


## Leads the Automation Degree in the Processing of Laser Scan Data to Better Final Products?

Ivo Milev

*Technet GmbH, Goethestr. 42 10625 Berlin*



### Scanning methods

---

- **Kinematic scanning**
  - Using the scanner profile mode and moving the platform
  - The platform position is calculated in realtime using DGNSS or robotic total station
  - The trajectories should be known as well the helix
- **Static scanning**
  - Sequential station by station scanning to covering the whole area of interest
  - Postprocessing work for registration and georeferencing

FIG Congress 2010 Facing the Challenges – Building the Capacity  
Sydney, Australia, 11-16 April 2010

## Registration Process

---

- Automated registration based on targets
- Usage of artificial targets in a manual identification step
- Automated generated targets – can be planes in overlapped scans but also another surfaces
- The scanned points in a 2-4 m area out of the scanner station can be removed in an automated way
- The far-out points from the first scanner station there are covering the overlapping zone with the second scanner station are noisy and should be removed

## The impact of targets on the registration process

---

- Where is the point of the measurement?
- In the case of point clouds it is not defined. Looking at a single point for the measurement it's position is random on the surfaces and inside the measurement standard deviation of the scanner.
- It depends also from the distance to the measured object. The points used for the registration are typically not distributed in the maximal measuring distance of the scanner because otherwise there should be too big. This leads to an extrapolation problem outside the target area and decreases the accuracy

RAIL 2010  
**TECHNET** SiRailSystems

Kinematic scan and error propagation

FIG Congress 2010 Facing the Challenges – Building the Capacity  
Sydney, Australia, 11-16 April 2010

RAIL 2010  
**TECHNET** SiRailSystems

Kinematic scan and used results

FIG Congress 2010 Facing the Challenges – Building the Capacity  
Sydney, Australia, 11-16 April 2010

RAIL 2010  
TECHNET

SiRailSystems

TECHNET

### Static scan of a district heating chamber



Koordinaten: -0.17295 0.44537 1.05153 21.599.069 Points

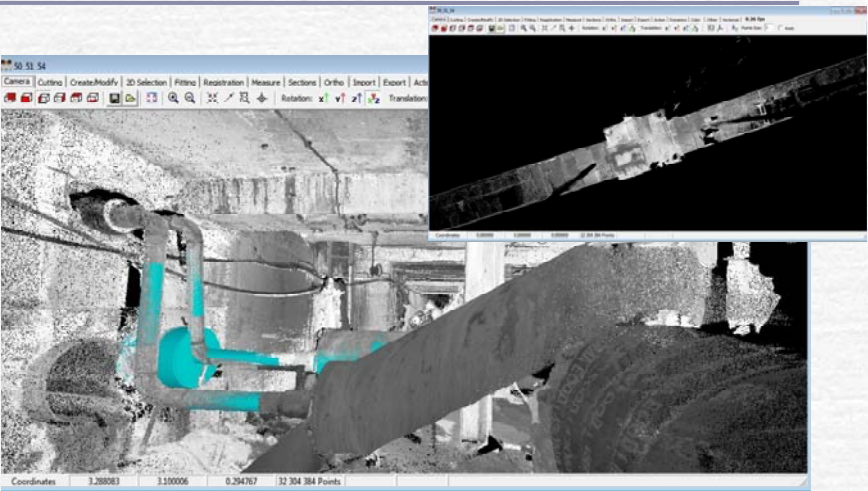
FIG Congress 2010 Facing the Challenges – Building the Capacity  
Sydney, Australia, 11-16 April 2010

RAIL 2010  
TECHNET

SiRailSystems

TECHNET

### 3 scan model and fitting of a primitive



Koordinaten: 3.208083 1.110006 0.304767 12.304.384 Points

FIG Congress 2010 Facing the Challenges – Building the Capacity  
Sydney, Australia, 11-16 April 2010

RAIL 2010  
**TECHNET** SiRailSystems

Static scan of a district heating camber




FIG Congress 2010 Facing the Challenges – Building the Capacity  
Sydney, Australia, 11-16 April 2010

RAIL 2010  
**TECHNET** SiRailSystems

Static scan of a colider



FIG Congress 2010 Facing the Challenges – Building the Capacity  
Sydney, Australia, 11-16 April 2010

RAIL 2010  
**TECHNET** SiRailSystems

Static scan

For a better surface representation we need a higher measurement density



FIG Congress 2010 Facing the Challenges – Building the Capacity  
Sydney, Australia, 11-16 April 2010

RAIL 2010  
**TECHNET** SiRailSystems

Static scan of a industrial object



FIG Congress 2010 Facing the Challenges – Building the Capacity  
Sydney, Australia, 11-16 April 2010

RAIL 2010  
TECHNET

SiRailSystems

TECHNET

### Calculating the real geometrical conditions

FIG Congress 2010 Facing the Challenges – Building the Capacity  
Sydney, Australia, 11-16 April 2010

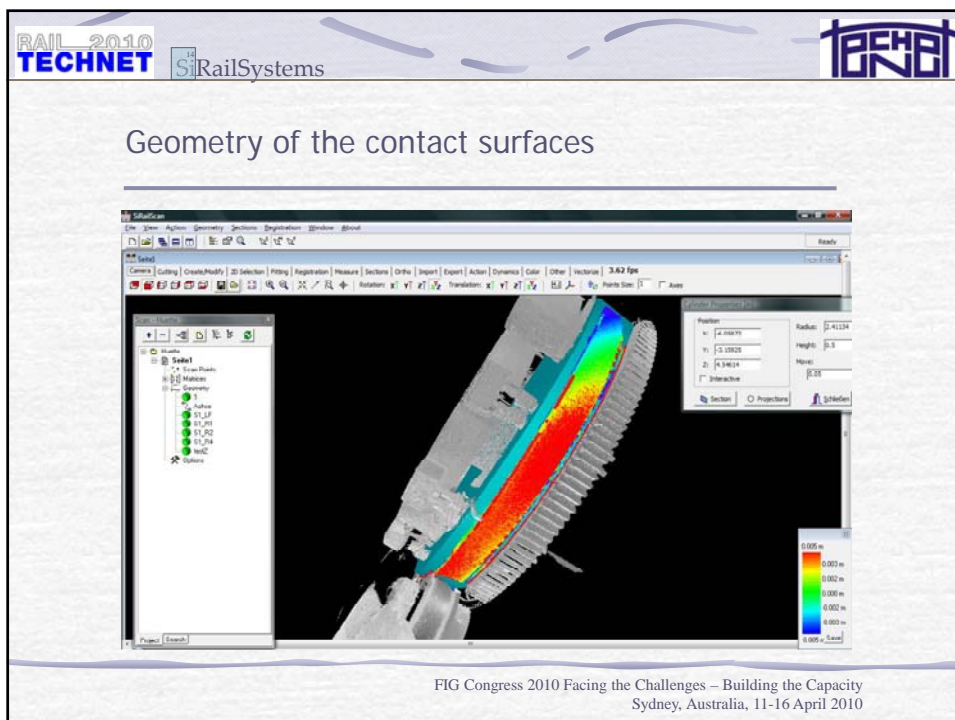
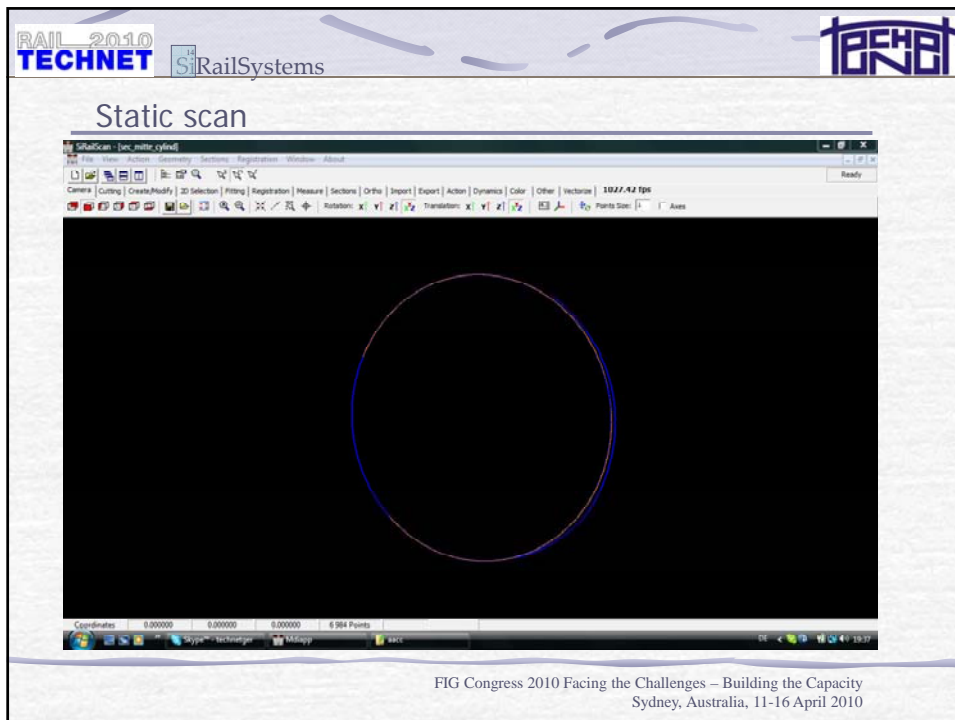
RAIL 2010  
TECHNET

SiRailSystems

TECHNET

### Distance diagram - differences to the ideal geometry

FIG Congress 2010 Facing the Challenges – Building the Capacity  
Sydney, Australia, 11-16 April 2010





RAIL 2010  
TECHNET

SiRailSystems

TECHNET

### Fitted versus designed dimensions

FIG Congress 2010 Facing the Challenges – Building the Capacity  
Sydney, Australia, 11-16 April 2010

RAIL 2010  
TECHNET

SiRailSystems

TECHNET

### Geometrical irregularities in the scanned object

FIG Congress 2010 Facing the Challenges – Building the Capacity  
Sydney, Australia, 11-16 April 2010

RAIL 2010  
TECHNET S RailSystems

Real axis based section

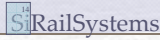

FIG Congress 2010 Facing the Challenges – Building the Capacity  
Sydney, Australia, 11-16 April 2010

RAIL 2010  
TECHNET S RailSystems

It leads to the accuracy estimation problem

Designed dimensions

FIG Congress 2010 Facing the Challenges – Building the Capacity  
Sydney, Australia, 11-16 April 2010

RAIL 2010  
**TECHNET**  

### 3D model

---

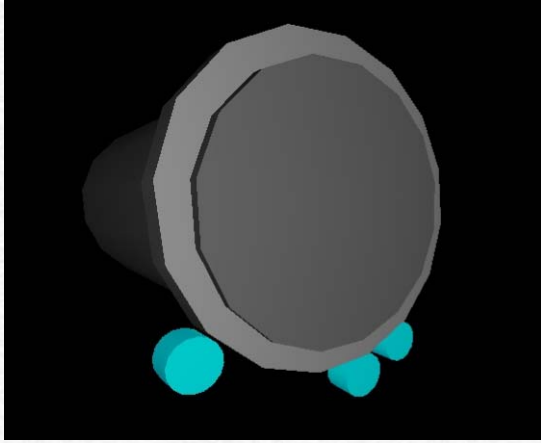


FIG Congress 2010 Facing the Challenges – Building the Capacity  
Sydney, Australia, 11-16 April 2010

RAIL 2010  
**TECHNET**  

### Real situation

---



FIG Congress 2010 Facing the Challenges – Building the Capacity  
Sydney, Australia, 11-16 April 2010

## Static Scan for railway wheel control



FIG Congress 2010 Facing the Challenges – Building the Capacity  
Sydney, Australia, 11-16 April 2010

## Railway Wheels Control – Material Distribution

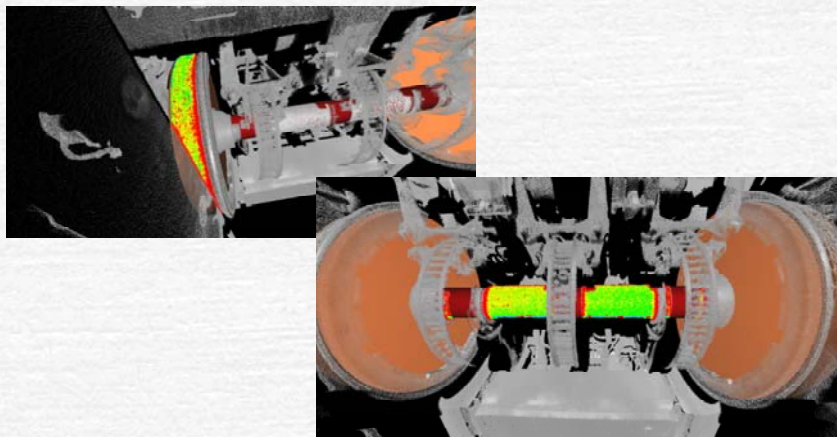


FIG Congress 2010 Facing the Challenges – Building the Capacity  
Sydney, Australia, 11-16 April 2010

TECHNET SiRailSystems

## Acknowledgements for engineering surveying projects

- Modeling by fitting vrs. modeling in sections / surface vrs. line
- It cannot be the target to waiting couple of minutes to finishing the scanning process if the first actions after the scanning measurement are to reduce the point numbers to half and more
- Reducing this number we are going in to the field of usage of scanning total stations
- Definitive the homogeneity is better in the case of plane registered scans because the algorithm selects all qualitative acceptable regions and the accuracy is < 3mm
- In some cases the targets are to fare away from the scanner and it takes time to scan them in additional fine scan step without better results

FIG Congress 2010 Facing the Challenges – Building the Capacity  
Sydney, Australia, 11-16 April 2010

TECHNET SiRailSystems

## Conclusions *Leads the Automation Degree in the Processing of Laser Scan Data to Better Final Products?*

- Yes! but we have to use all scanned points
- Not reduce them to single sections and some regions
- The big redundancy is rising the accuracy of the results
- Best fitting algorithms trough all points leads to a better representation of the real geometry, to a higher accuracy and to better results, Adjustment methods for quality verification
- For wide area scans and linear objects the kinematic method is more efficient and homogeneous
- Single shots or scanning of preselected areas are in most of the cases not that we want
- There are also feature lines or other geometric elements that can be taken in account

FIG Congress 2010 Facing the Challenges – Building the Capacity  
Sydney, Australia, 11-16 April 2010