As-built Documentation and Reverse Engineering Derived from Laser Scanning

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Outlines

- Project structure
- Unique reference frame
- Tools for data processing
- Surface approximation

- Data acquisition of railway facilities
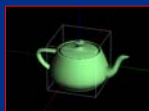- Clearance simulation

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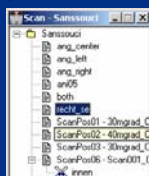FIG Working Week 2005 - Cairo, Egypt April 16-21, 2005

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Project structure and project management

Common conditions :

virtual reality

- Data base related point cloud management
- Object oriented data processing
- Nodes , Edges , Polygons, Surfaces, Volume bodies

- As build documentation and related maintenance

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Final products derived from the Laser scan data processing?

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North Pavilion – Big Colonnades Schloss Sanssouci

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Registration of the Scanner Stations Data

- Targets placed on the object
- Station linkage via non natural references placed in the scans
  - Cylinder
  - Sphere
- Object space references
  - Planes
  - Curved surfaces

- Iterative-Closest-Point-Method

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Data Acquisition - 14 Scans
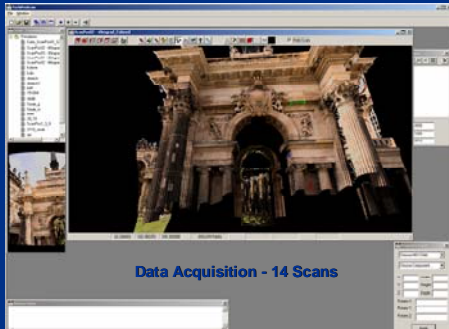
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Corresponding point cloud surfaces

Increase the accuracy

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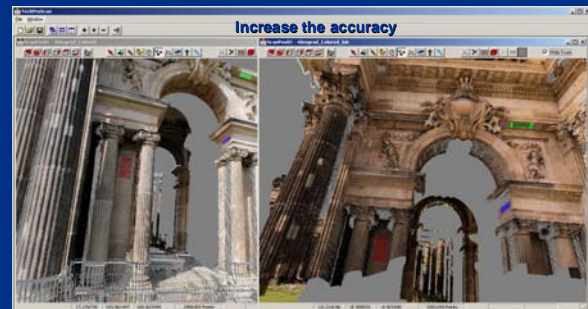Berlin 1989 - 2005

Processing tools

➢ Fitting of geometrical primitives like lines, circles, ellipses, planes, spheres, cylinders and cones

➢ Non completed point clouds fitting of circle and ellipses curves, sphere segments, parts of cylinders, cone obtuse

➢ Fitting of cover elements for circle, sphere and quader (important for the segmentation - the so called functional patches)

➢ Fitting of smooth free form curves (NURBS)

➢ Comparison between the point cloud and the fitted element with deflections, measuring against CAD and false color visualization

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Geometrical Primitives
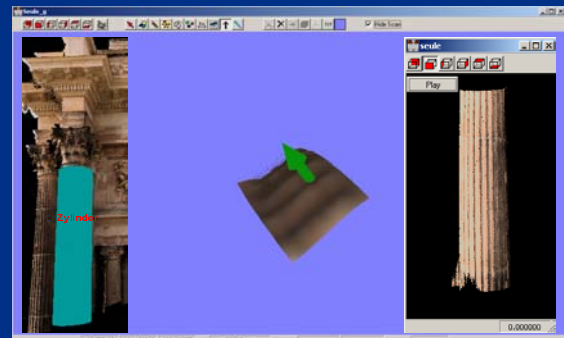
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Non Uniform Rational B-Spline (NURBS)

● NURBS have a precise and well-known definition.

● NURBS can accurately represent both: standard geometric objects like lines, circles, ellipses, spheres and tori, and free-form geometry like car bodies, other complex double curved surfaces also human bodies.

● The amount of information required for a NURBS representation of a piece of geometry is much smaller than the amount of information required by common faceted approximations .

● NURBS can be implemented on a computer in a way that is both efficient and accurate.

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Generation of free form surfaces

noise

known function

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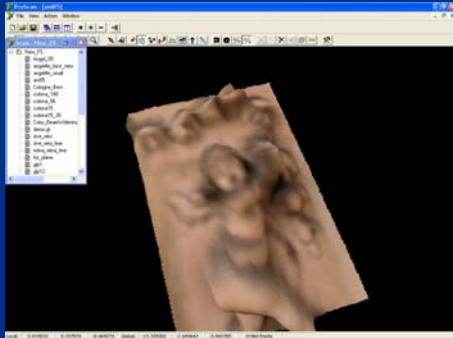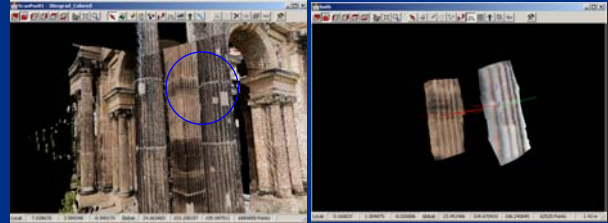
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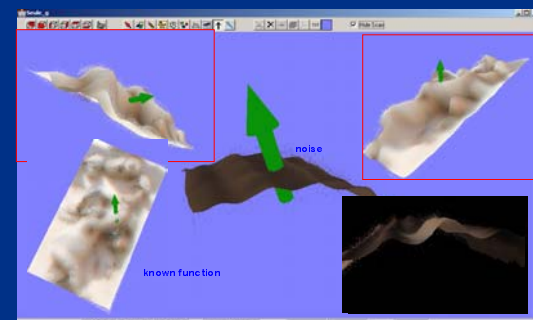
Generation of free form surfaces

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Measuring distances between free form surfaces

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Feasibility study Railway

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3D Data - Restriction

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Automated Rail Geometry Recovery (ARGR)

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TLS for 3D Data Acquisition

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Clearance drive through Simulation

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Source DB-Net system specifications
Drive dynamic und clearance

Die Bahn DB

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TLS in 2D CAD Applications

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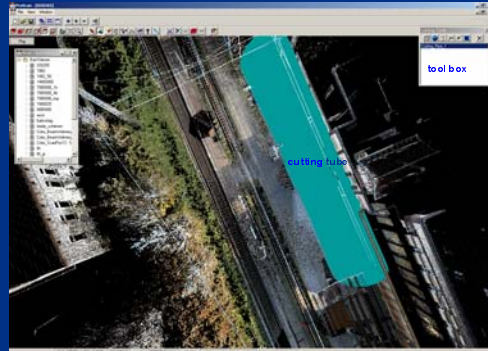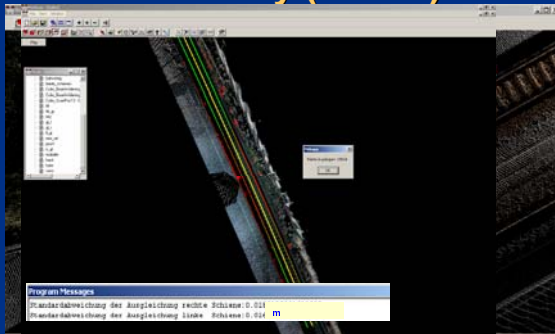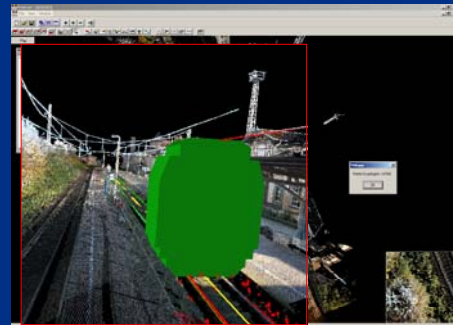FIG Working Week 2005 - Cairo, Egypt April 16-21, 2005
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Conclusions

Very high algorithmic complexity using adjustment with resulting accuracy and quality improvement

- Data reduction/-filtering
- Point cloud Registration(Transformation) of the single stations in a unique reference system
- Calculation of planes and profiles
- Extraction of panoramas and Orthophotos
- Deduction of form functions

This in the highest possible degree of automation

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