3D Object Registration in the Wild

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Motivation

- **GOAL:** Autonomous robot navigation using on-board depth camera.
- **METHOD:** Recognition and registration of objects from point clouds recorded along navigation path.
- **PROBLEM:** Loop closure in navigation requires re-recognition of objects from different viewpoints which often fails if low-level features are used.

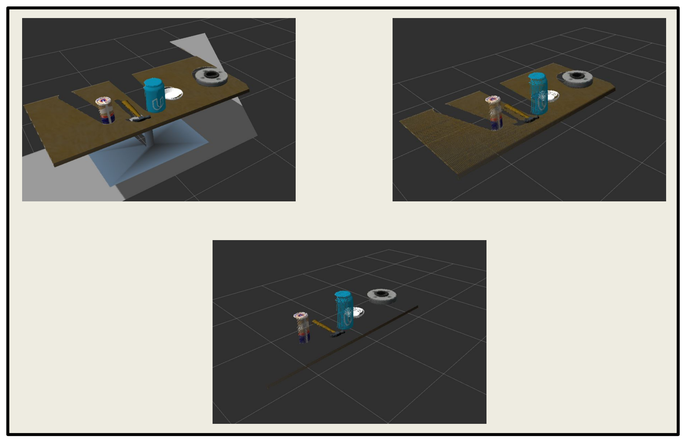
- **SOLUTION:** Leverage deep learning to reliably detect and recognize objects, and register them using the Iterative Closest Point (ICP) algorithm.

Object detection and recognition

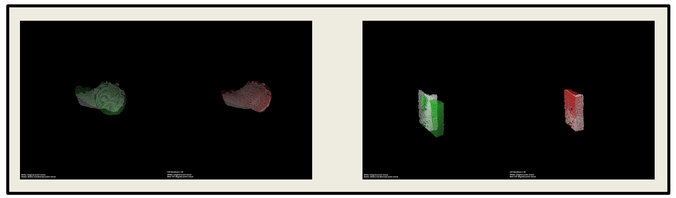
- Tensorflow SSD-Mobilenet on COCO dataset.

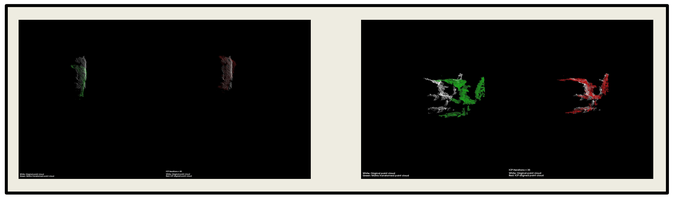
Point cloud segmentation

- **Passthrough filter:** Filtering along a specified dimension – that is, cut off values that are either inside or outside a given user range.
- RANSAC geometric filtration algorithm extracts the outliers to remove points corresponding to the table face to get a better approximation as prior to ICP.



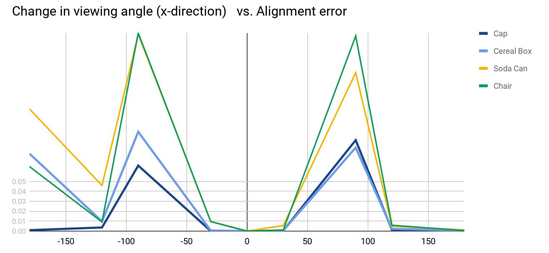
Point cloud registration





	No. of iterations	Alignment error	Angle X-axis (in degrees)	Angle Y-axis (in degrees)	Angle Z-axis (in degrees)
Cap	40	0.0000445	30	10	2
Cereal Box	85	0.00056	192	-3	0
Soda Can	80	0.2563	55	0	0
Chair	35	0.0000236	15	6	0

Variation of viewing angle vs. alignment error



Conclusion

- This method works well upto ±70-75° variation in xy-axis, ±45-55° in yz-axis and ±70-75° in xz-axis of the viewing angles.

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