# Pixel Selection and Intensity Directed Symmetry for High Frame Rate and Ultra-Low Delay Matching System

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## Background

◆ Human-machine interactive applications

- Gesture Recognition
- Virtual Reality
- Projection Mapping[1]

[1] http://channel.panasonic.com/jp/contents/16313/

High Frame Rate & Ultra-Low Delay Vision System

**Important !**

## Target・Challenges

Camera → FPGA → Projector…

Binary local feature based matching

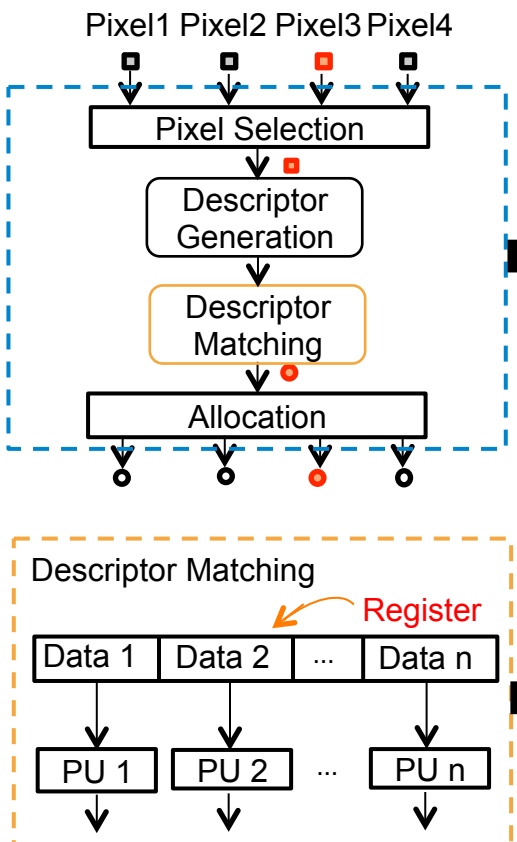
**Target**: Implement **1000fps** & **1ms** matching system with FPGA!

**Challenges** in my work:

High process speed (1000fps) × Low delay (1ms) × Limited resource

## Proposals

### (1) Pixel selection based 4-1-4 parallel matching



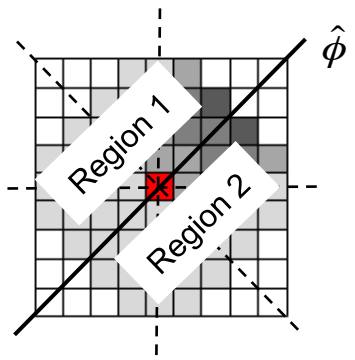

Part1: Pixel selection based 4-1-4 structure

- Process Speed (↑)
- Resource Cost (−)

Part2: Register storage based parallel matching

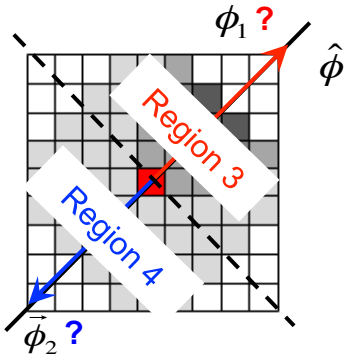
- Delay (↓)

### (2) Intensity directed symmetry (Orientation operator)




Step1: Calculate $\hat{\phi}$ based on Corner Symmetry

$\hat{\phi}$ : the line which bisect the patch best

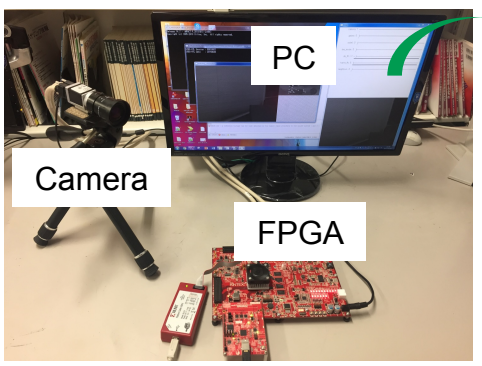


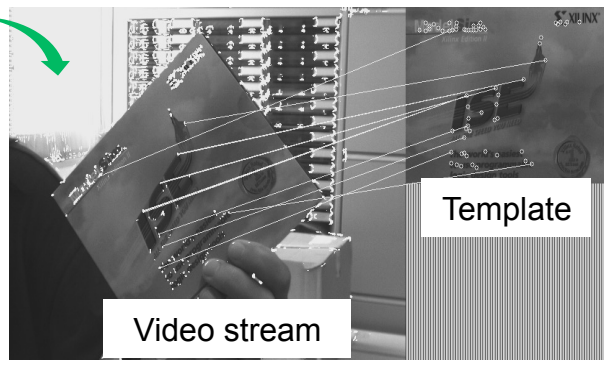

Step2: Determine the direction of $\hat{\phi}$ based on Region Intensity

- Range: (0°, 360°)
- Hardware-friendly

## Experiment Result

| | | |
|---|---|---|
| Camera | Frame rate | 784fps |
| | Resolution | 640480 |
| Image Core | Maximum frequency | 171.18MHz |
| | Process speed | 1306fps |
| | Process time(1 frame) | 0.808ms |




Camera → FPGA ↔ PC

## Conclusion

Based on the above proposals, the designed image processing core can achieve 0.808ms/frame and 1306fps matching, and the matching system is robust to rotation.

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