BOP Challenge 2024 on Model-Based and Model-Free 6D Object Pose Estimation

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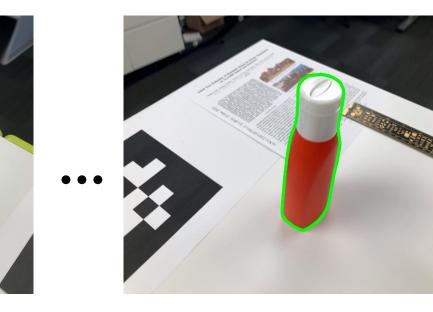


What's new?

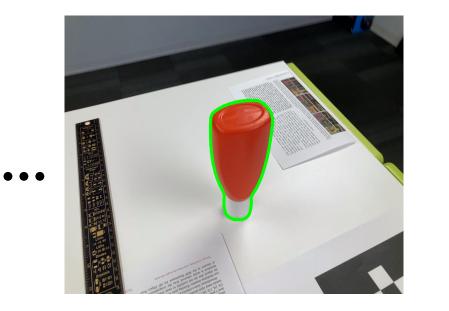
New model-free tasks: Most existing methods require 3D object models that are expensive to obtain. In 2024, we introduced new model-free tasks, where only reference videos are available during a short onboarding (< 5min, 1 GPU):

Static onboarding: Object is static, camera is moving (2 videos: up and down).









Dynamic onboarding: A fixed camera captures objects manipulated by hand.



New BOP-H3 datasets: We introduced 3 new datasets referred jointly as BOP-H3: HOT3D, HOPEv2, and HANDAL to enable the model-free tasks and their comparison with the model-based variants.





New 6D detection task: We now evaluate on two 6D pose estimation tasks:

- 6D object localization: Identifiers of present object instances are provided.
- 6D object detection (new in 2024): No prior information is provided.

BOP datasets



- 16 test datasets in a unified format: Each dataset includes color 3D models, test images of scenes with graded complexity, and real/synthetic training images.
- Currently 3 dataset groups:
 - o BOP-H3 (new in 2024): 3 datasets of 98 objects.
 - BOP-Industrial (new in 2025): 3 datasets of 53 industrial objects.
 - o BOP-Classic: 12 datasets of 199 objects (including BOP-Classic-Core).
- MegaPose training set: 2M+ PBR images showing 50K+ diverse objects.

Evaluation methodology

Challenge tracks: Participants competed on seven challenge tracks on unseen objects (target objects not seen during training), with each track defined by a type of object onboarding (model-based, model-free), a task (6D localization, 6D detection, 2D detection), and a dataset group.

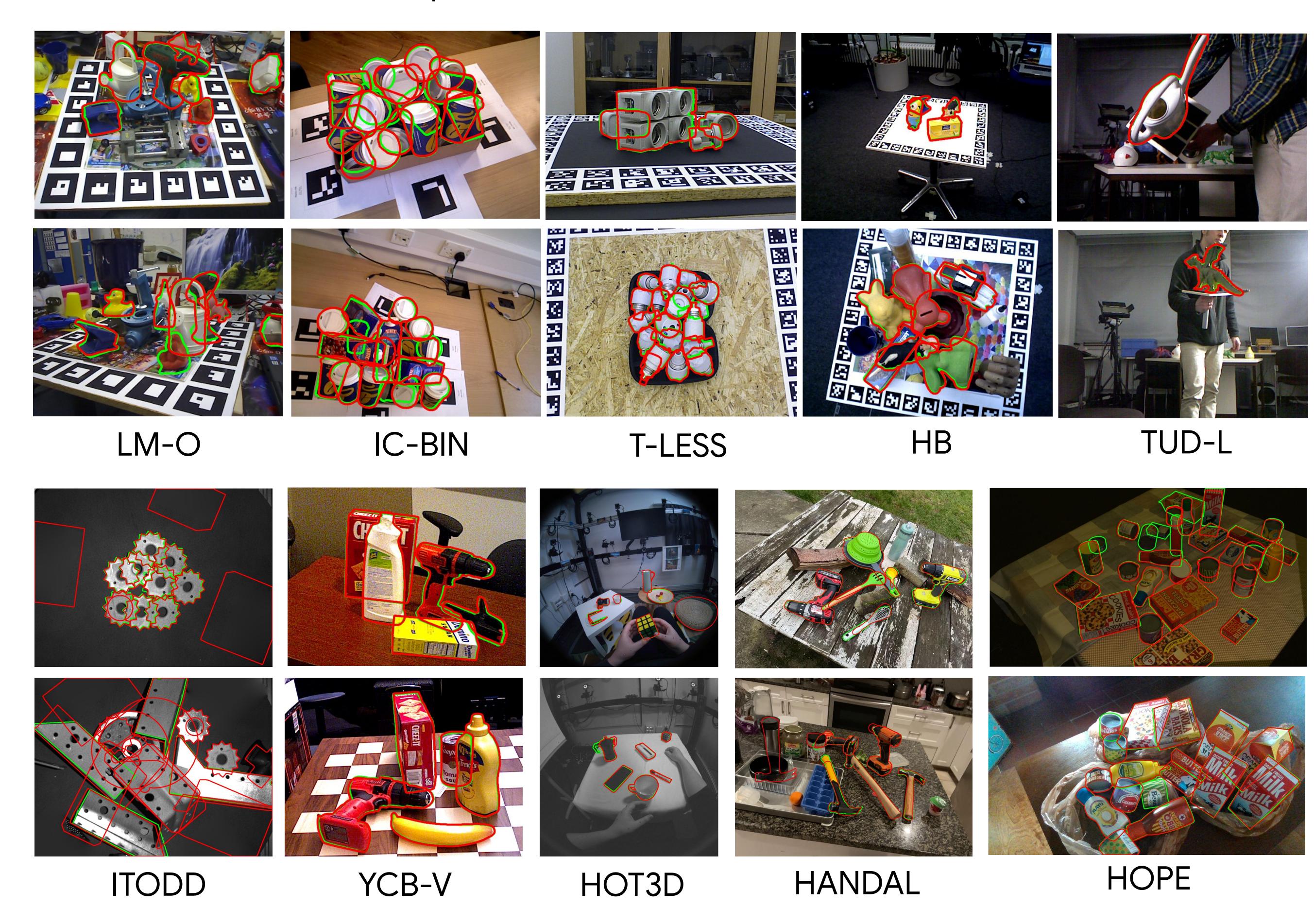
Metrics:

- 6D object localization: Average Recall (AR) w.r.t. MSSD, MSPD, VSD.
- 6D object detection: Average Precision (AP) w.r.t. MSSD, MSPD.
- 2D object detection: Average Precision (AP) w.r.t. loU.

Evaluation system at bop.felk.cvut.cz stays open!

Results

Qualitative results of the top methods for model-based 6D detection:



- Model-based 6D localization: The best 2024 method (FreeZeV2.1) achieves 82.1 AR, only 3.5 AR behind the best method for seen objects (GPose2023).
- Model-based 6D detection: Ranking of methods is consistent with 6D localization, suggesting that 6D detection and 6D localization tasks present similar difficulties.
- Model-based 2D detection: The best 2024 method (MUSE) is 21-29% above the best 2023 method (CNOS), but -35% the best method for seen objects (GDet2023).

BOP Challenge 2025

BOP 2025 is associated with the OpenCV Challenge for Bin-picking. We introduce new BOP-Industrial datasets and multi-view evaluations.

