

# Spatial Integration of 3D Scan Data for a New Beamline at MAX IV



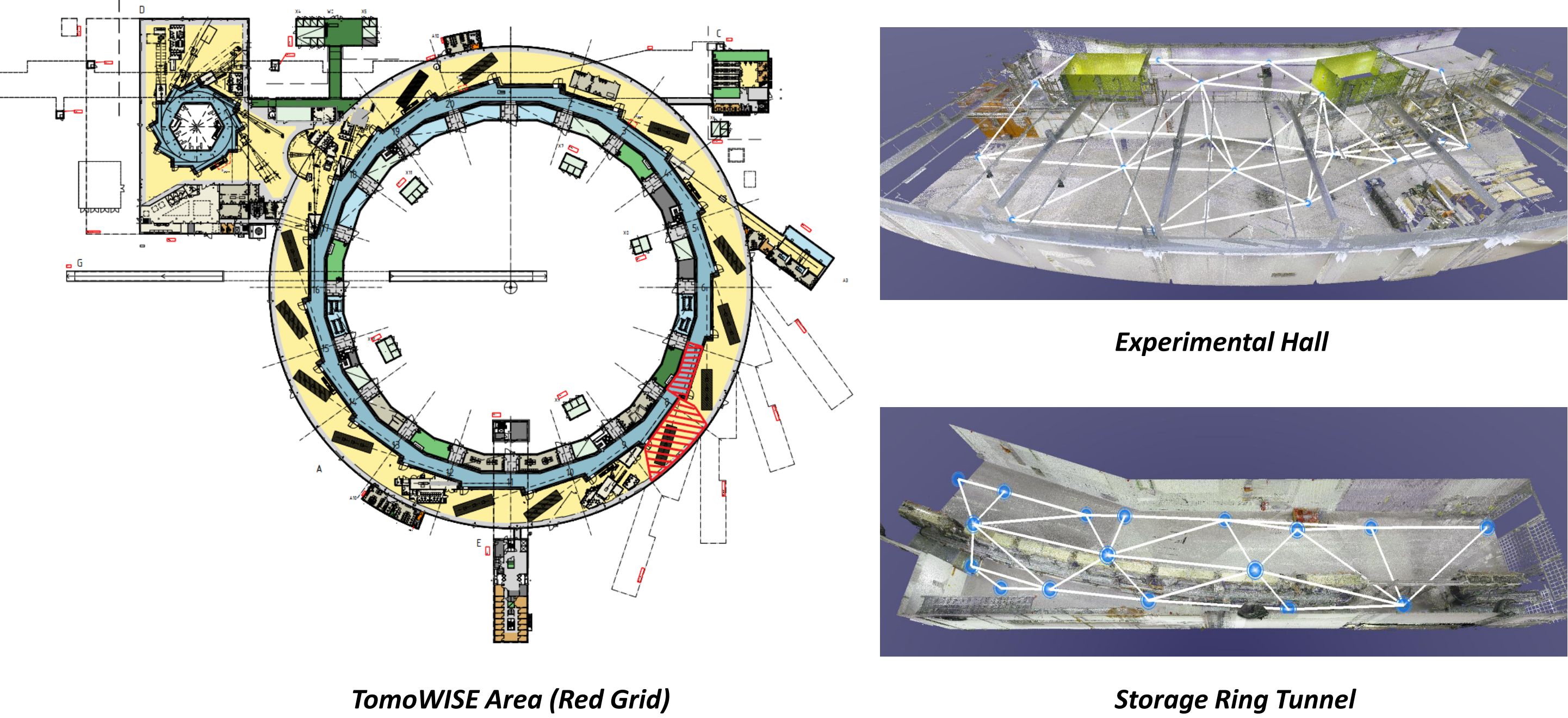
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## Abstract

This poster presents the integration of high-precision 3D scanning data into the MAX IV spatial metrological network during the construction of the new TomoWISE beamline. By registering point cloud data within the facility global coordinate system, the scanned data can be accurately overlaid with the beamline CAD model, providing a reliable digital representation of the installation area. This procedure supports design verification, enabling the early detection of potential collisions, geometric discrepancies, and installation conflicts before the installation phase. Identifying these issues in advance allows for corrective action, reducing risks, minimizing costly rework, and improving installation planning and execution.

## Scanned Area

The installation area is divided into two sections. The experimental hall, where the optics, end station, and lead hutch will be constructed, and the storage ring tunnel, where the insertion device and the front end of the beamline will be installed.



Scanning at the highest resolution, the hall was registered with 22 scan setups and 48 links in between, a total of 2.6 billion points, while the tunnel area had 17 scans with 36 links and a total of 1.5 billion points.

|                     | Raw Data File | Exported Point Cloud | Mesh   |
|---------------------|---------------|----------------------|--------|
| Experimental Hall   | 158 GB        | 42 GB                | 716 MB |
| Storage Ring Tunnel | 62 GB         | 19 GB                | 139 MB |

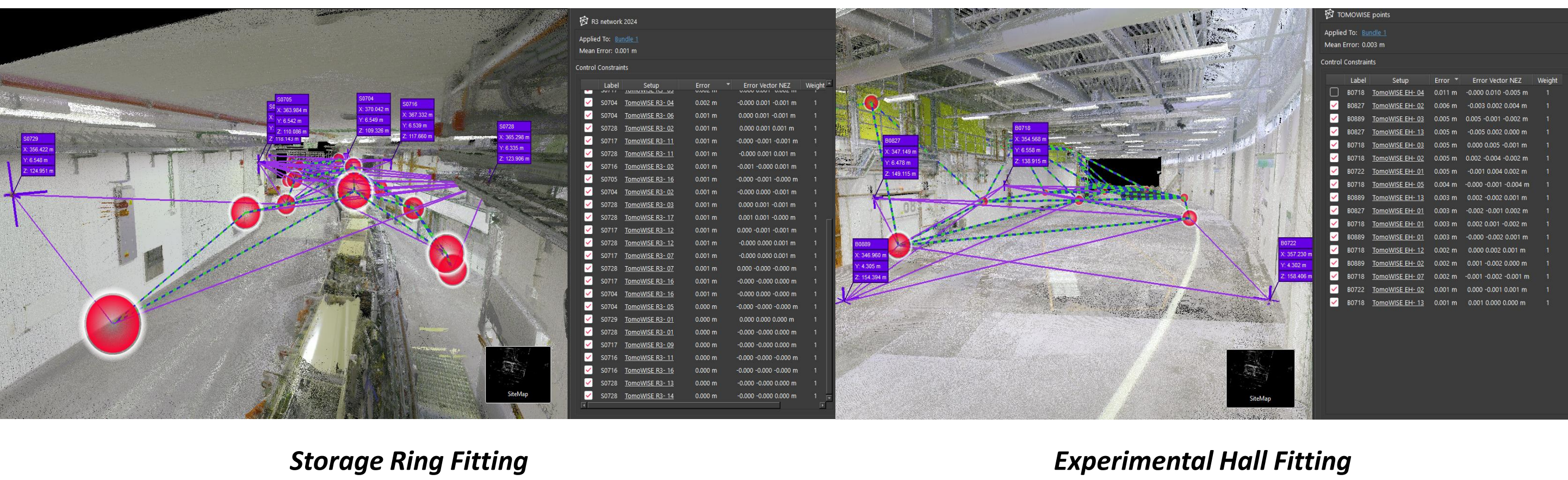
Data amount table

## Scan Data Integration with the Alignment Network

Overlapping of the scanned data with the alignment network was done by using super precision scan spheres (SPSS), as connection targets of the Laser Tracker retroreflectors (SMR 1.5"). These spheres are sufficiently large (2.5") and are made of non-reflective material to ensure reliable detection by the scanner.

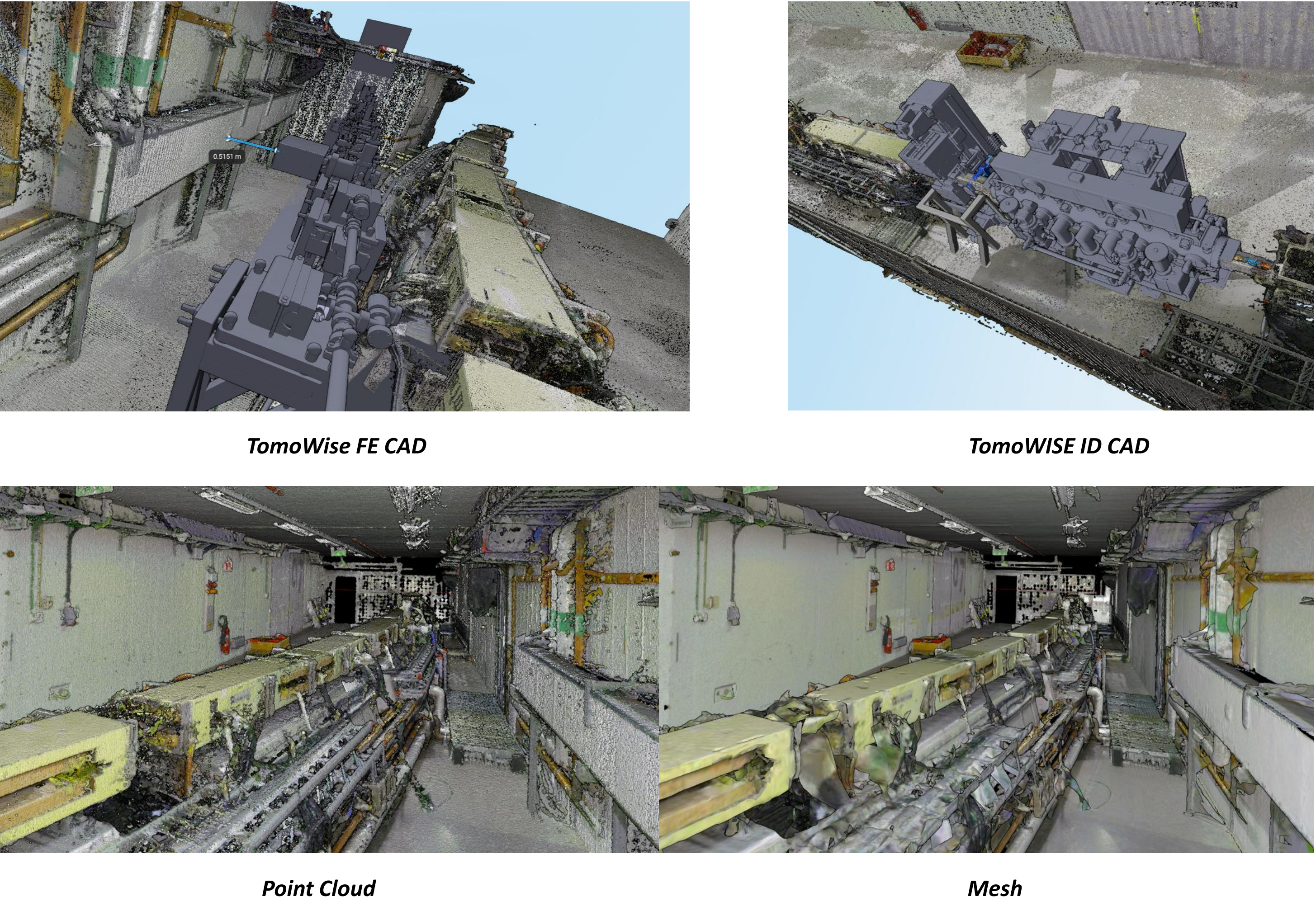


A total of 17 sphere measurements were obtained in the experimental hall, with a fitting mean error of 3 mm. In the tunnel, 41 sphere measurements were obtained, achieving a significantly lower mean error of 1 mm. This difference is mainly because of the distribution and extension of the alignment network. In the experimental hall, not all areas are covered by network points, as alignment requirements do not apply throughout the entire space. However, the tunnel is fully covered by alignment network points, providing a denser and more consistent network since the storage ring has to be aligned along the entire tunnel.



## CAD - Scan Overlapping and Meshing in GeoCloud

There are several software solutions available for the visualization and analysis of point cloud data with CAD. One of the most used platforms in MAX IV is GeoCloud, it's a cloud-based platform for meshing, managing, visualizing, analyzing, and sharing geospatial data. Its cloud-based nature makes it particularly useful for sharing datasets without requiring high-performance hardware.



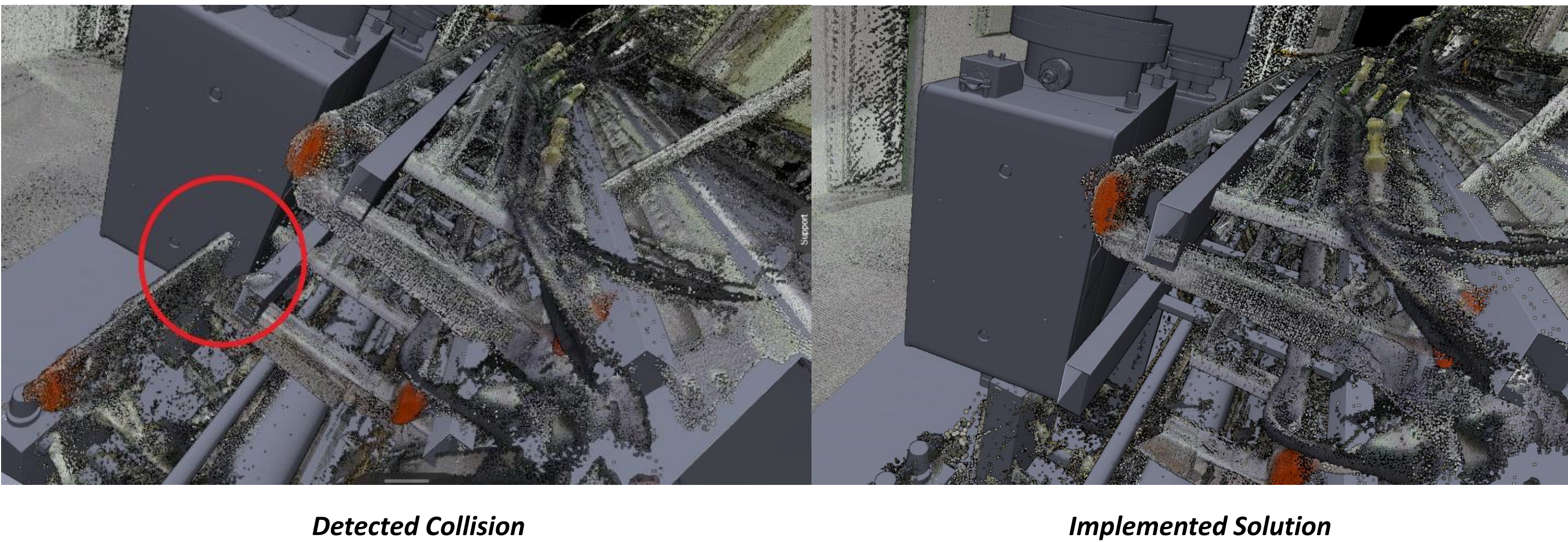
## SolidWorks CAD Software

Mechanical designers at Max IV work with SolidWorks software, where point cloud data is not easily recognized or handled. Therefore, meshes are imported into the software in .obj format, generated through the GeoCloud platform.



## Collision Detection

A collision was identified between one of the components designed for the front end, specifically a vacuum pump, and an existing cable tray in the storage ring. Based on this finding, it was decided to modify the cable tray in advance by cutting and adjusting it to provide sufficient space.



The installation work is currently ongoing, involving the assembly of both external and in-house designed components. The scan data is already being used to support pipework connections and to determine drilling locations through walls and floors.

## Contacts

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