# Object Level Change Detection in Cluttered Environments using LiDAR SLAM

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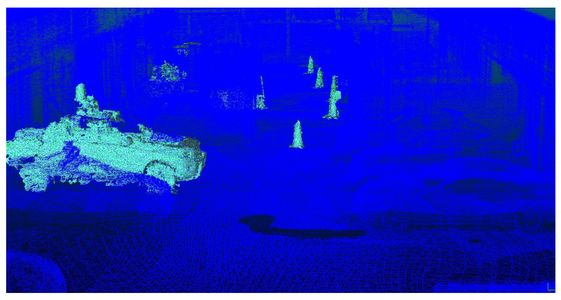
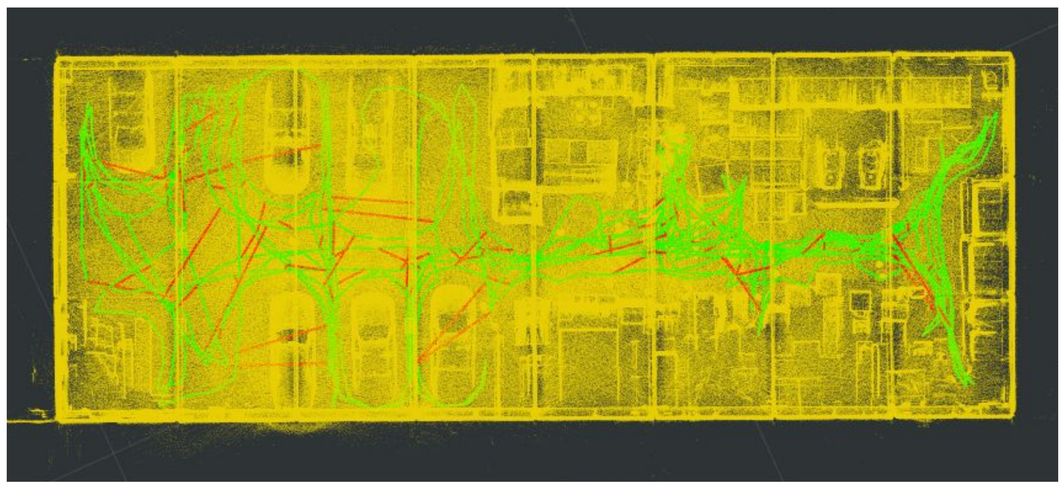
## Highlights

- Change detection can be performed in cluttered industrial environments, classifying changed objects without the need for labelled data
- Performed over time using volumetric representation after multi-mission registration with offline VILENS-SLAM algorithm
- Clustering and meshing of changed objects for object correspondence and classification using a triplet loss pre-trained neural network InstaLoc



## Data

- ➢ Handheld LiDAR-based 3D SLAM (Hesai XT32)
- ➢ Five missions acquired in nuclear fusion facility storage site
- ➢ Multi-mission graph-level map registration using ICP

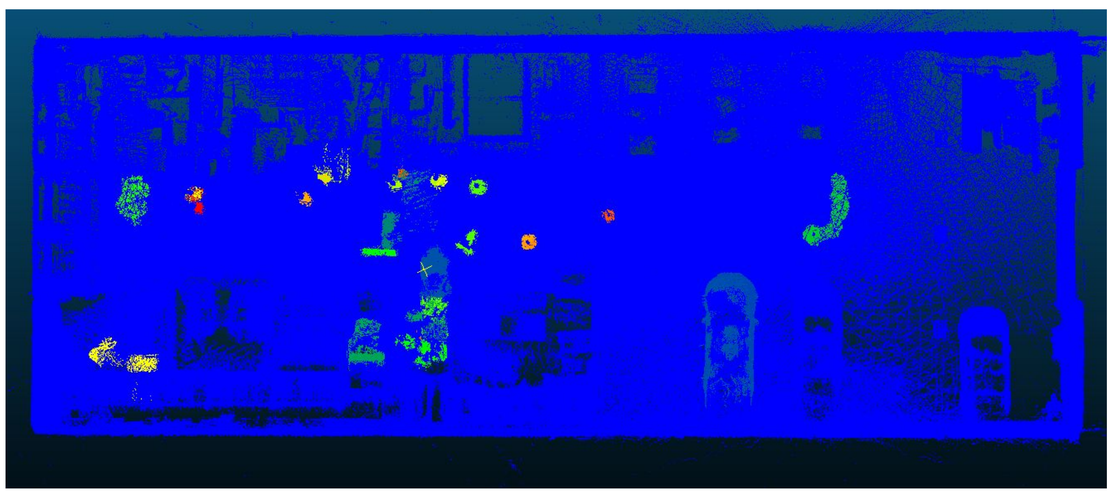


## Method

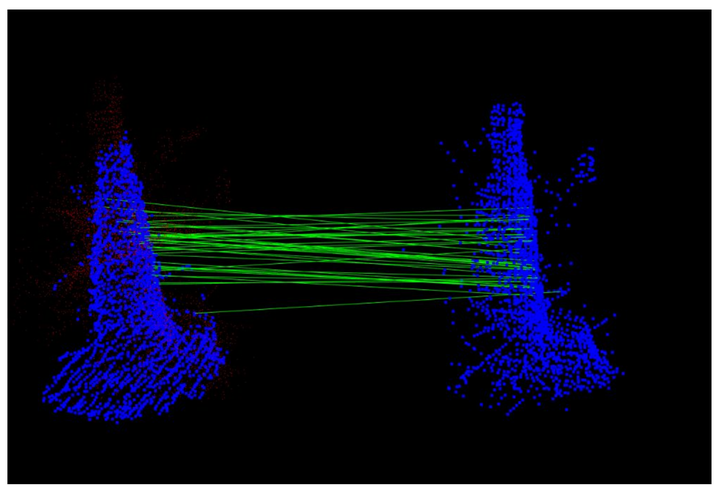
1. Multi-mission registration of handheld* LiDAR SLAM data acquired at UKAEA RACE
2. Volumetric change detection for differencing and clustering of object point clouds.
3. Correspondence-based grouping of point clouds for label-free classification of previously unobserved objects, employing SHOT estimation and neural network-based instance description. Subsequently, the object transformations across missions are computed using Singular Value Decomposition (SVD), providing valuable insights into the displacement patterns of objects.


Frontier V7; LiDAR, Camera & IMU in-house sensor suite

## Experiments and Results



Top down view of multi-mission object based change detection point cloud. Discrete additive and subtractive changed object clusters shown in different colours.



Object correspondence matching using learned 3D feature descriptors and triplet loss neural network based method InstaLoc.

### Ongoing and Future Work

- Learned object correspondences for object correspondence matching
- Incorporate object pose constraints into SLAM
- Validate change detection with simulated Unreal Engine LiDAR data
- *Autonomous Spot quadruped in hazardous environments data to be acquired

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