which increases at larger distances.
NTRIP inconsistency	The NTRIP system produced higher data ranges than the onsite base likely due to loss of connection or delays from the server.

Conclusion

All systems can achieve a GCP point-point mean accuracy of ±25mm however an RTK Base station outperforms the other two systems with a mean point-point accuracy of ±10mm and 1σ STD upper boundary of ±15mm.

NTRIP can achieve higher accuracies however it is inconsistent and not suitable for challenging environments.

An RTK system will reduce the altitude estimation from metres to values within expected drone movements.



The most relevant SDGs related to the presentation and theme of this session

1st relevant SDG

2nd relevant SDG

3rd relevant SDG

SUSTAINABLE DEVELOPMENT GOALS

International Federation of Surveyors supports the Sustainable Development Goals