



XXVII FIG CONGRESS

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Volunteering
for the future –
Geospatial excellence
for a better living

A first step towards automatic construction progress monitoring (11665)

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ORGANISED BY

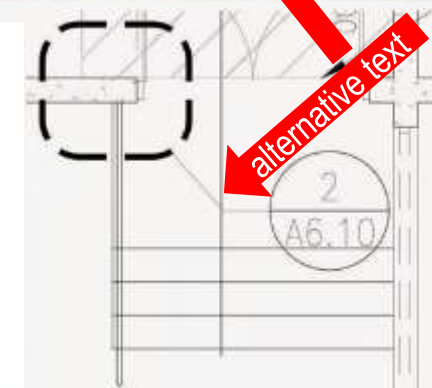
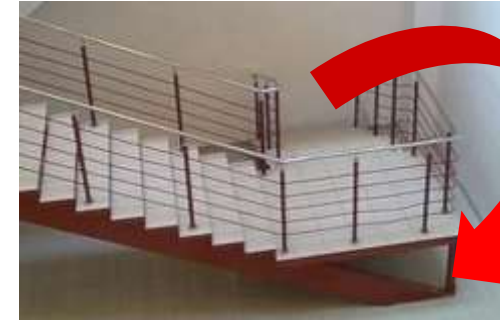


FACULTY OF ENGINEERING
AND ARCHITECTURE

PLATINUM SPONSORS



Introduction



Theory

- Progress monitoring
 - design = BIM
 - as built = (laser scan) point cloud
- Problem
 - reference system as built \neq reference system design
 - manual georeferencing of as built and design model \Rightarrow time consuming + requires specialist knowledge



Theory

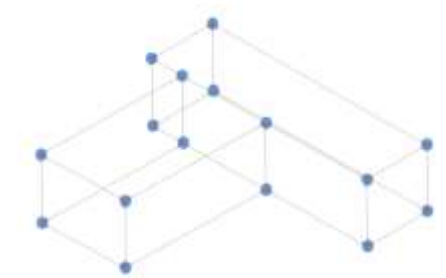
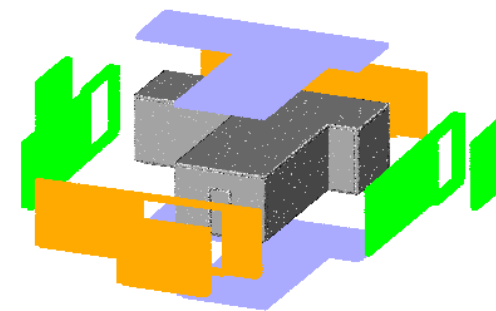
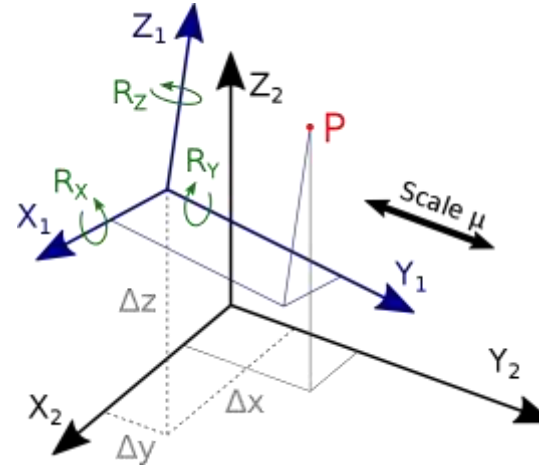
- What is new?

semi-automated coarse registration (or geo-referencing) methods,
to be used for *incomplete* as-built models >> *progress monitoring*
clutter-proof

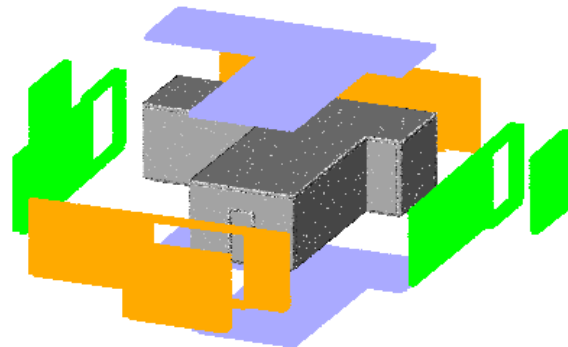
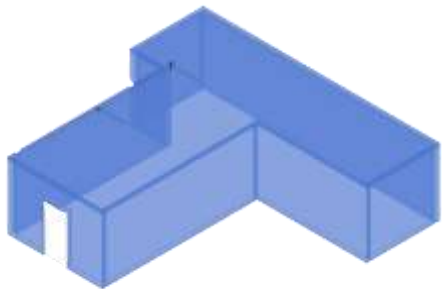
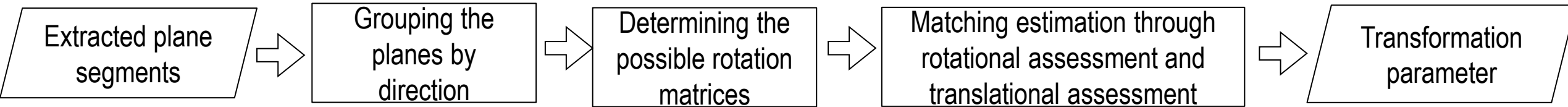
- What is it not?
a fine registration method >> several existing algorithms (ICP)

Method

- geo-referencing (registration process)
 - coordinate transformation
 - 3 rotation parameters
 - 3 translation parameters
 - laser scanning \Rightarrow scale factor = 1
 - calculation of transformation parameters based on
 - building geometry
 - plane segments (plane-based method)
 - corner points (corner point-based method)

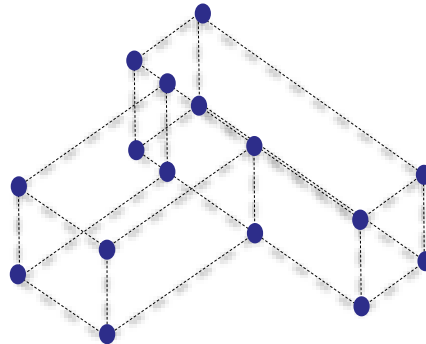
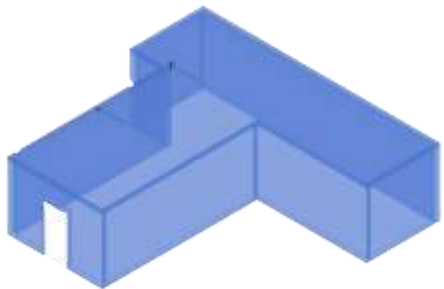
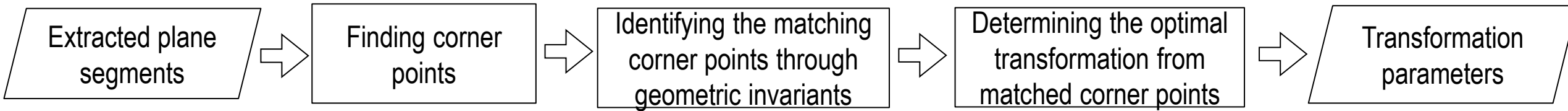


Workflow PLANE-based method



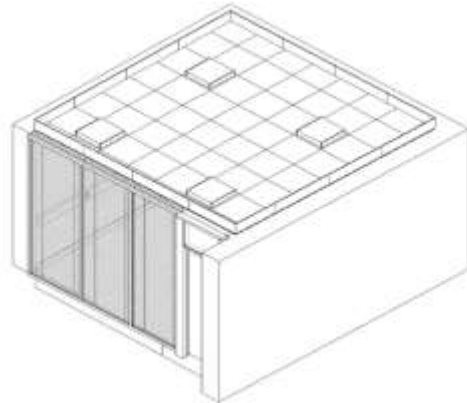
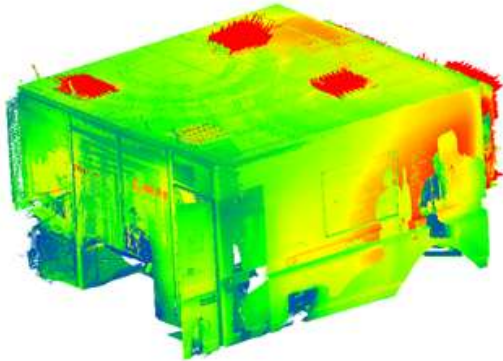
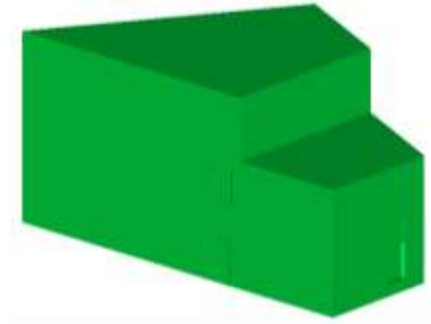
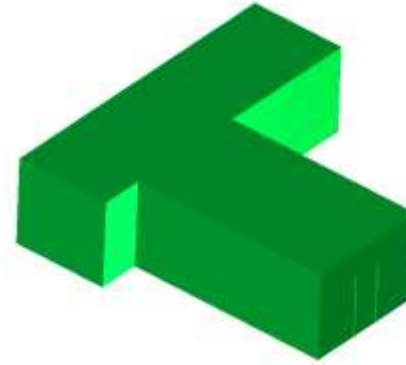
Ref: Sheik, N.A.; Deruyter, G.; Veelaert, P. Plane-Based Robust Registration of a Building Scan with Its BIM. *Remote Sens.* **2022**, *14*, 1979. <https://doi.org/10.3390/rs14091979>

Workflow CORNER POINT -based method

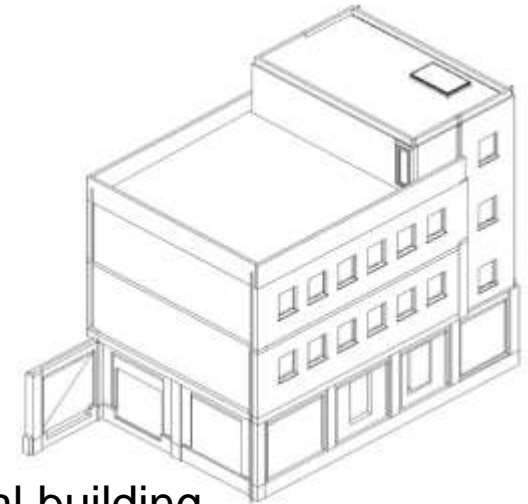
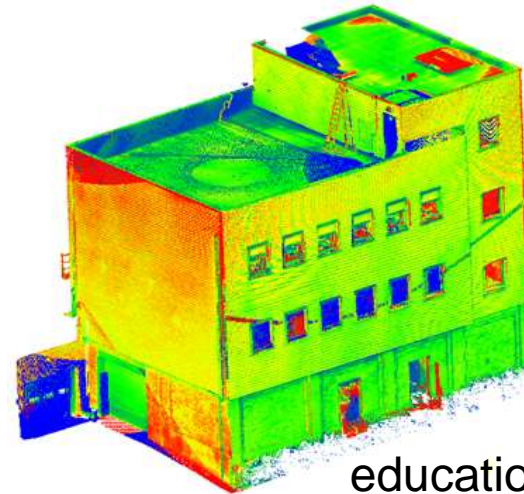


Results

- Simulated datasets: for testing the algorithms
- Real-life datasets



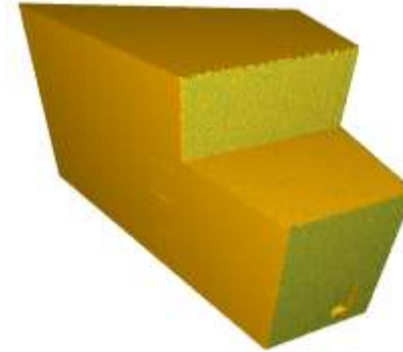
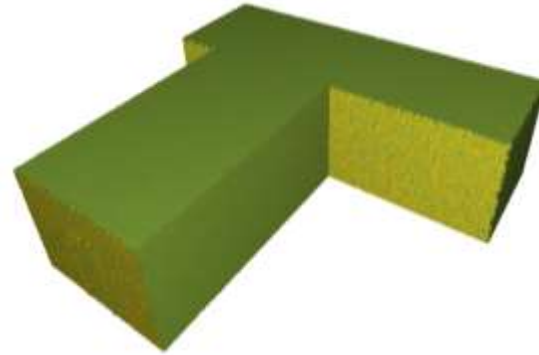
conference room



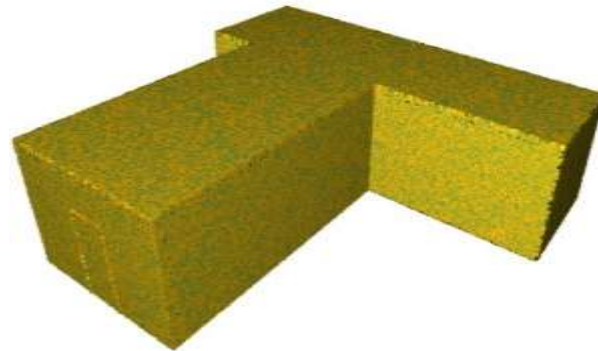
educational building

Visual results simulated datasets

PLANE-based



CORNER POINT -based



BIM: green

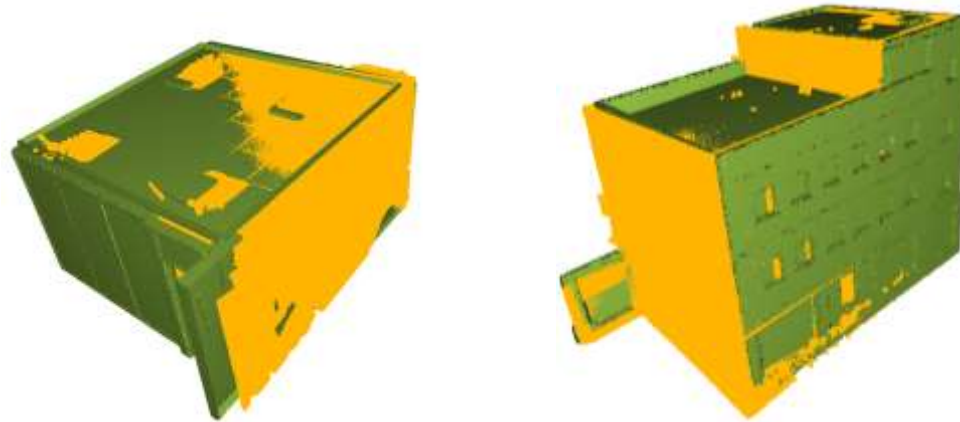
point cloud: yellow

Visual results real-life datasets

PLANE-based





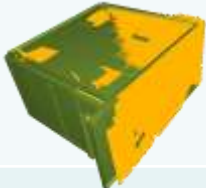

CORNER POINT -based



BIM: green

point cloud: yellow

Results - analytical

	PLANE-based			CORNER POINT -based		
	RMSE [mm]	X_R [°]	X_T [mm]	RMSE [mm]	X_R [°]	X_T [mm]
simulated (1 floor) 	7.2	0.007	29.2	7.5	0.002	4.0
simulated (2 floors) 	8.8	0.005	35.4	8.5	0.003	7.8
conference room 	18.1	0.027	94.3	15.9	0.015	37.6
educational building 	17.8	0.021	107.1	16.1	0.009	39.7

Results: limitations

- Plane-based method
 - as-built point cloud: minimum 3 plane segments in distinct directions
 - size of as-built planes \neq size of BIM-planes
- Corner point-based method
 - minimum 2 corner points (= 6 plane segments) in the scan model
 - minimum one corner point non-symmetric relative to the others

Conclusion

- Progress monitoring
 - building cost ↘ efficiency ↗
 - recurrent accurate registration of as-built point clouds
- Existing registration algorithms
 - specialized human intervention
 - or completed buildings

Conclusion

- Proposed methods
 - based on common dominant geometries
 - less sensitive for noise and outliers
 - suitable for incomplete buildings
- Corner point-based
 - more accurate
- Plane-based method
 - more suitable in early stages of the construction process
- Basis for automated progress monitoring

thanks

