

# USB: Universal-Scale Object Detection Benchmark

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**Insufficient scale variation** → **USB** (Universal-Scale object detection Benchmark)

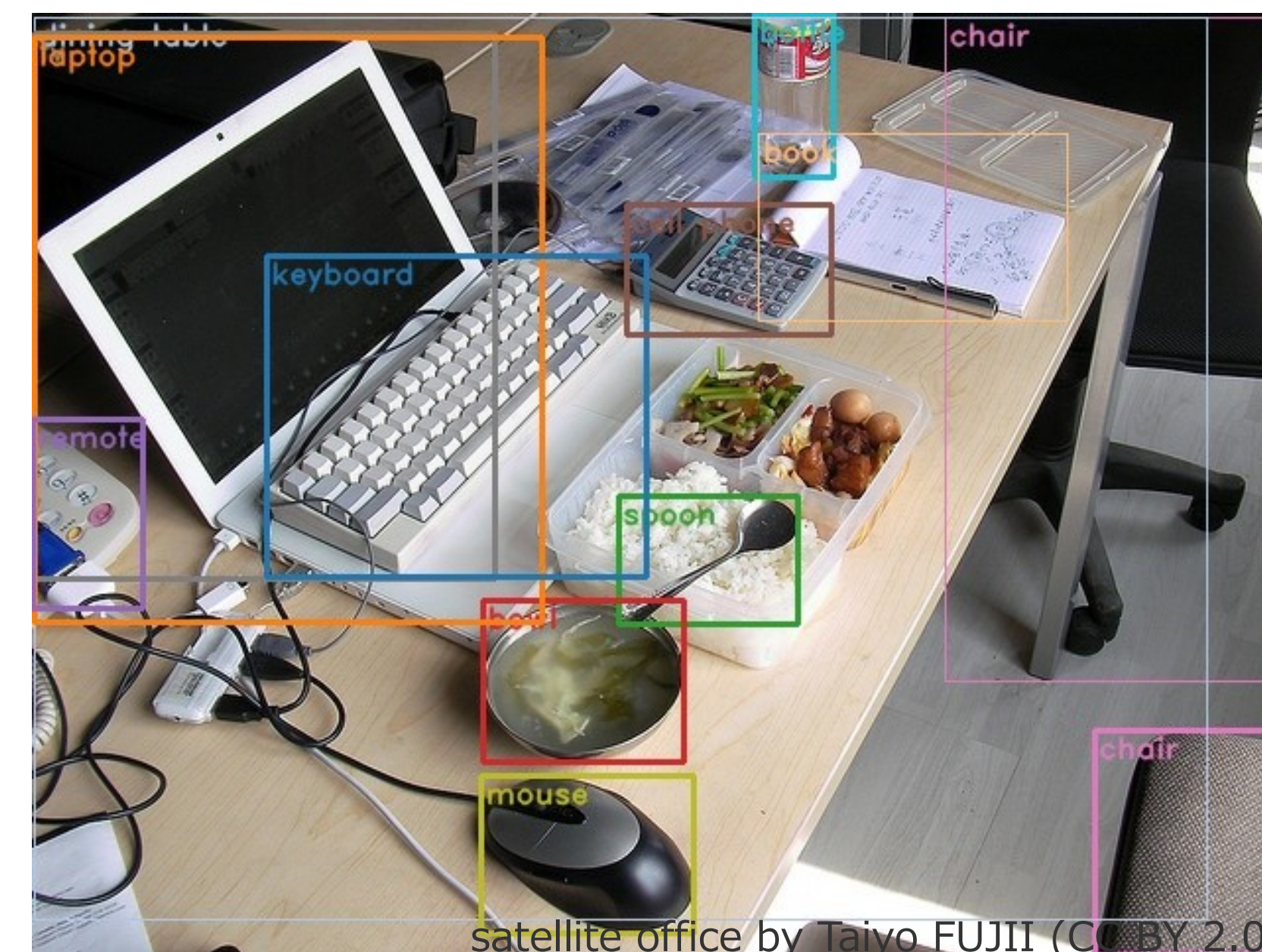
**COCO** [Tsung-Yi Lin+, ECCV 2014]

- ✗ Single-domain benchmark
- ✗ Photograph-specific variation
- ✗ Insufficient tiny objects
- ✗ Coarse scale-wise evaluation

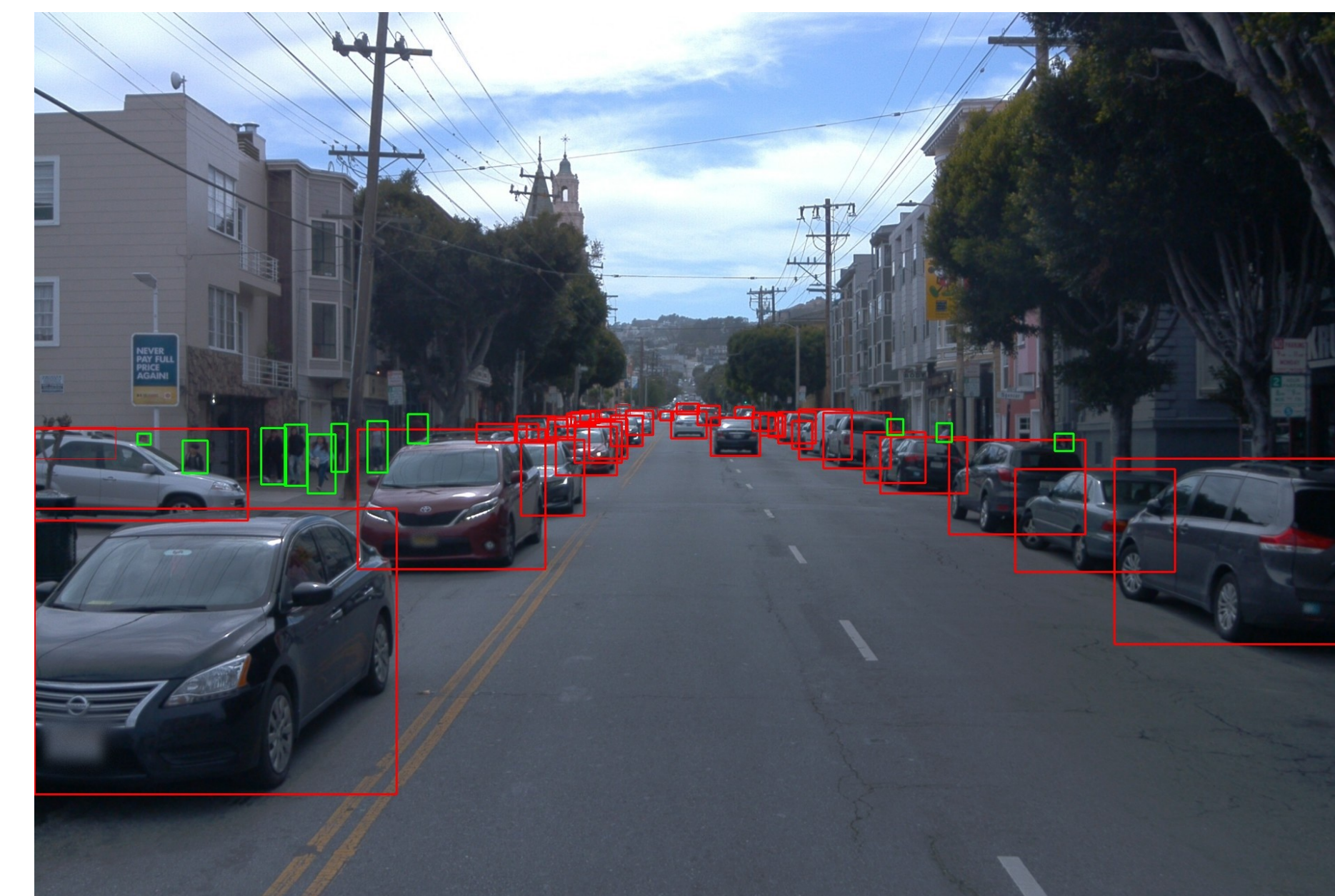
**UODB** [Xudong Wang+, CVPR 2019]

- ✓ Multi-domain benchmark
- ✗ Limited scale variation
- ✗ Insufficient instances
- ✗ No scale-wise evaluation

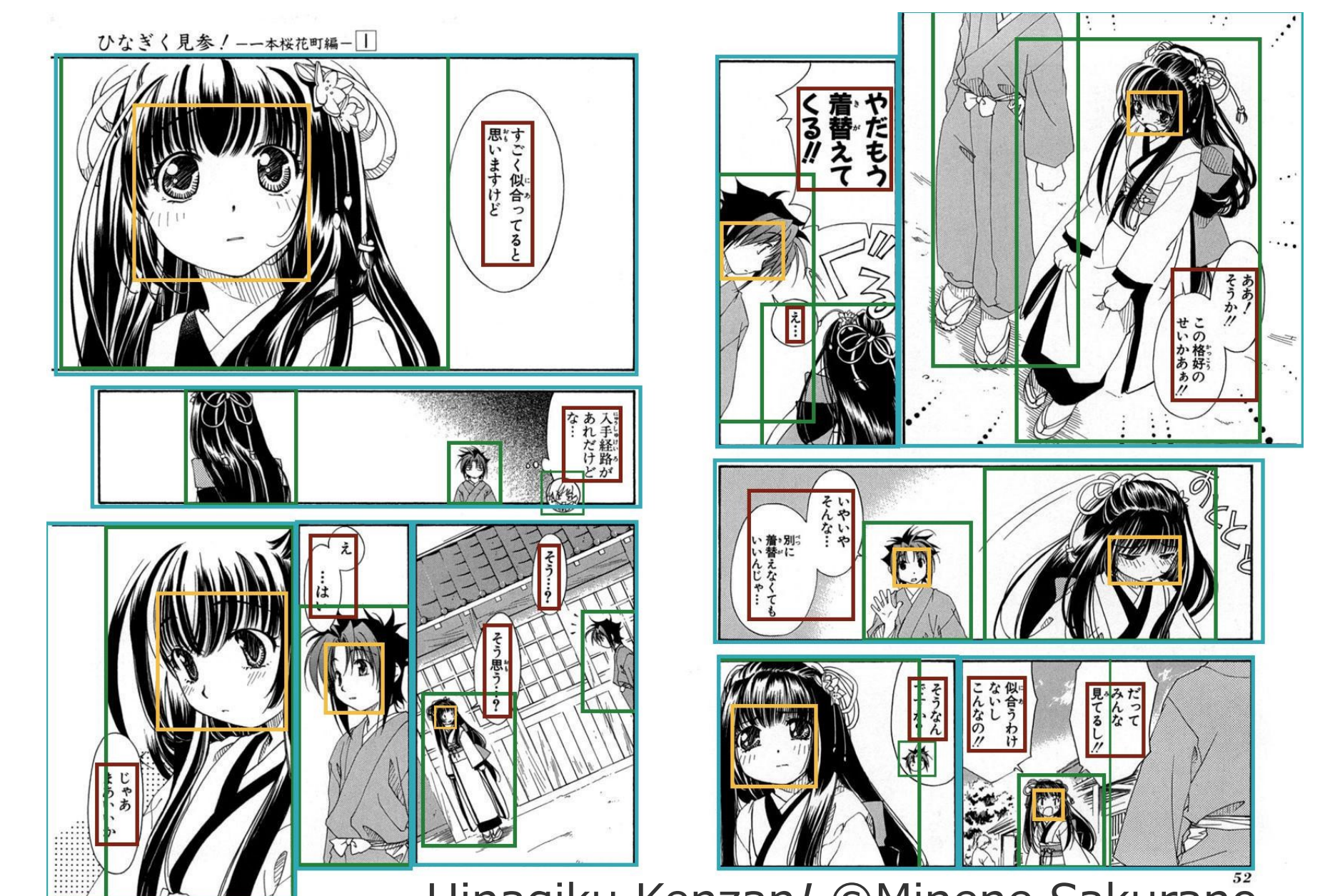
COCO



Waymo Open Dataset



Manga109-s



- ✓ Multi-domain benchmark
- ✓ Larger scale variation
- ✓ More instances for reliable evaluation
- ✓ Fine scale-wise evaluation

**Inadequate protocols**

→ **USB protocols** for fair comparison and inclusive research

	Max epoch	Learning rate	Test scale
Standard setting	24	0.01, 0.02	1333×800
YOLOv4	273	0.00261	
EfficientDet-D0	300		512×512
EfficientDet-D7x	600		1536×1536
DETR	500		

- ✗ Scattered settings
- ✗ Unfair comparison
- Well-funded researchers buy strong results [Roy Schwartz+, CACM 2020]

USB training protocols

Protocol	Max epoch	AHPO	Compatibility	Example
USB 1.0	24	✗	—	2× schedule [26, 29]
USB 2.0	73	✗	USB 1.0	6× schedule [29]
USB 3.0	300	✗	USB 1.0, 2.0	EfficientDet-D6 [69]
USB 3.1	300	✓	USB 1.0, 2.0, 3.0	YOLOv4 [5]
Freestyle	∞	✓	—	EfficientDet-D7x [70]

USB evaluation protocols

Protocol	Max reso.	Typical scale	Reference
Standard USB	1,066,667	1333× 800	Popular in COCO [11, 26, 40]
Mini USB	262,144	512× 512	Popular in VOC [20, 44]
Micro USB	50,176	224× 224	Popular in ImageNet [28, 56]
Large USB	2,457,600	1920× 1280	WOD front cameras [62]
Huge USB	7,526,400	3360× 2240	WOD methods ([33], ours)
Freestyle	∞	—	—

- ✓ Divisions for training epochs and evaluation image resolutions
- ✓ Fair comparison
- Backward compatibility promotes inclusive research
- Don't report only higher protocols (longer training)
- Do report also lower protocols (shorter training)