1. **EXPERIMENTAL RESULTS**

Example Application A was performed with an Aubo i5 on a welding table with a RP-LiDAR A2 mounted to the end effector for generating 3D pointsclouds shown in figure 9. In the scanning stage the arm performed a sweeping motion while collecting a point cloud containing approximately half of the workpiece, a large portion of the table, and a small portion of the arm itself. The recorded points are restricted to those that fall in a selected region of the usable workspace of the robot. This collection process produces redundant data points representing the objects and the cloud data can become large. The approach presented is applied to the raw projected LiDAR points as described with respect to the base frame of the robot.

Calibration of 3D LiDAR

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1. **RESULTS AND DISCUSSION**

The results show that the proposed method of automated weld path generation effectively using RANSAC and ICP algorithms is viable for workpiece localization. The alignment achieved in the simulated examples is strong as shown in the table and proved that these algorithms can be implemented even in the case of increased noise in the target point cloud due to clamping mechanisms or miscellaneous items on the weld surface. The accuracy of the simulated tests is to be expected given that the simulated scene contained geometric features designed in CAD which closely resembled the target pointcloud features.

The physical experiment shows that this approach can be applied to a welding application using physical data in a realistic environment given that proper calibration is completed. The 3D LiDAR scans require calibration to accurately transform the source cloud to the target cloud. Further investigation is required to determine if the accuracy of the resulting workpiece localization is inside a working tolerance for a welding operation.

The implementation of down sampling and filtering with voxel and bounding box is an essential step prior to the segmentation algorithm with RANSAC. Furthermore, with the increased utilization of RANSAC, outlier rejection is a required step when there are features such as clamps included in the target pointlcoud set. Correspondence matching and alignment with ICP is proven to only be effective when sufficient outliers have been rejected and a good initial guess is provided by RANSAC. Utilization of cascaded RANSAC segmentation provides an effective means for sufficient outlier removal such that workpiece alignment accurate enough to be applied to a physical welding process.