

A Low-Cost, High-Speed, and Robust Bin Picking System for Factory Automation Enabled by a Non-stop, Multi-View, and Active Vision Scheme

Xingdou Fu*, Lin Miao, Yasuhiro Ohnishi, Yuki Hasegawa, Masaki Suwa

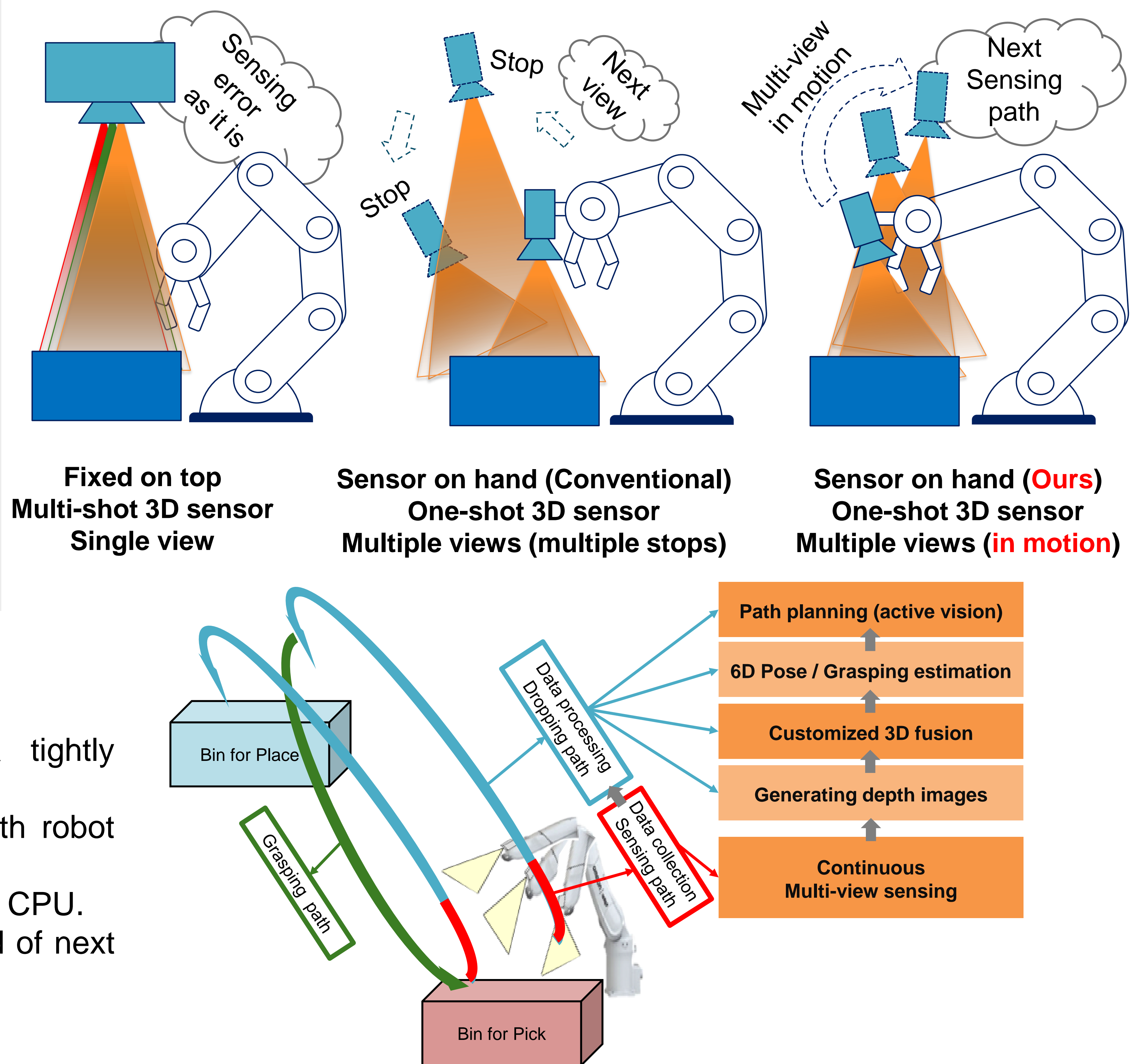
① Background and our goal

- Metallic objects (without texture) cause noisy 3D data and fail bin picking applications in FA.
- Multi-view approaches with “sensor on hand” configuration are getting popularity due to effectiveness and low cost but suffering from low-speed issues.
- Our goal is to address this problem so that multi-view systems can cover time-critical applications without sacrificing robustness and cost efficacy.

② Approach

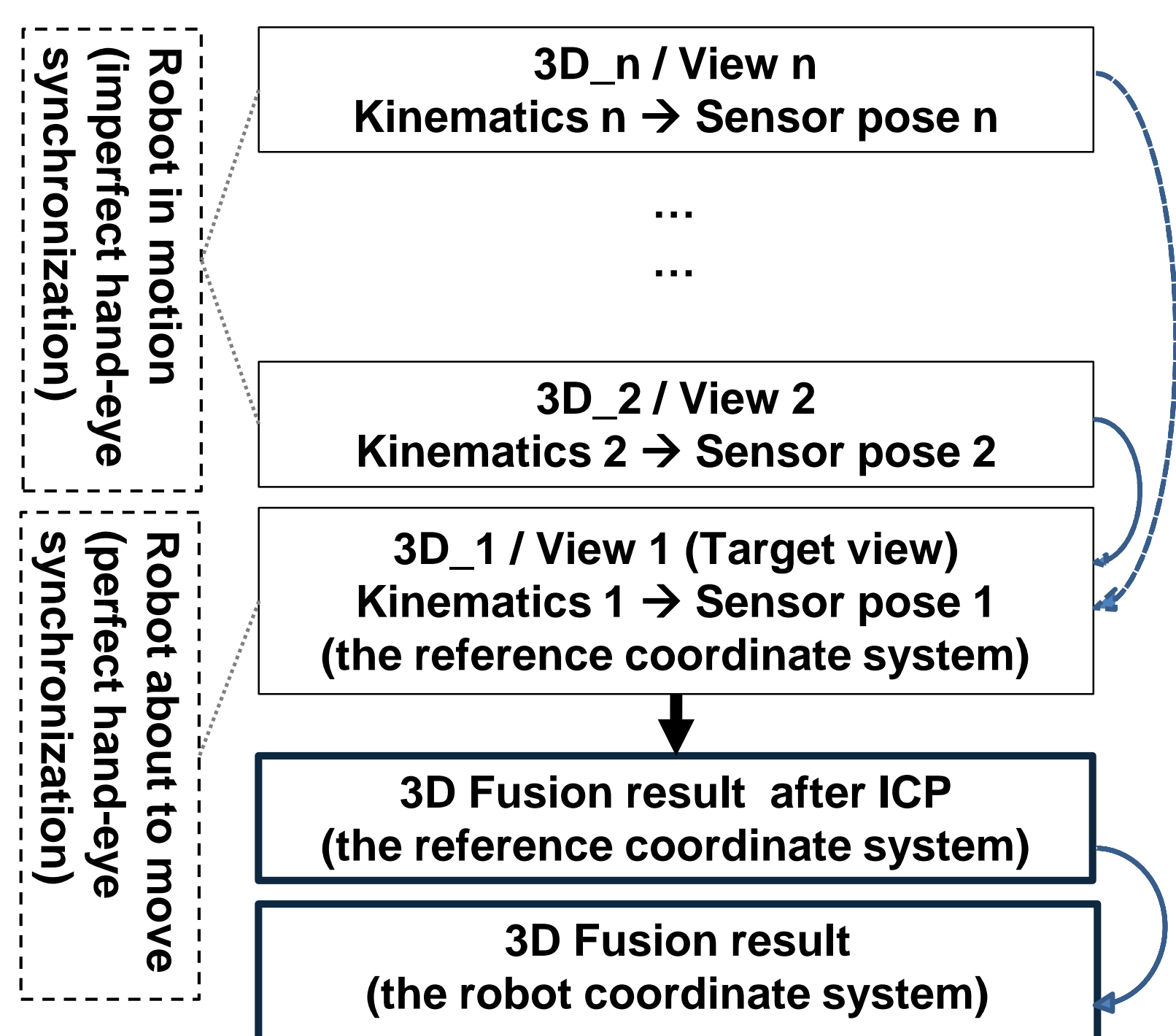
A high-speed active vision bin picking system with a tightly coupled sensing scheme

- Reorganize the workflow / Parallelized sensing with robot place action
- Continuous sensing / Customized 3D fusion runs on CPU.
- Lightweight active vision (next sensing path instead of next best view) for picking continuity



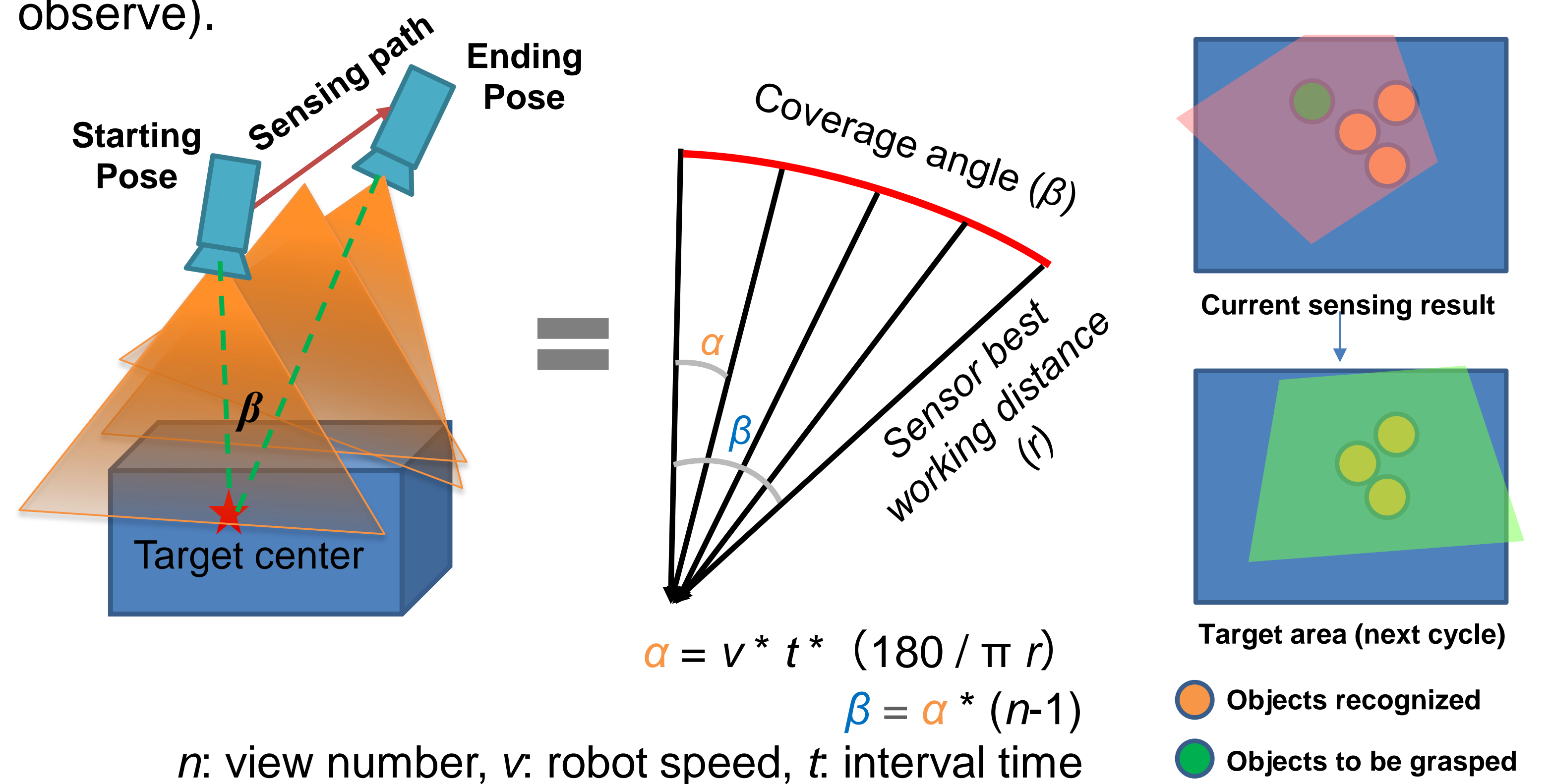
③ High-speed 3D fusion

We do not stop the robot for each view as others because we realized 3D fusion and sensor-robot coordinate transformation are different.

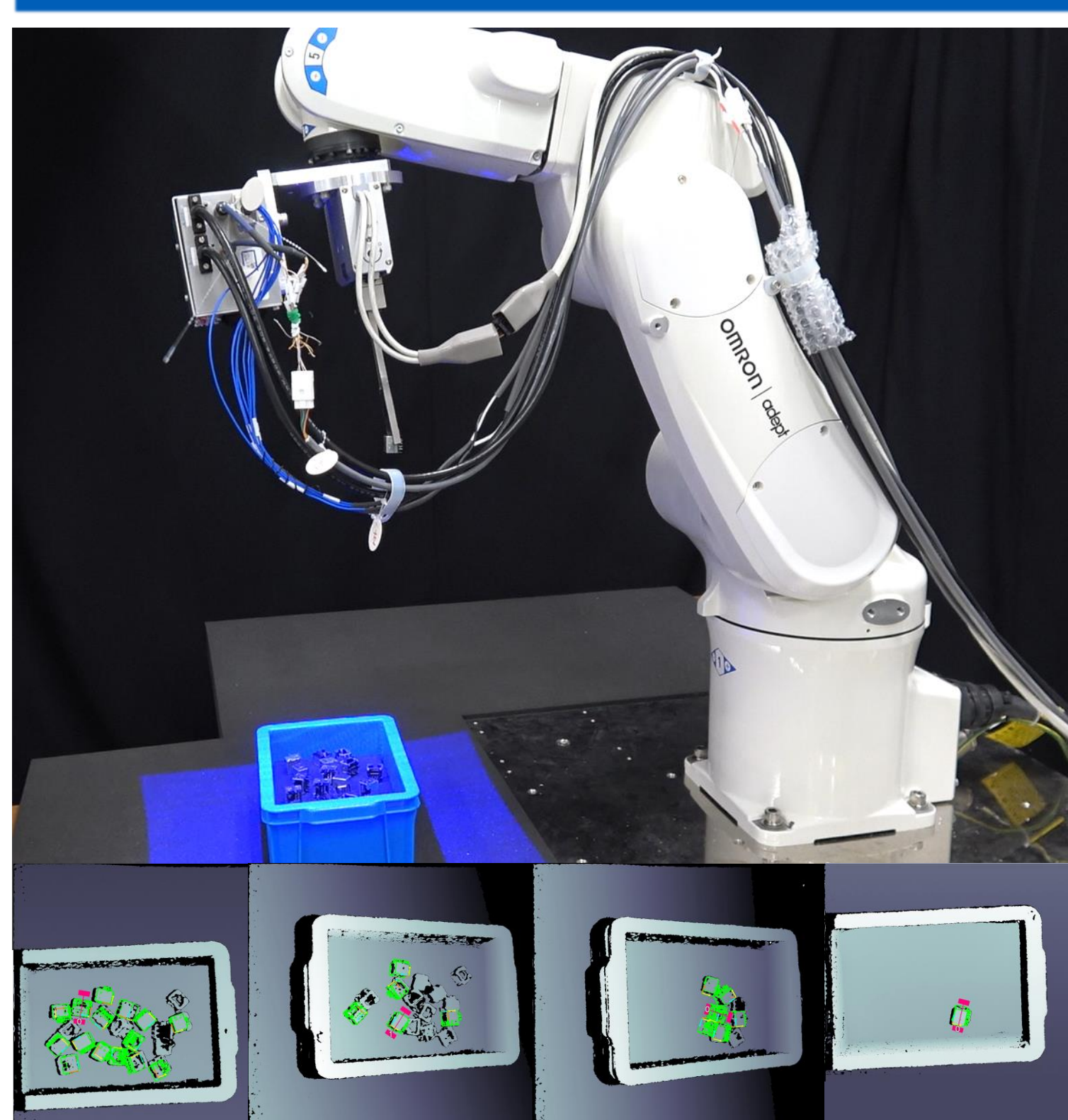


④ Active vision / Sensing path planning

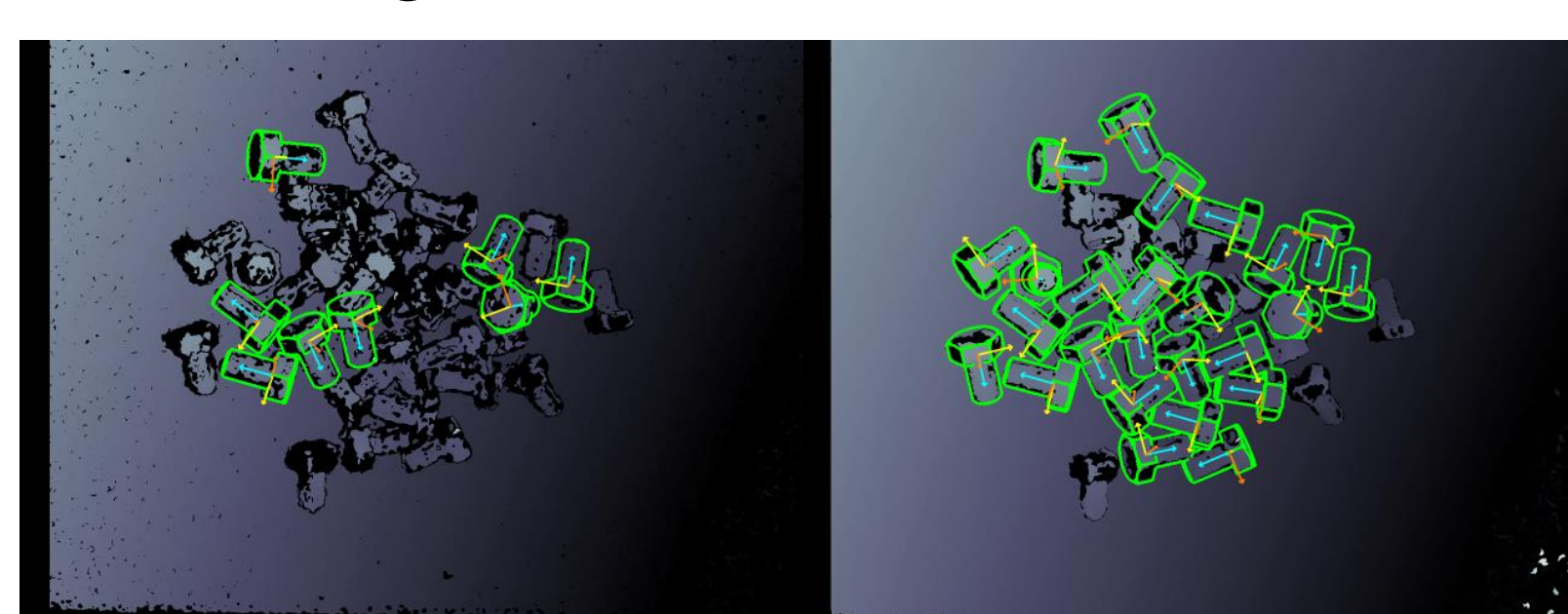
Sensing path = interpolation between “starting pose” and “ending pose”. Each pose = target (where to observe) and location (from where to observe).



⑤ Experiment



Single view v.s. Multi-view



Random path v.s. Active vision



Sensing time cost in takt time

Robot Fusion [12]	More Fusion [14]	MV6D, ROBI-related [16], [6-8]	Ours
≈6.0 s	≈8.0 s	Not applicable	≈0.635 s

Picking test results (simplified than paper vision)

Gripper	Two-finger				Vacuum
Objects	Small screw	Lan connector	Mirror nut	Pencil coupler	Circle nut
Sensing Parameters (view number, interval, speed)	4 views 30ms 70%	4 views 30ms 80%	3 views 60ms 60%	4 views 30ms 80%	4 views 30ms 80%
Average complete rate	100%	97.75%	98.75%	100%	100%