STSM Report : Evaluation and validation of the 3D Data from the Bremen “Cog” monitoring project - German Maritime Museum

Reference: Short Term Scientific Mission, COST TD1201 - 210915-062809

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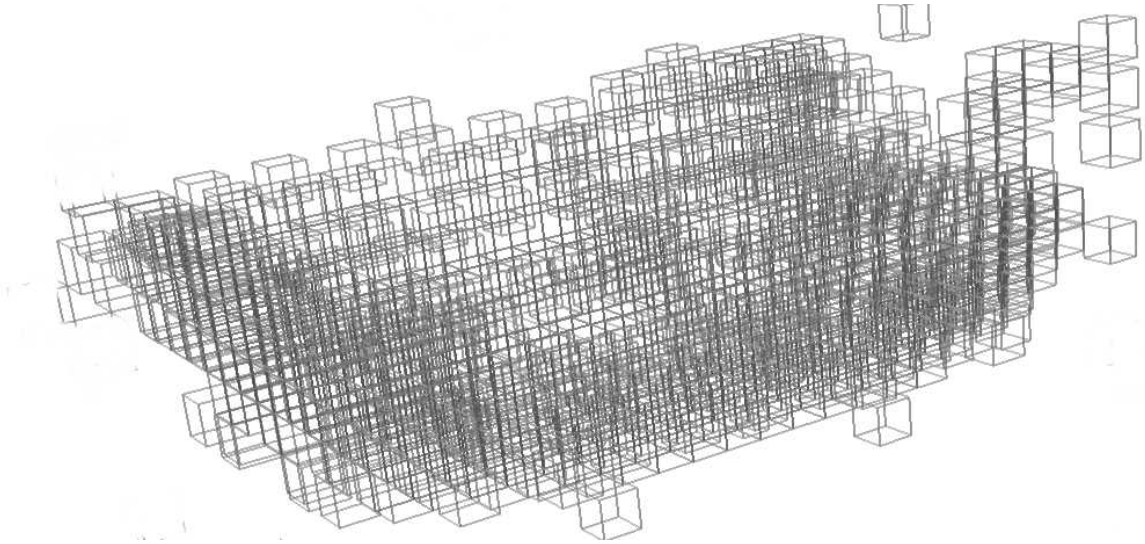
Period: from 20/09/2015 to 27/09/2015

Place: German Maritime Museum (Deutsches Schiffahrtsmuseum), Bremerhaven, Germany, Bremerhaven, Germany



1 Objectives of the STSM

The main purpose of the current STSM proposal is to investigate the use of heterogeneous data in the surface monitoring process of the Ship from the German Maritime Museum. Several types of recorded data from different epochs are available capturing this object, thus the monitoring of the surface involves the comparison of various data sources such as lidar, RGB or RGBD data.

2 Description of the work carried out

The main work phases of this STSM included:

- Preprocessing of the data in order to have all the measurements in a common coordinate frame using keypoint-feaure correspondences.
- Registration of the per-aligned data from the previous step using GICP techniques in order to minimize the error global distance between the two models and to be have a common reference for the different data sets.
- Compare the structure of the data using octree representation ensuring the relevant difference detection in the 3D heterogeneous data.

The first alignment results are visible in Illustration 1.

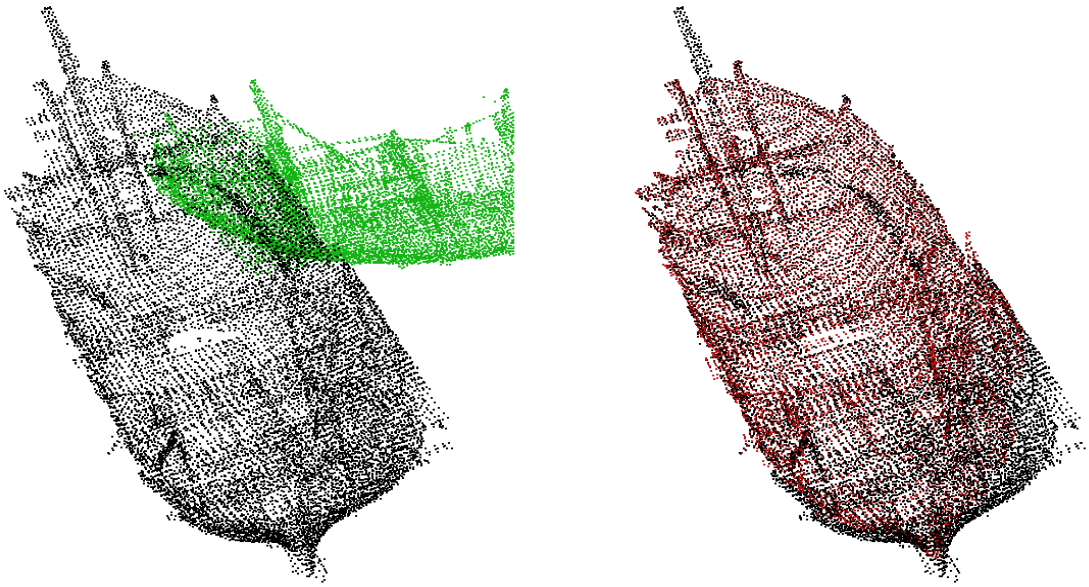


Illustration 1: Laser (i3mainz) 2014 - Laser (KSF) 2009; left hand: initial position in space; right hand side aligned variant

The second alignment was performed on laser and SfM data from the same year(STSM report of J. Guery). As it can be seen on Illustration 2, the SfM fits well the reference laser data.

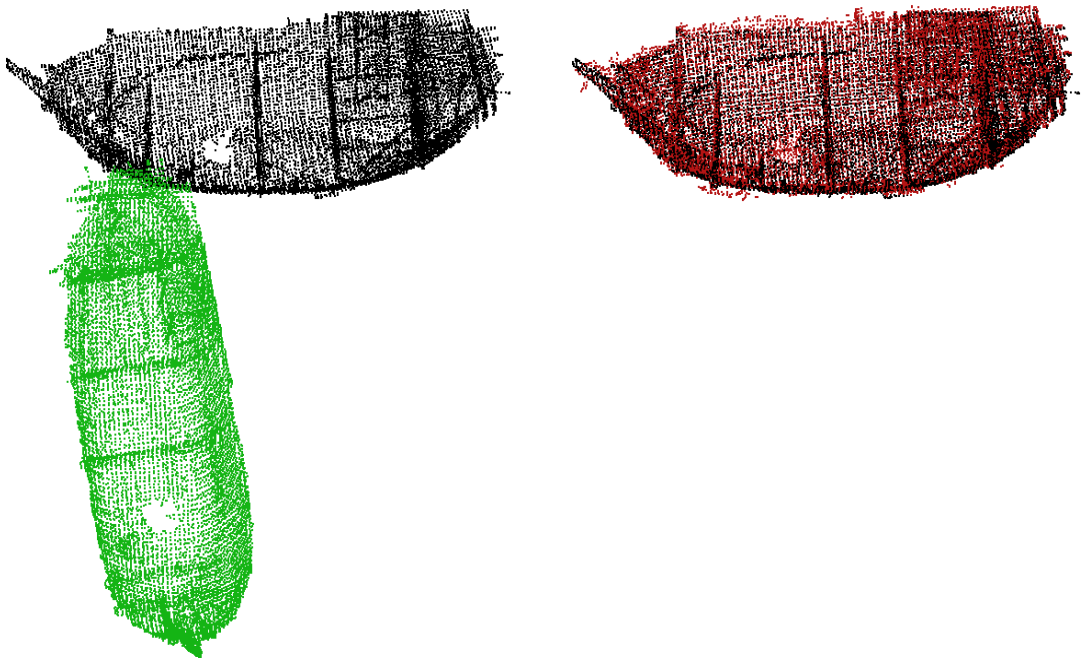


Illustration 2: Laser (i3mainz) 2014 - SfM (Captair) 2014: left hand side showing the data in its original coordinate; at hand side with the aligned data. Details regarding the SfM measurements can be found in the STSM report of J. Guery

The third aligning was using the Laser data from 2014 and the high resolution (under millimetre precision) structured-light scan from the same year. The result of the registration is visible in Illustration 3.

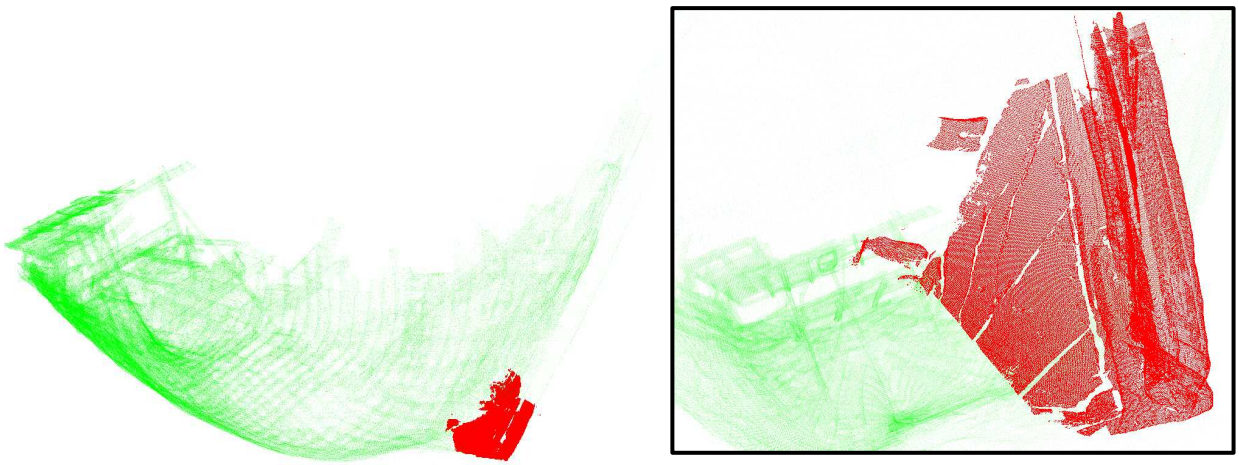


Illustration 3: Laser -- structured light registration (zoomed section on the right hand side)

Euclidean distance metrics evaluation

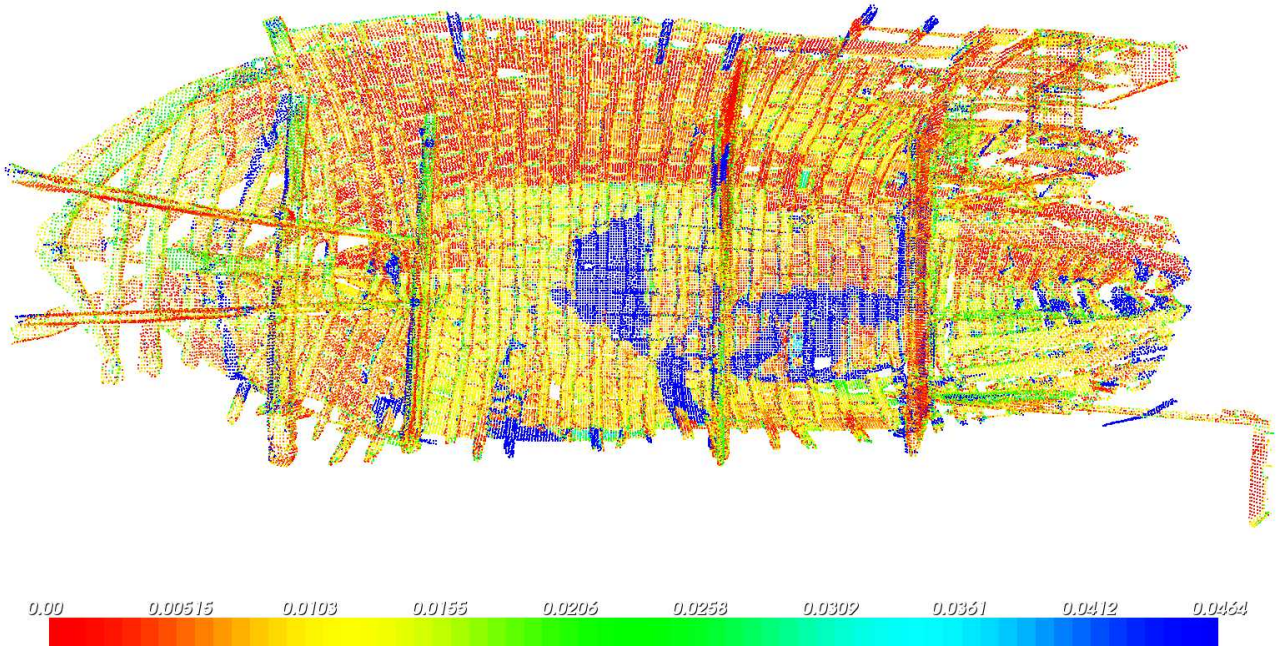


Illustration 4: Interior dense 3D data comparison from 2009 and 2014 (top view of the ship)

Tree structure based difference detection

Tree structure based difference detectio is presented in Illustration 5. The dark blue points are the differences between the scans (a part was not scanned in 2009 and which was present in the other scan from 2014.)

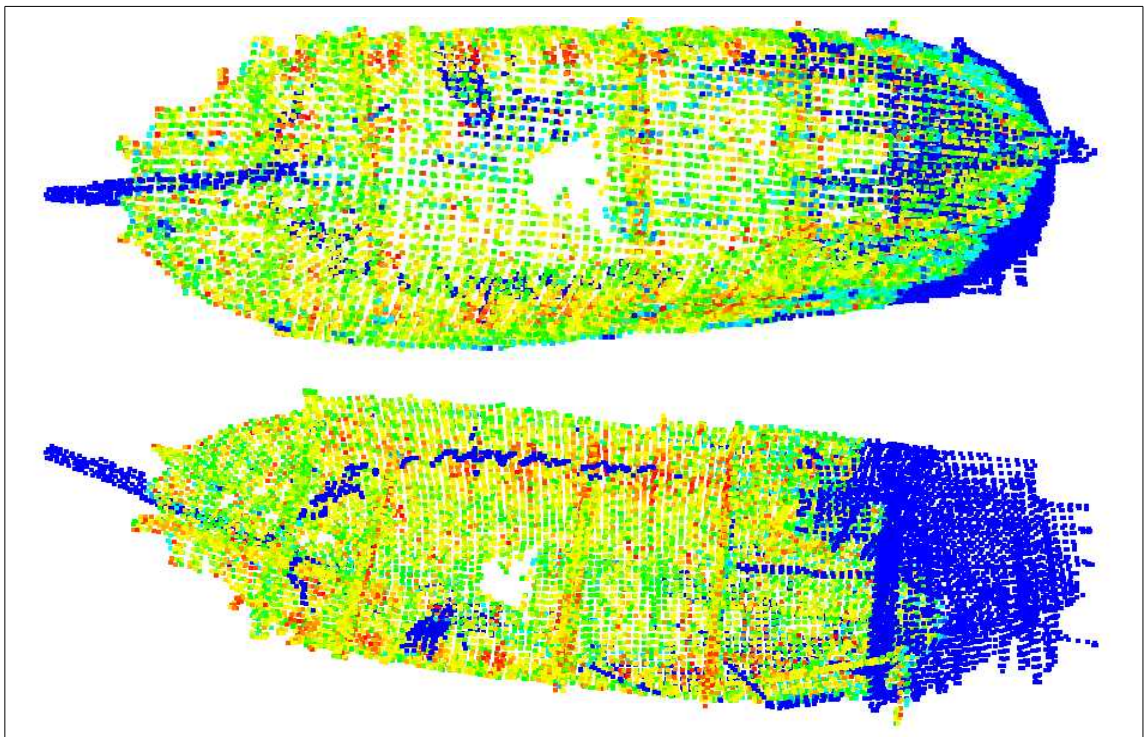


Illustration 5: Change detection with octree structures: bottom(up) and top(down) view of the ship

Cross section analysis

The last analysis was focusing on the 2D cross sections of the different parts of the ship. A summary of these cross sections are presented below in Illustration 6 and Illustration 7:

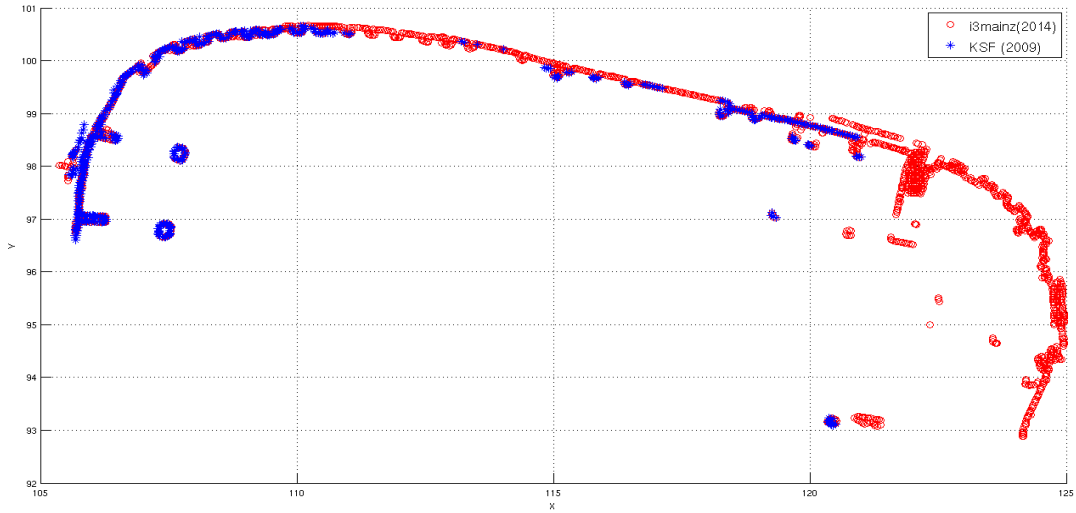


Illustration 6: Cross section cut at 2 (m) height: blue from scan 2009 and red from 20014