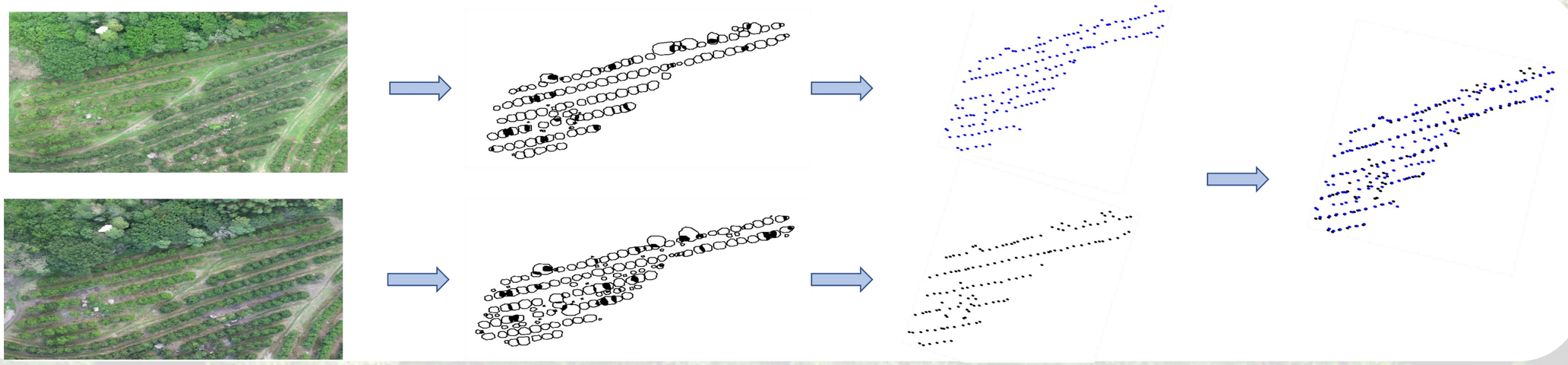
TREEREG:
Detection Based Registration

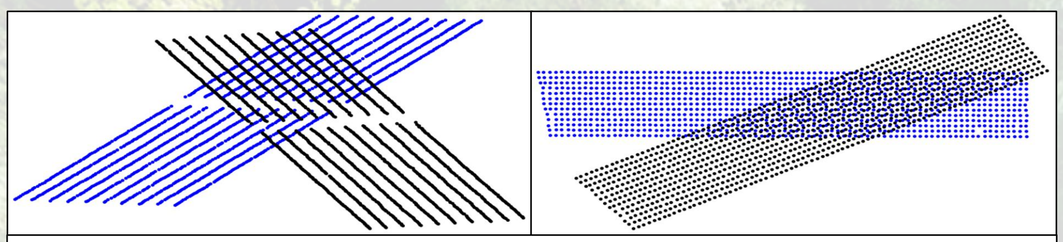
Using tree instance detections to accurately align images of orchards taken at different dates.

OUTLINE

- Image registration is the process of aligning two or more images of the same scene taken at different times, from different viewpoints, and/or by different sensors.
- The main goal of this project is to register two orthomosaic images of orchards taken at different times.
- Individual tree segment polygons were provided by Aerobotics to be used as the base of registration.
- The implemented processes should be completely automated and comparable in accuracy to the current human-based approach at Aerobotics.
- Two probabilistic Point Cloud Registration algorithms were used: Coherent Point Drift and Robust Point Matching.



POINT CLOUD REGISTRATION PROCESS



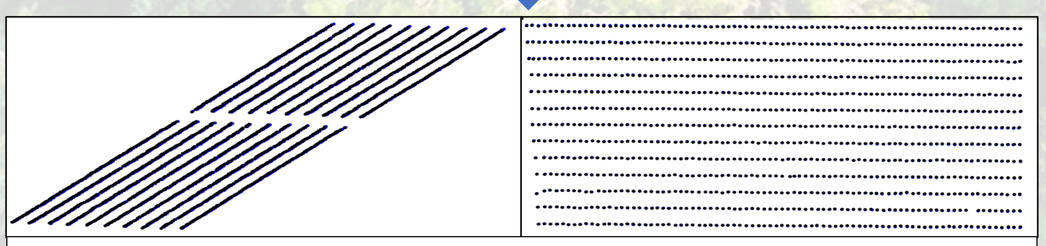
Input: Sets of Misregistered Point Clouds

Robust Point Matching (RPM)

- Point correspondence estimation using cost function and soft assignment
- Transformation parameters estimation using coordinate descent
- Control Parameter

Coherent Point Drift (CPD)

- Input point sets modelled as observations of a Guassian Mixture Model (GMM)
- Probability of point cloud alignment calculated using the variance of the GMM
- Transformation parameters estimated to maximize alignment probability
- (Loop until optimal alignment)

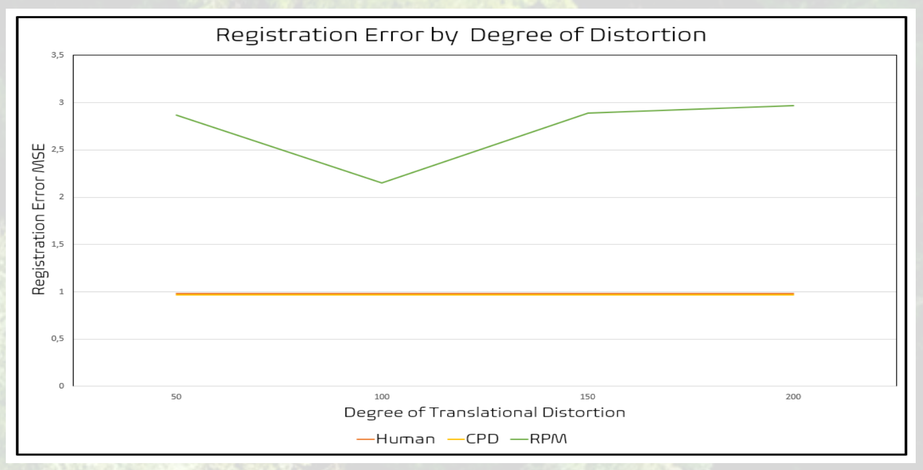


Output: Sets of Registered Point Clouds

RESULTS

	Human Method		CPD		RPM	
	MSE	Time (sec)	MSE	Time (sec)	MSE	Time (sec)
Orchard 1	2.61	≈600	2.63	0.04	6.40	70.2
Orchard 2	0.19	≈600	0.14	56.11	0.16	9024
Orchard 3	0.15	≈600	0.14	6.55	0.21	2079

The above table displays the average registration error (MSE) and time of each method over all tests on all orchard datasets. As seen, the methods do come close to the human method's accuracy, with CPD beating it in some cases, in a fraction of the time.



The above graph displays the registration error of each method over a wide range of distortions applied to the input data. CPD is shown to show consistent accurate results, matching the human method, over all distortions.

CONCLUSIONS

This investigation showed that two Point Cloud Registration methods, CPD and RPM, were capable of automatically registering multitemporal orchard images using tree detections as inputs. This was shown by the similarity in their registration accuracy to the human method over a wide range of distortions applied to the data. Thus the aim of the project was met.

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