

# Computer Vision for Manufacturing Quality Inspection with Synthetic Data

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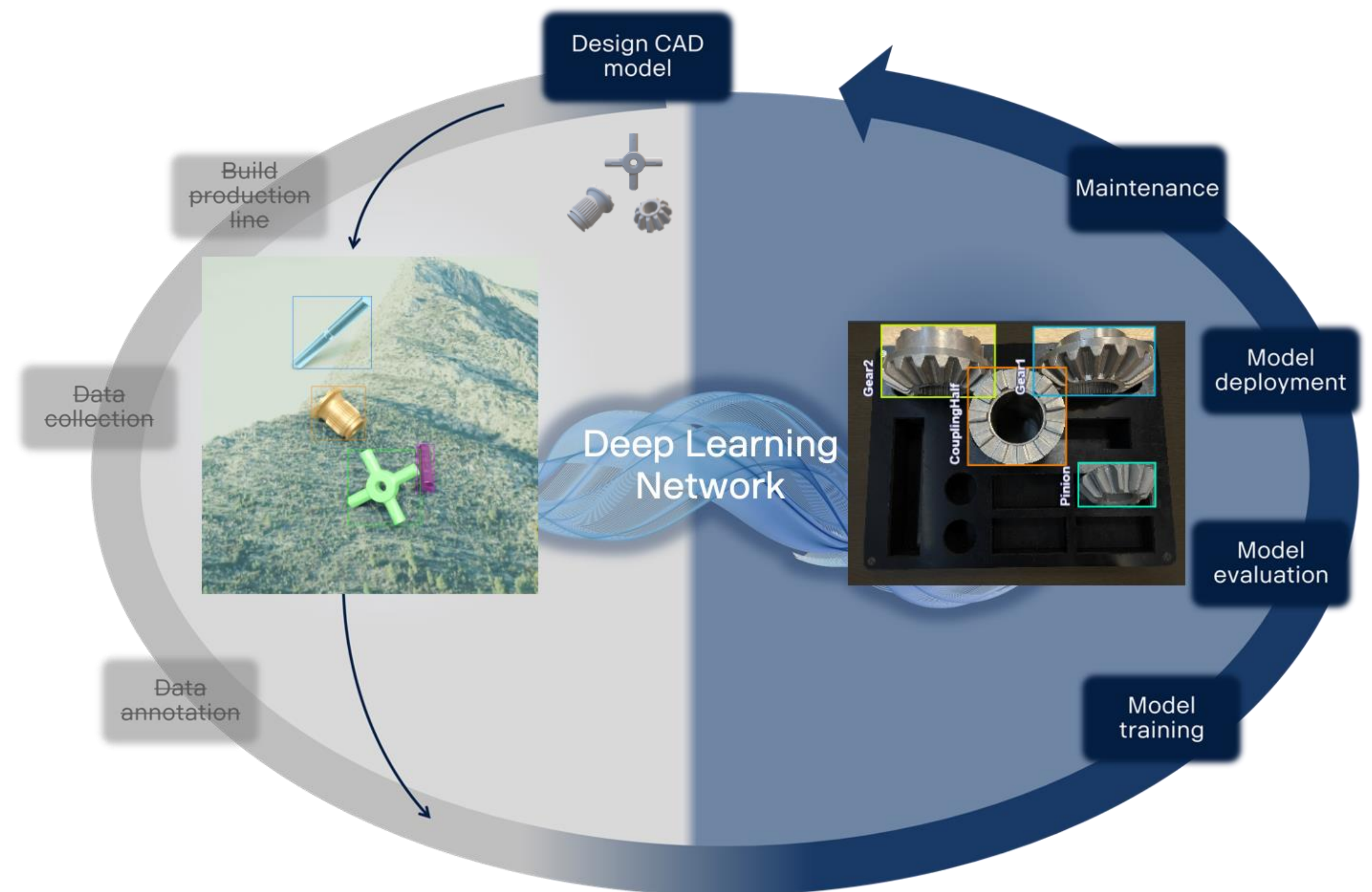
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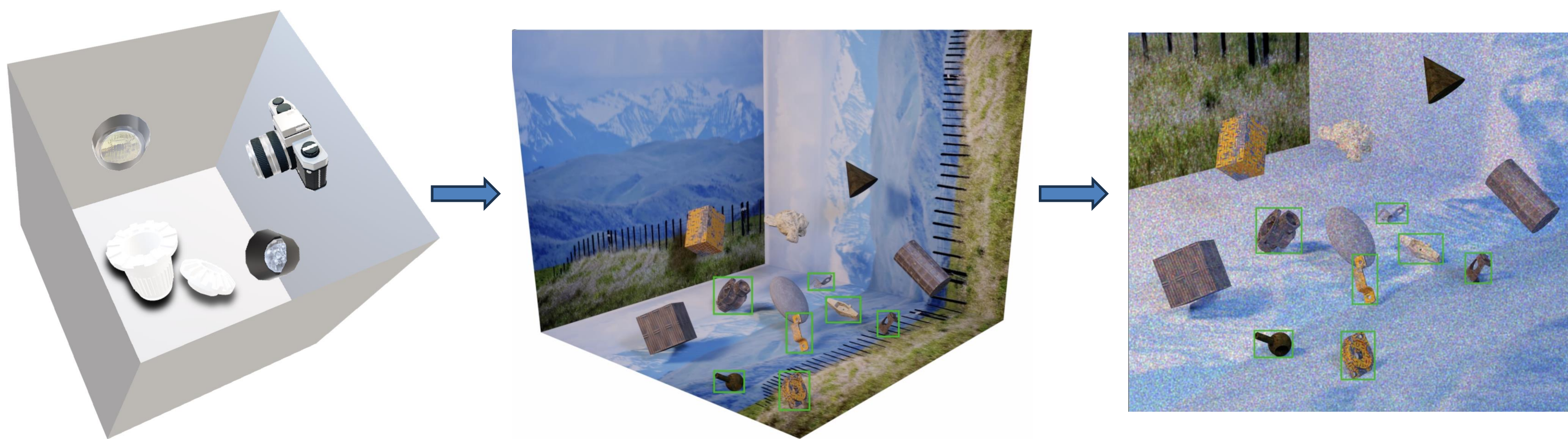
## Abstract:

One challenge in applying deep learning-based computer vision for manufacturing quality inspection is the limited availability of annotated data, which can be costly and time-consuming to collect. We address this by generating synthetic data from CAD models with domain randomization, varying object characteristics, backgrounds, lighting, and camera settings to reduce the domain gap.

We evaluate our synthetic data on a public robotics dataset [1] and our Synthetic Industrial Parts dataset (SIP15-OD) [2], achieving over 90% detection accuracy and demonstrating the effectiveness of synthetic data for sim-to-real transfer.



## Method:



Using **Domain Randomization** to generate robust synthetic data:

- Object: Quantity, Pose, Gravity, Texture (RGB, Images, Material);
- Background: Images, Distractors;
- Camera: Pose, Focus point, FOV;
- Illumination: Quantity, Energy, Color;
- Post-processing: Noise, Blur;
- Rendering: Ray tracing, Rasterization;

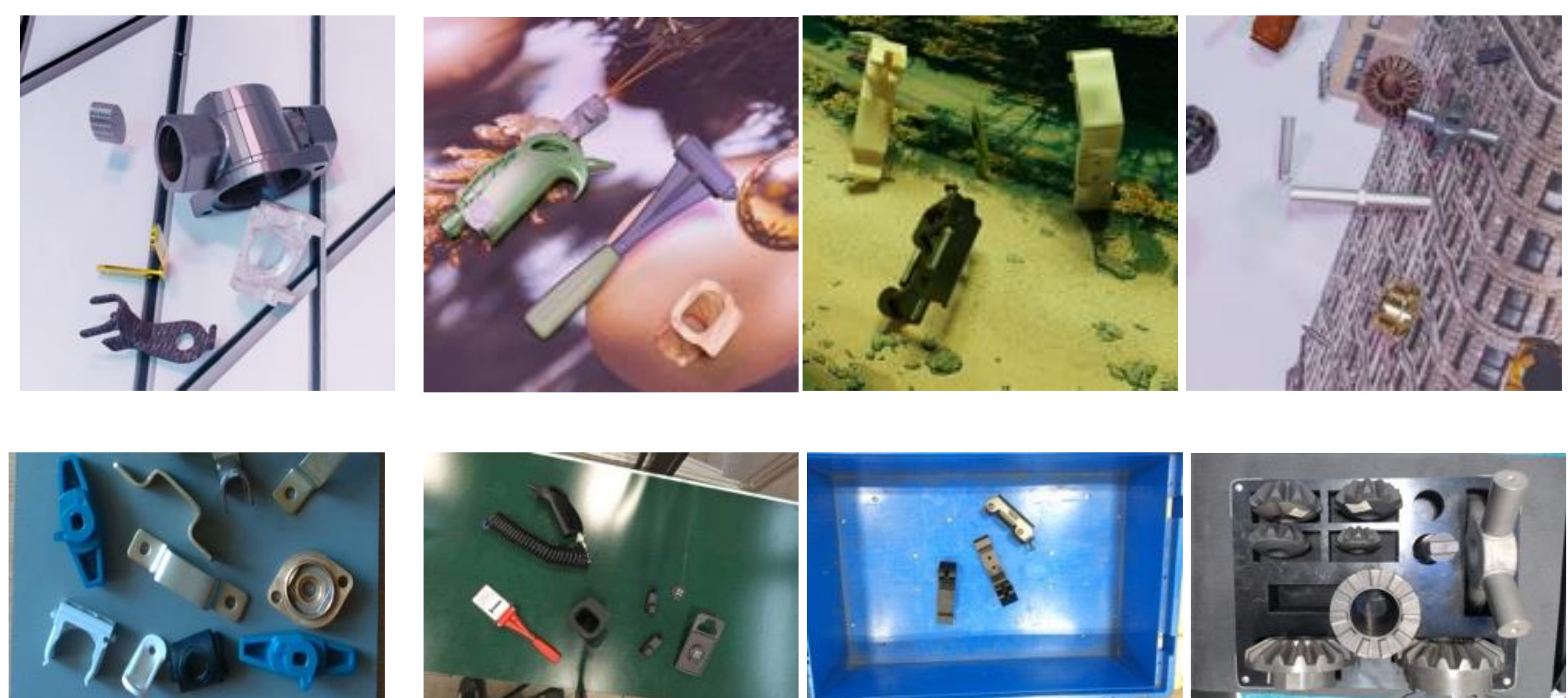
## Datasets:

Robotics [1]

SIP15-U1 [2]

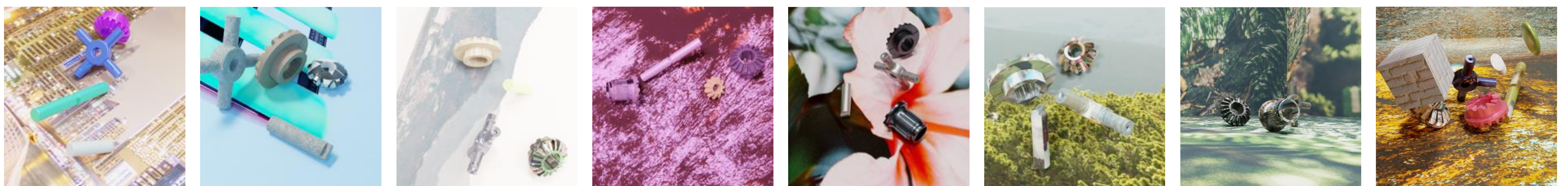
SIP15-U2 [2]

SIP15-U3 [2]



**Results:** (with Yolov8, only trained on synthetic data and test on real data):

	Robotics	SIP15-U1	SIP15-U2	SIP15-U3
mAP@50 (%)	96.4	94.1	99.5	95.3



## References

[1] Horváth, Dániel, et al. "Object detection using sim2real domain randomization for robotic applications." *IEEE Transactions on Robotics* 39.2 (2022): 1225-1243.

[2] Zhu, Xiaomeng, et al. "Towards sim-to-real industrial parts classification with synthetic dataset." *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition*. 2023.