



FIG  "From the wisdom of the ages
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Applied surveying education: documenting cultural heritage in 3D in the city of Ghent (Belgium) using laser scanning and photo modelling

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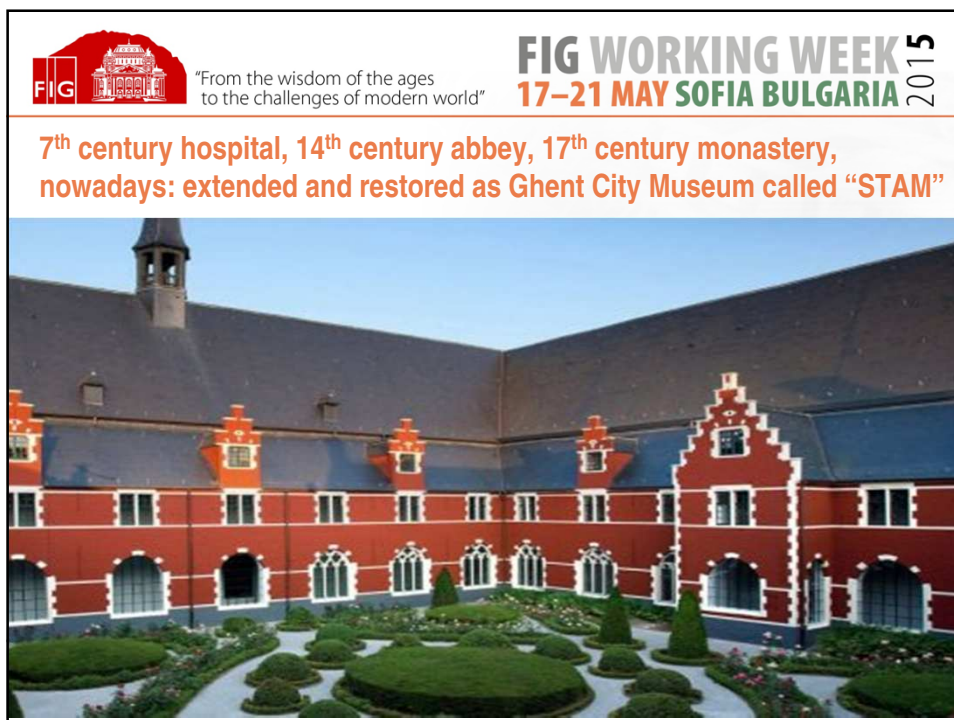



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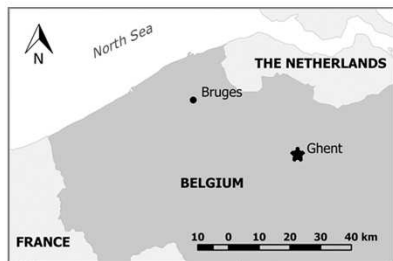
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**7th century hospital, 14th century abbey, 17th century monastery,
nowadays: extended and restored as Ghent City Museum called "STAM"**

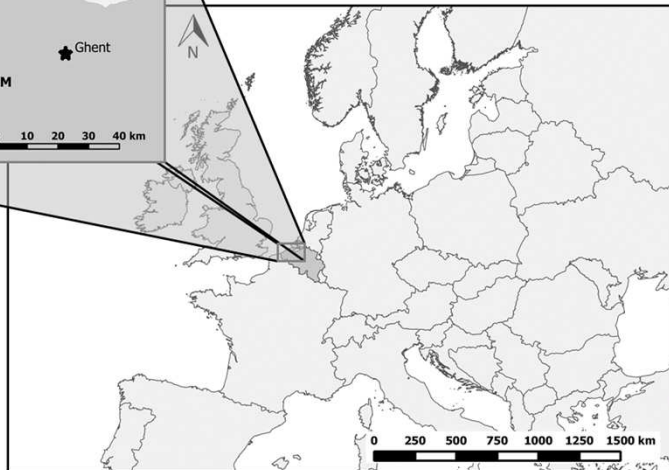


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Location: Ghent City Museum (STAM)



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- **City of Ghent (Belgium) and the Ghent University, Department of Geography work together to document and measure important cultural heritage sites in 3D.**
- **This partnership enables Master students in Geomatics and Surveying at the Ghent University to take part in a project driven measuring campaign: the Data acquisition of the Ghent City Museum (*Stadsmuseum* or *STAM*).**
- **After successful completion of the course, students have gained a significant expertise concerning the processing of topographic data, 3D point clouds and imagery in an integrated way**





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Data acquisition using

1. Engineering surveying with total station and GNSS
2. Photo modelling
3. Terrestrial laser scanning

Expected results:

1. extensive quality control by comparison of the techniques
2. high-level 3D model
3. orthophoto maps useable for documentation/restoration



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1. Engineering surveying using GNSS and total station

- Determination of a first set of ca. 10 Ground Control Points (GCP) with Trimble R8 (FLEPOS) RTK-GNSS receivers (1-2 cm), to georeference all measurements in the Belgian Lambert72 conic coordinate system (EPSG 31370)
- Second set of GCPs consists of highly distinguishable features on the walls (min. 40/wall), measured by Trimble M3 total stations and connect to the GNSS points.
- A third set of points are the target points used for the terrestrial laserscanning, also connected to the GNSS points.





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2. Photo modelling

- Canon EOS 1Ds camera (11 Mp), full frame (24mm x 36mm), 50 mm lens, photoscale approx. 1/500 (ca. 25 m distance).
- Images are processed using a Structure from Motion and Multiview Stereo (SfM-MVS) workflow (software: Agisoft Photoscan Professional)
 - Detection of feature points
 - Feature point matching between consecutive images
 - Building of a 3D geometry using triangulation or meshing
 - Texture map is added
- Results: 3D point cloud with photorealistic colors, 3D meshed geometry with texturing, orthophoto maps,...



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2. Photo modelling: resulting 3D model





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3. Terrestrial laser scanning

- Leica phase-based laser scanner HDS6100 (accuracy of 1-2 mm at 25 m distance).
- Resolution level of 0.018° → a point spacing of 8 mm at a distance of 25 meter.
- Processed using target-to-target registration in Autodesk Recap Pro
- point cloud with artificial colors (reflection strength)



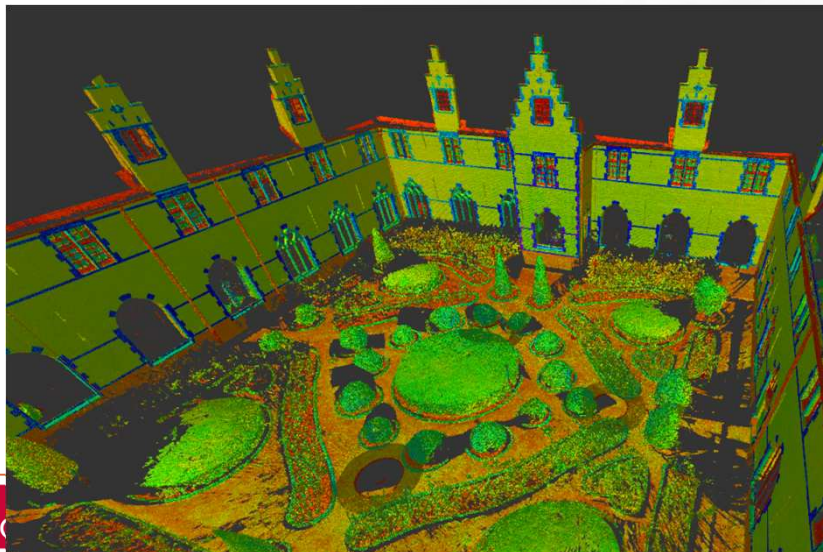
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3. Terrestrial laser scanning: resulting 3D model

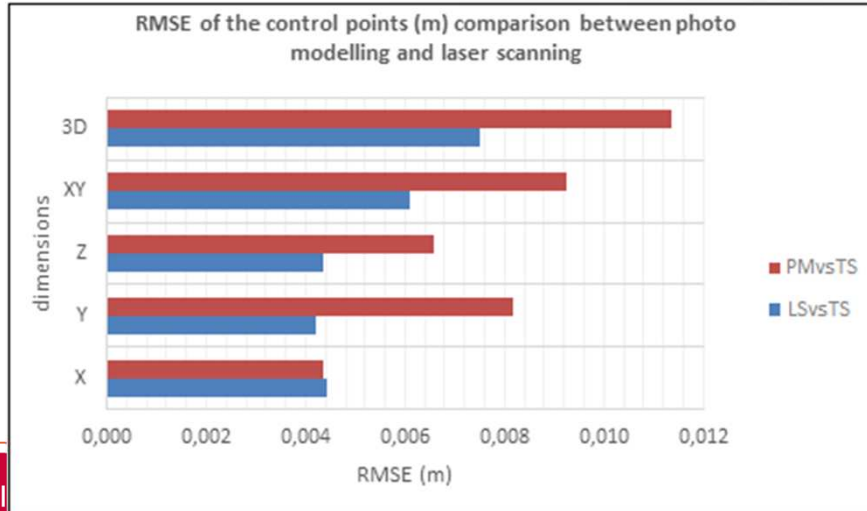




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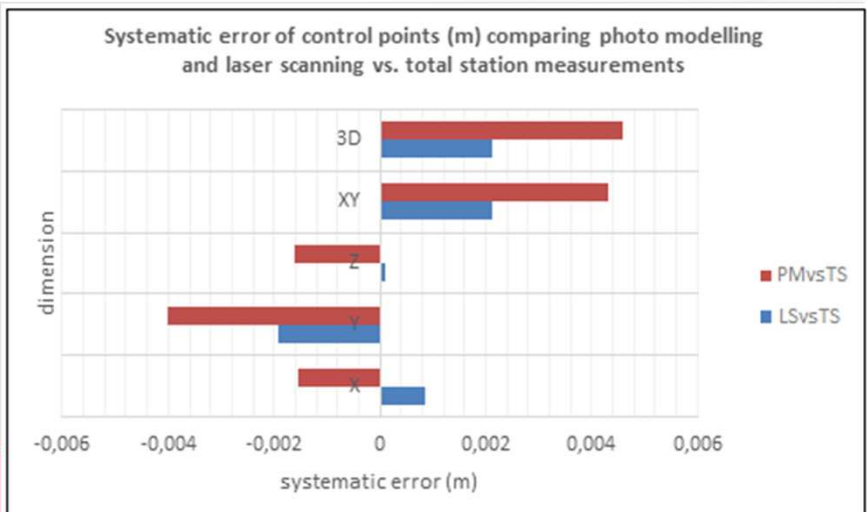
Analysis: Comparing results of photomodelling and laserscanning with "total station / GNSS truth" using statistical analysis (using GCP as ground truth)



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Analysis: Comparing results of photomodelling and laserscanning with "total station / GNSS truth" using statistical analysis (using GCP as ground truth)

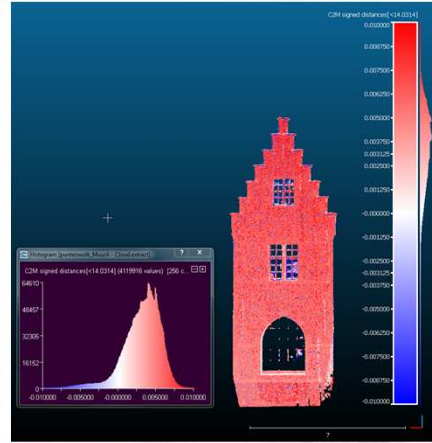
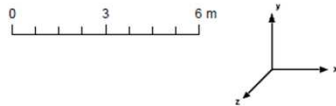




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Results: orthophotoplan (left), difference DEM model (right)



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Conclusion

- Students
 - Use and compare several 3D data acquisition method
 - Implement their theoretical knowledge in the field
 - Are stimulated by the fact that the work they are doing is really useful for historical heritage conservation
 - Experience the challenges of working together on a real-world project
 - Are encouraged to think outside-the-box



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Thank you for your attention



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