

UNIVERSITEIT GENT **3D DATA ACQUISITION**

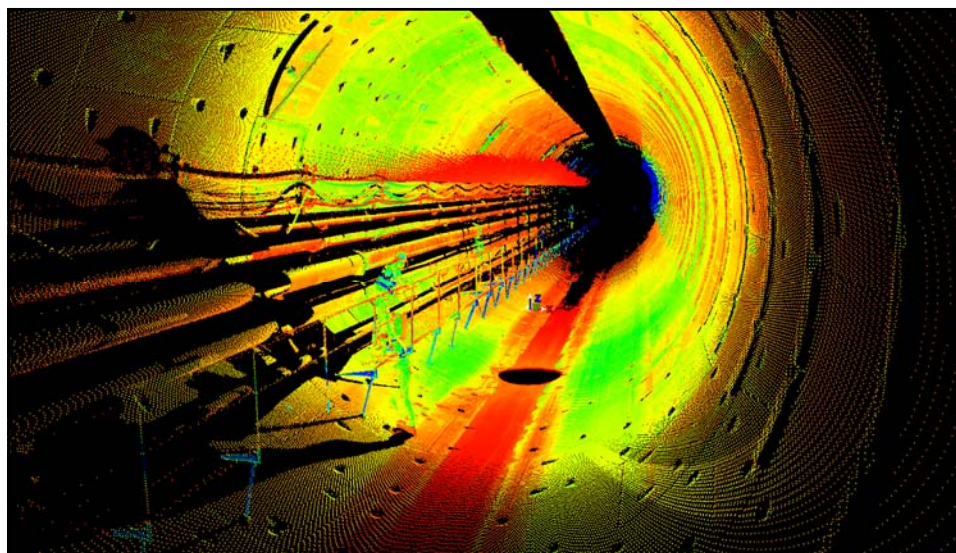
geography department Ghent University

## AUTOMATIC FILTERING OF TERRESTRIAL LASER SCANNER DATA FROM CYLINDRICAL TUNNELS

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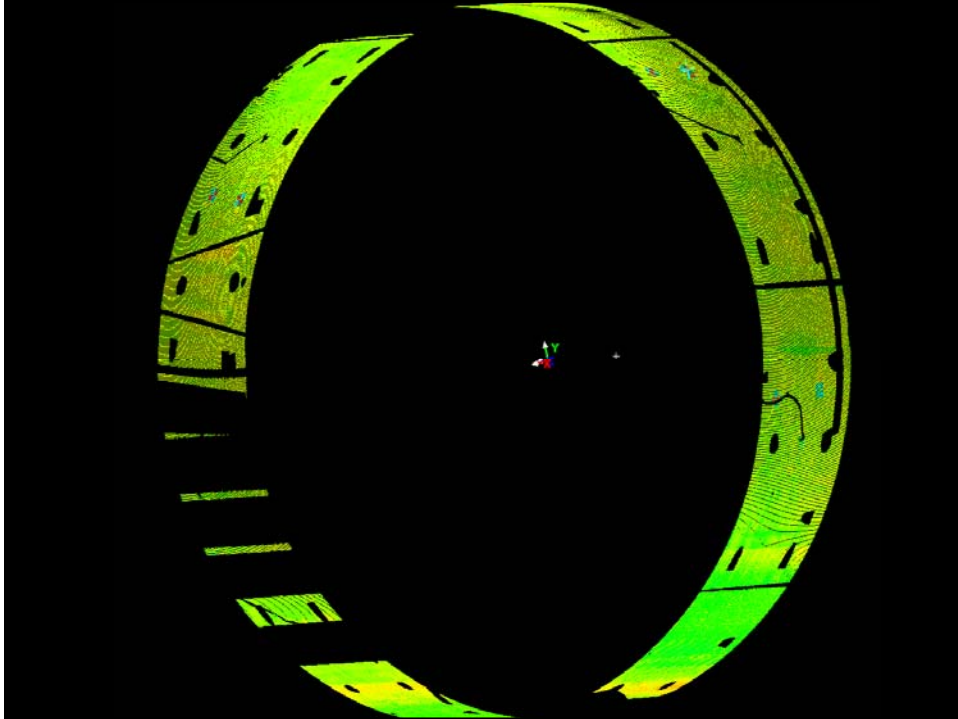
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**FIG** FIG WORKING WEEK 2012



Deformation measurements of newly built tunnels with a Leica HDS 6100 phase-based laser scanner.  
'Liefkenshoek rail link' project (Antwerp, Belgium)





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## AUTOMATIC FILTERING OF TERRESTRIAL LASER SCANNER DATA FROM CYLINDRICAL TUNNELS

Point set filtering: removal of points not belonging to the tunnel's surface → binary filtering

- Manual: time consuming
- Automatic: assume the local section as a cylinder  
→ **implementation of Levenberg-Marquardt algorithm**

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## AUTOMATIC FILTERING OF TERRESTRIAL LASER SCANNER DATA FROM CYLINDRICAL TUNNELS

**Levenberg-Marquardt algorithm:**

- Iterative parameter adjustment and point removal
- Gauss-Newton method (assumption of global non-linearity)
- Steepest descent method (assumption of local linearity)
- For a given point set  $\mathbf{x}$  with  $(\mathbf{x} \in R^3)$ , the parameter estimation of a cylinder will result in a set of parameters  $\mathbf{p}$  with  $\mathbf{p} = (\mathbf{x}, \mathbf{A}, r)$ . Here,  $\mathbf{x}$  is any point on the cylinder axis,  $\mathbf{A}$  is the rotation matrix and  $r$  is the cylinder radius

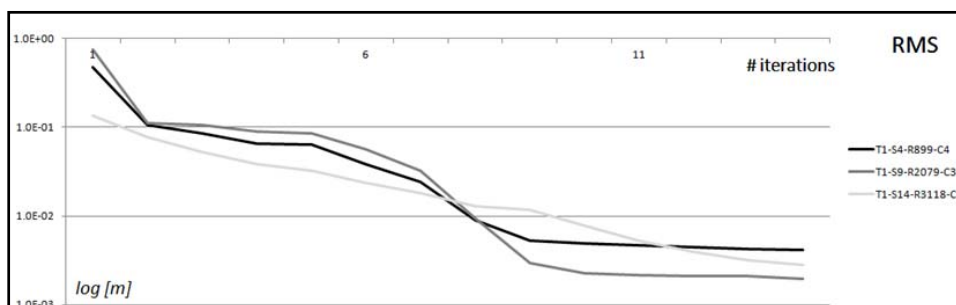


Figure 3: Evolution of the RMS of the cylinder over different iterations

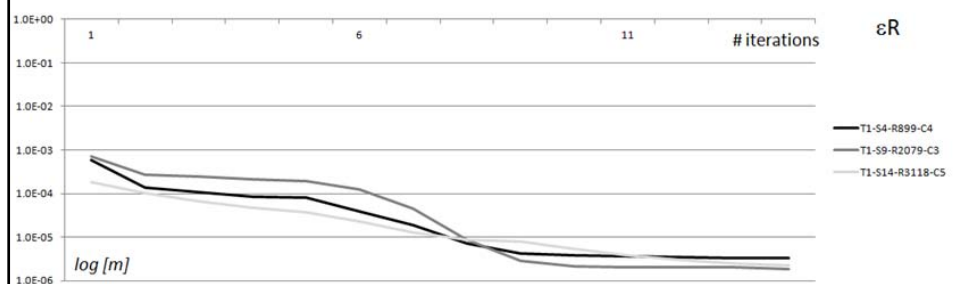





Figure 4: Evolution of the error of the calculated radius over different iterations






## AUTOMATIC FILTERING OF TERRESTRIAL LASER SCANNER DATA FROM CYLINDRICAL TUNNELS

Comparison between cross-sections derived from


- manually filtered point cloud
- automatically filtered point cloud

Two-sided t-test to determine whether the difference is statistical significant (95 % level of confidence).



## CONCLUSIONS

- Levenberg-Marquardt algorithm has proven to be successful for filtering
- Satisfactory results (comparable cross-sections) were obtained
- Further optimization of application to reduce processing time is needed



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**Thank you !**

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