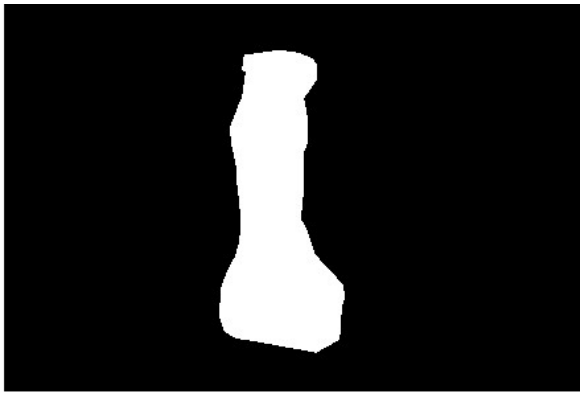
Experiment on MOPED for estimating drill position

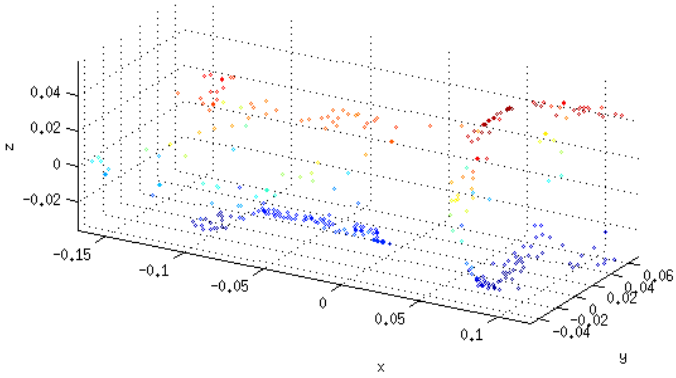
1. Building 3D SIFT model for drill

Steps:
- Put the object on a textured cardboard (to help the feature association)
- Take about 40 pictures of the object from various views.
- Calibrate the camera to get intrinsic parameters.
- Feed the data to bundler (Structure-from-motion program attached in moped), output 3D points
- Draw a mask for each picture to mask out the background.
- Generate model file: 3D points + SIFT descriptors. Use the above mask to filter points in the background. Carefully rotate the 3D points to a straight pose in the model space. Also, scale the model to be of the same size as the real object (scale is undetermined in the SFM result)

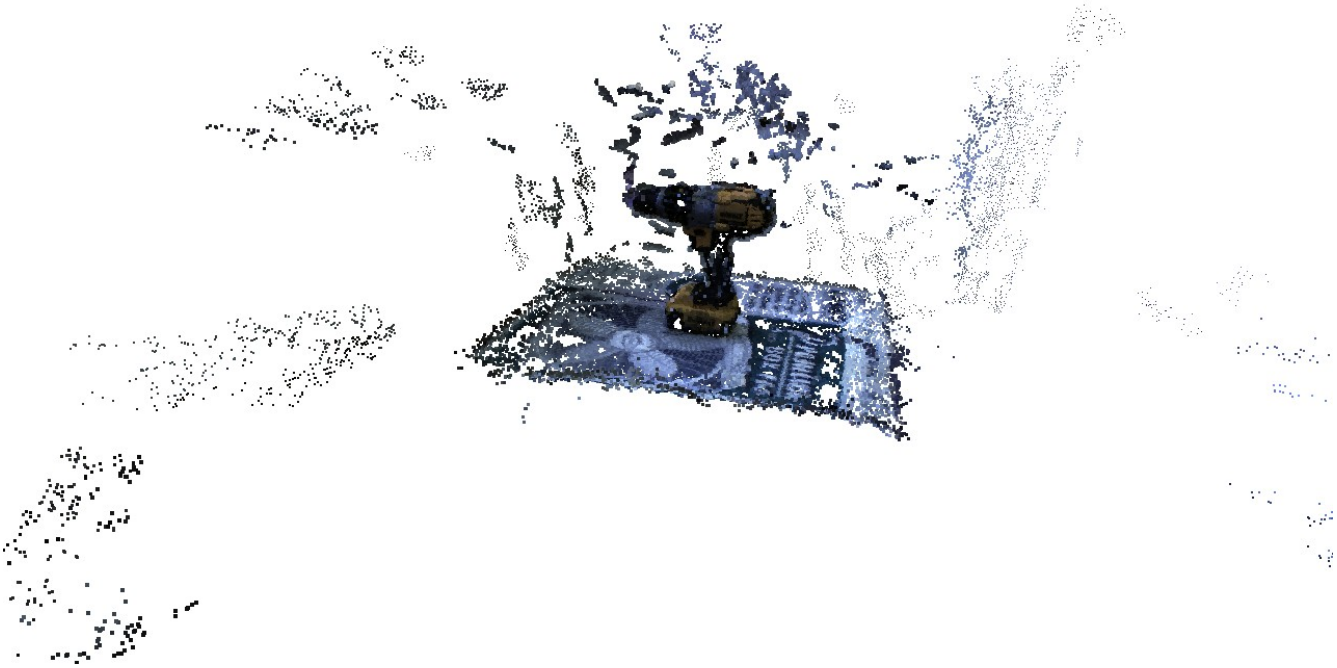
Issues: not enough textures on drill, bundler was not working well. So, I added some tapes with texts on it, like this:



3D model produced: (the drill is lying, head pointing toward negative x; color corresponds to z value); the result (345 points) is not dense compared to example models from MOPED (~1000 points).

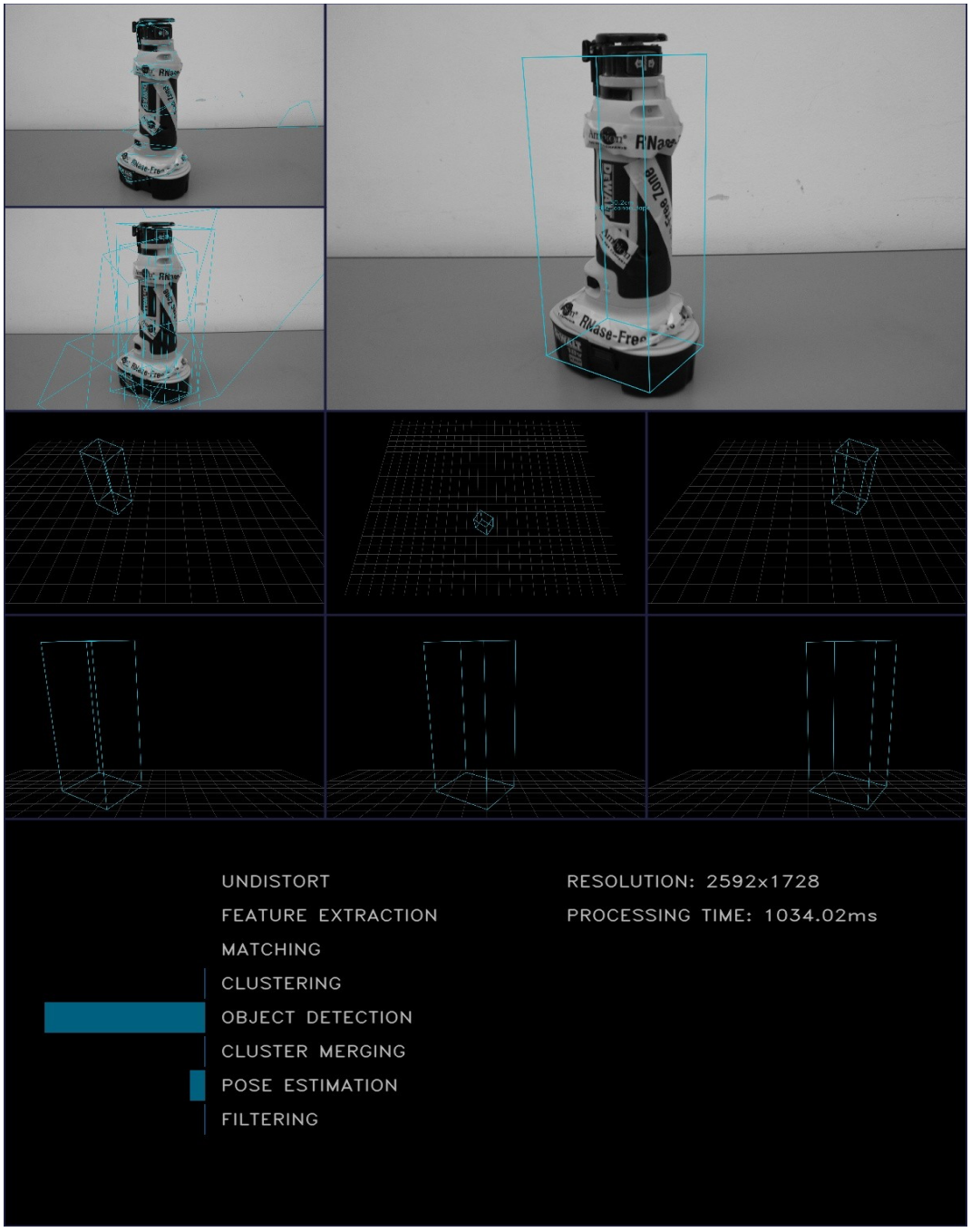


Fancy dense model produced from PMVS (Not used, just for getting a feeling of bundler's result):



2. **Test MOPED with our model**

Built-in viewer:



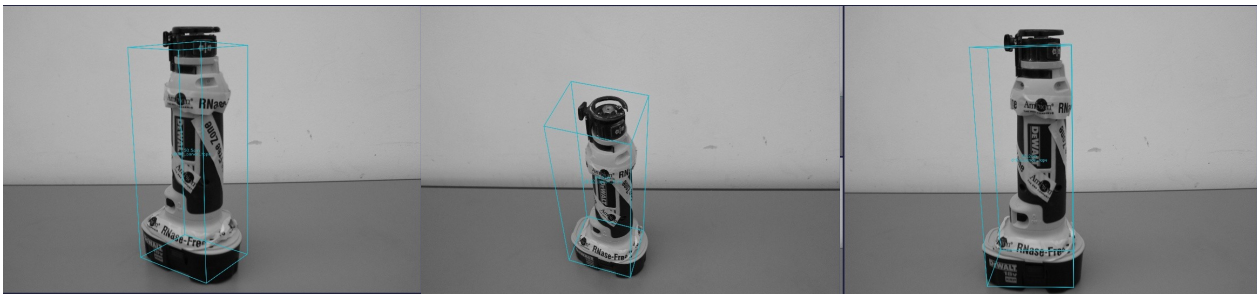
Top left: feature detection and matching, then do mean shift clustering on image coordinate (upper). Pose hypotheses generated with each cluster (lower).

Top right: pose estimation result by further optimizing and clustering the hypotheses in 6D.

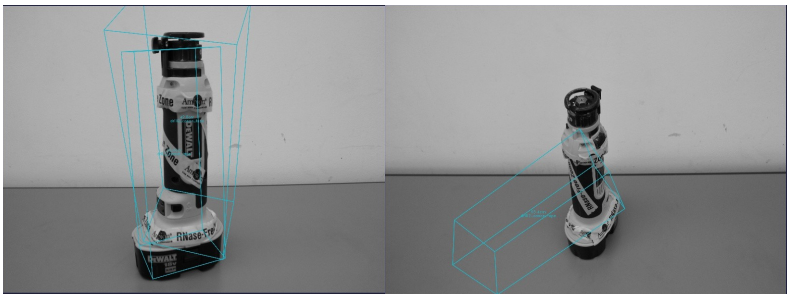
Middle: various views in 3D.

Bottom left: the bar shows processing time

Good results



Bad results



Many other views did not have detections

detection rate was only about 2 / 22

Observations

1. Pose estimation seems quite accurate if the detection is correct.
2. Detection depends highly on the number of matched features on that view. Generally from side views like in “Good results” there is much more detections than from frontal or back view. The built model has more features on the sides.
3. Generally, the drill does not have enough features for MOPED to work reliably.