

Estimating 6D poses without CAD models or external references using semantic-aware and geometry-aware features

Motivation

- **6D Pose estimation**
 - Estimate an object's 3D position and 3D orientation.
- **Why prior-free?**
 - CAD models and reference images are often unavailable or expensive to obtain.
 - Improved generalization to unseen objects.
- **Limitations of current works:**
 - Need CAD models
 - Need reference images
 - Poor robustness under occlusion and clutter
- **Datasets:**
 - ICBIN
 - textured household objects such as coffee cups and juice boxes
 - XYZ-IBD
 - texture-less industrial metallic objects such as gears and brackets

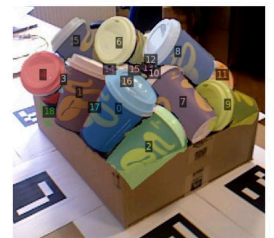
Approach

- Step 1:** Instance segmentation
- Step 2:** Geometric and semantic feature extraction
- Step 3:** Anchor selection
- Step 4:** Transformation estimation

Input: RGBD image



a. Instance segmentation



b. Anchor selection



Pairwise pose estimation



Figure1. Proposed pipeline.

Results

Table1. Quantitative results. (TE: translation error, RE: rotation error, IR: inlier ratio)

	Semantic features			Geometric features			Geometric + Semantic		
	TE [mm]	RE [°]	IR	TE [mm]	RE [°]	IR	TE [mm]	RE [°]	IR
Coffee cups	12.67	57.56	0.20	14.73	61.72	0.20	8.68	41.27	0.32
Juice boxes	23.39	36.73	0.53	29.41	81.06	0.39	25.27	23.51	0.59
Gears	4.47	79.98	0.36	2.74	40.94	0.48	2.75	59.64	0.49
Metal Brackets	6.98	69.73	0.36	7.95	35.3	0.5	4.58	34.58	0.5

Semantic-aware Geometric-aware Semantic and Geometric

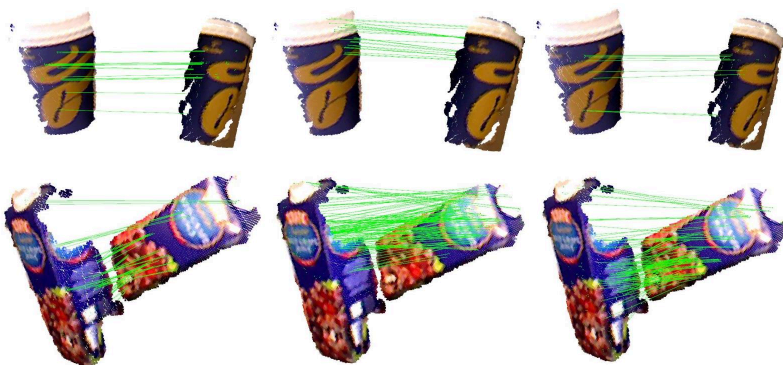


Figure2. Inlier correspondences using semantic, geometric, and their combination.

Input Semantic features Geometric features combined

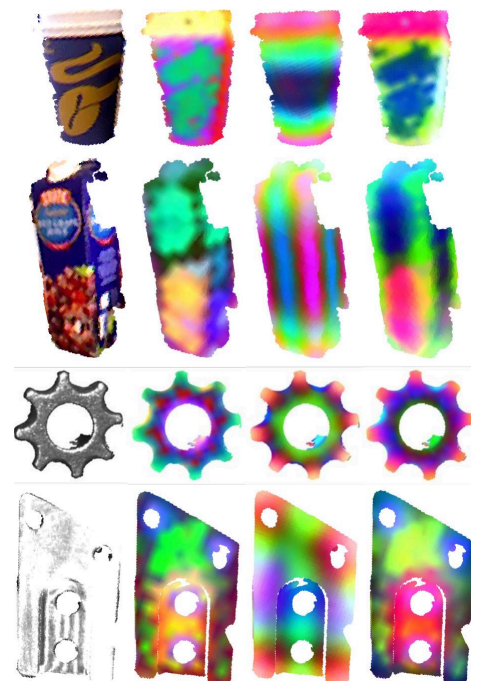


Figure3. Feature representations on different object using PCA.