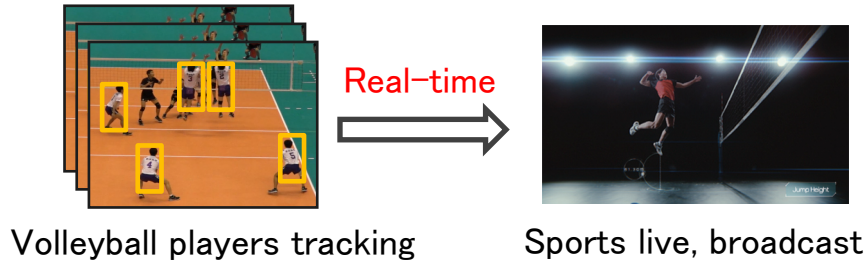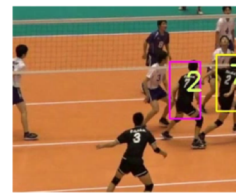# Color Weighted Spatial and HSV-Sobel Alternated Temporal Observation for 60fps 3D Tracking of Twelve Volleyball Players on GPU

修士課程卒業　趙　一鳴

➤ Background

Volleyball players tracking
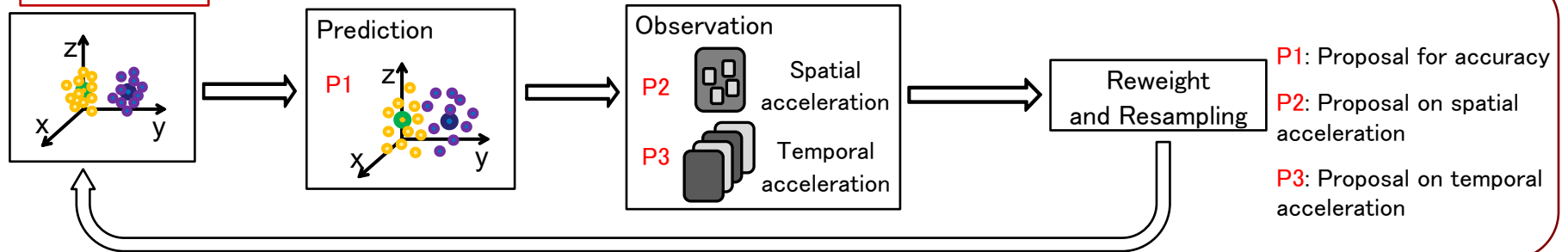
Real-time

Sports live, broadcast

Problems & Challenges

Wrong position exchange

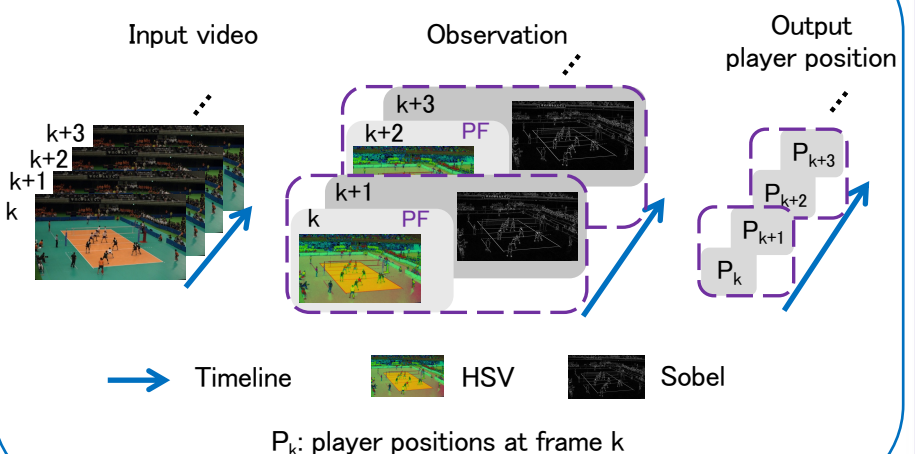|	Ball	Players
Target number	1	12
Area size (Pixels to observe)	●	20 times larger
Feature Used	HSV	HSV & Sobel

Large calculation cost

➤ Proposals

Framework

Prediction

P1

Observation

P2　Spatial acceleration

P3　Temporal acceleration

Reweight and Resampling

P1: Proposal for accuracy

P2: Proposal on spatial acceleration

P3: Proposal on temporal acceleration

P1: Body Region Constraint Prediction

unreasonable particles

to predict player ●

other player ●

outside ✓

inside ✗

other player's body

invalid particle

uncrossed particles distribution
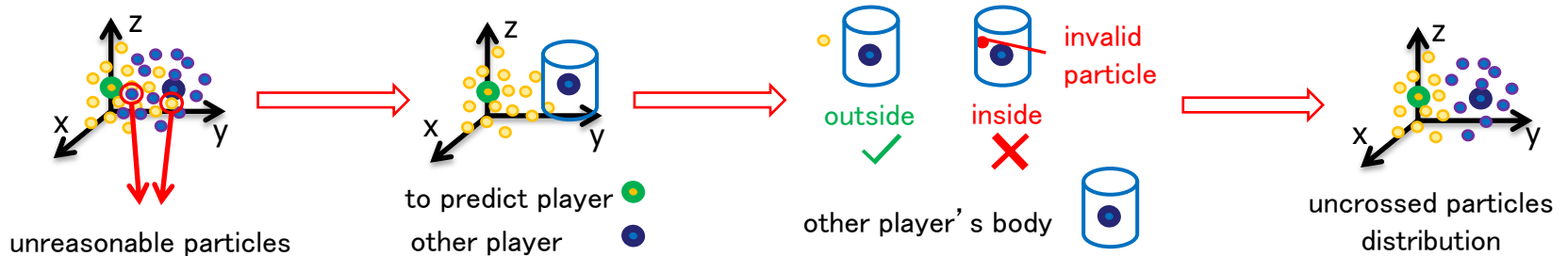
P2: Color Weighted Spatial Pixels Selection

Original → Divide → Select → After P2

frequency

■ original
■ after P2

HSV histogram
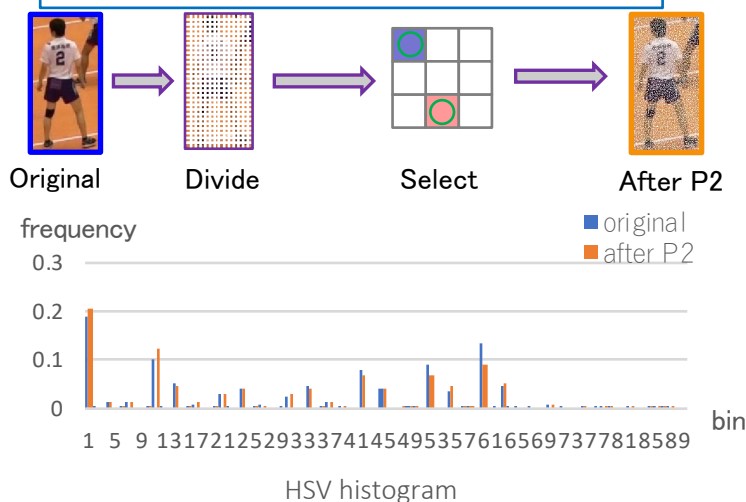
P3: HSV-Sobel Alternated Temporal Acceleration

Input video

Observation

Output player position

→ Timeline　　HSV　　Sobel

P_k: player positions at frame k

➤ Experiment result

Accuracy		Team1	Team2	Team3	Team4	Total
RU*Players		372	372	348	348	1440
Conventional	Tracked	370	353	330	340	1393
	Success rate	99.46%	94.89%	94.82%	97.70%	96.73%
P1	Tracked	370	361	342	344	1417
	Success rate	99.46%	97.04%	98.27%	98.85%	98.40%
P1+P2+P3	Tracked	363	356	338	340	1397
	Success rate	97.58%	95.69%	97.12%	97.70%	97.01%

Time cost (ms/frame)	CPU	GPU (GTX 1080Ti)		
		Conventional	P1 + P2	P1 + P2 + P3
Task 1: CvtColor	130	0.5	0.5	0.5
Task 2: Prediction	20	0.65	0.66	0.34
Task 3: Observation	23620	182.01	26.62	13.44
Task 4: Reweight & Resampling	30	3.45	3.47	1.73
SUM	23800	186.62	31.23	16.01

➤ Conclusion

Achieves 60fps for twelve volleyball players tracking with higher than 97% success rate.