Particle Reselection and State Re-search for 1ms Tracking System in Factory Automation

修士課程卒業　丁 瀚宇

Background

Automatic picking

Robot arm

Complex environment

Requires

- Object tracking
- High processing speed
- High accuracy

Previous tracking system

- KLT based system
- Do not have high accuracy in the case of illumination change
- Not suitable for objects with few corner features

Target

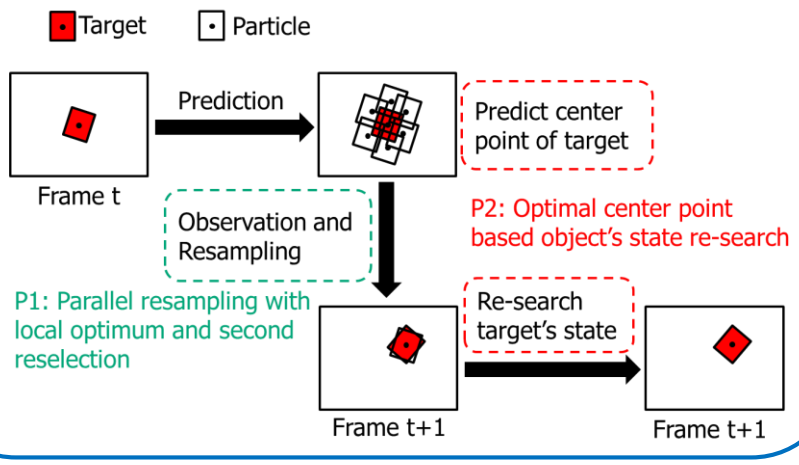
- Implement hardware-oriented Particle filter within one frame delay and keep high accuracy

Challenges

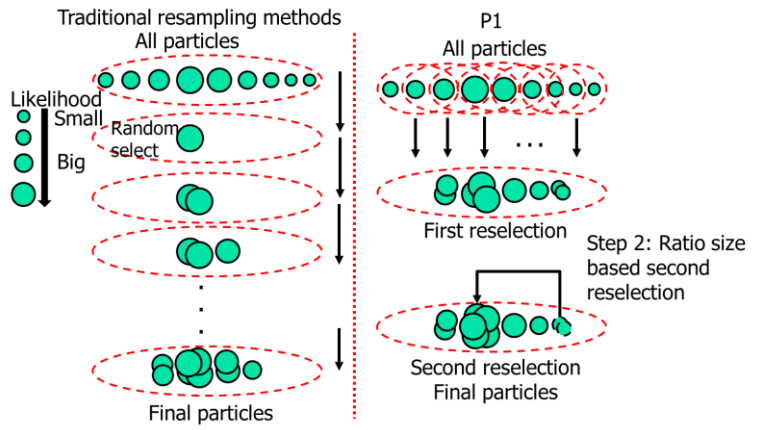
- Sequentially resampling
- Large number of particles

Proposals

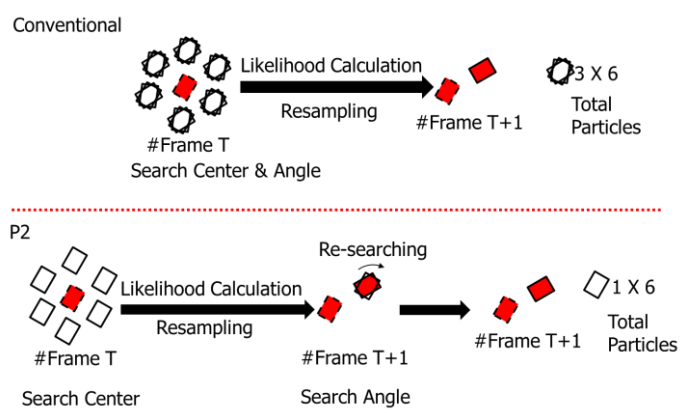
Framework



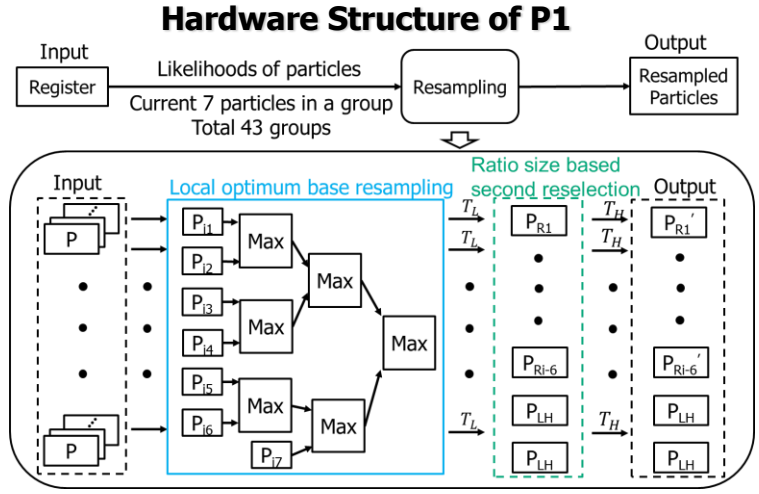
P1: Parallel resampling with optimum and second reselection



P2: Optimal center point based state re-search



Hardware Structure of P1



Experiment results

Method	Accuracy
Conventional work (343 particles)	99.58%
P1 (343 particles)	99.58%
P1+P2 (49 particles)	98.33%

Hardware performance	Conventional work	Proposed Particle Filter
Input Frequency	100 MHz	100 MHz
Input Frame rate	784 fps	784 fps
Processing Delay	4.102 ms/frame	0.914 ms/frame

Hardware resource utilization	Conventional work (343 particles)	Proposed Particle Filter (49 particles)	Available
LUT	730992(358.7%)	117783(57.8%)	203800
FF	338526(83%)	40170(9.9%)	407600
IO	331(66%)	331(66%)	500
DSP	0	0	840
BUFG	1(3%)	1(3%)	32

Conclusion

- Implement Particle filter on high frame rate and ultra-low delay tracking system, processing delay is 0.914ms/frame

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