# Temporal Constraints and Block Weighting Judgement Based Mismatch Removal for High Frame Rate and Ultra-Low Delay Matching System

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## Background

- Human-machine interaction
  - Projection mapping[1]
  - Gesture recognition

Real ⟷ Virtual
seamless

⇒ High frame rate & ultra-low delay system

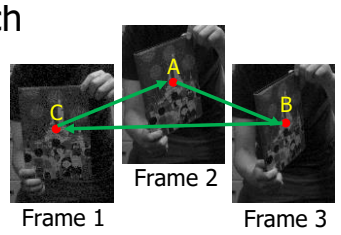
- Target
  - FPGA based high frame rate and ultra-low delay mismatch removal system
  - Processing speed within 1ms
- Challenges
  - Complex arithmetic operations
  - Unknown iteration times

[1] http://channel.panasonic.com/jp/contents/16913.

## Proposals

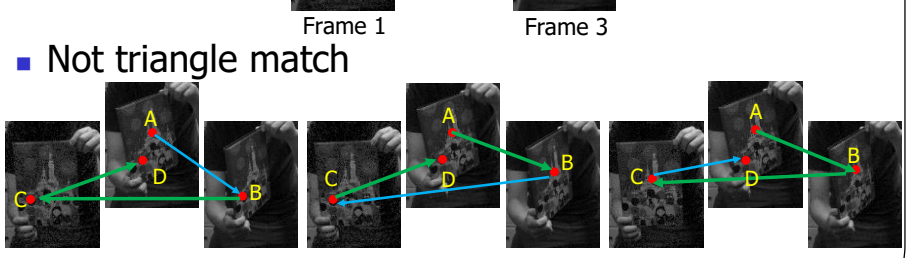
### Proposal 1: Keypoints triangle check

- Triangle match



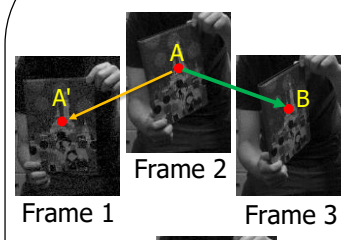

True match

- Not triangle match



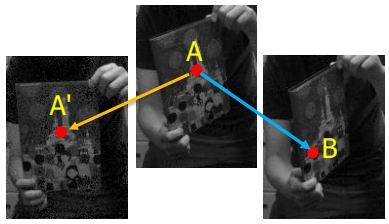

Ground truth　False match　True match　True match

### Proposal 2: Hamming distance verification

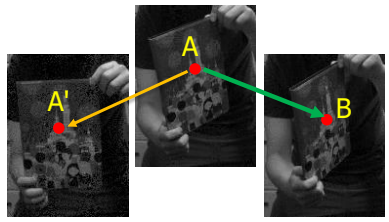



Matching: A → B, A → A'

(B, A') same ? ⇒ Hamming distance verify

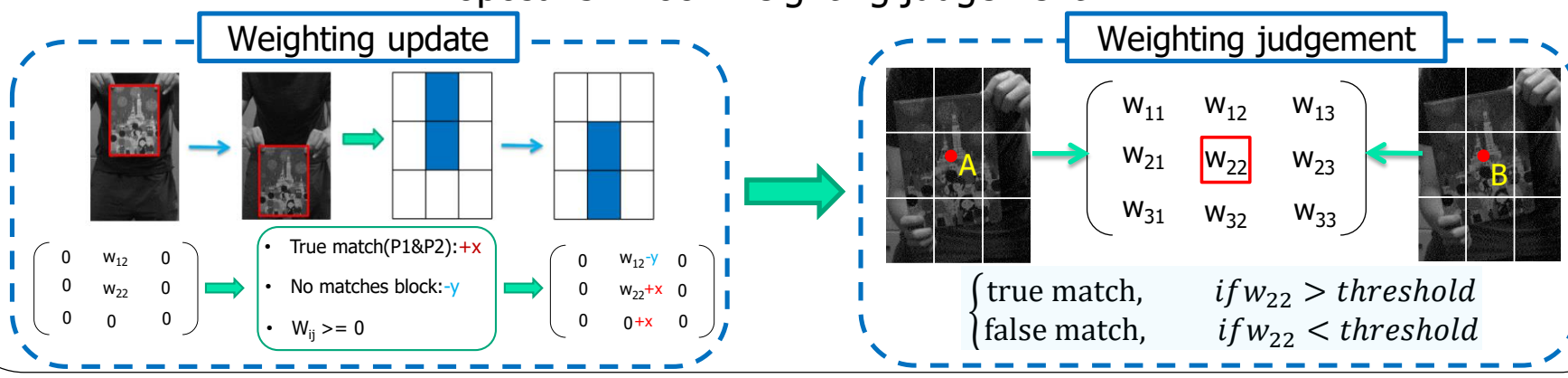



Hamming(A', B)>Threshold
False match



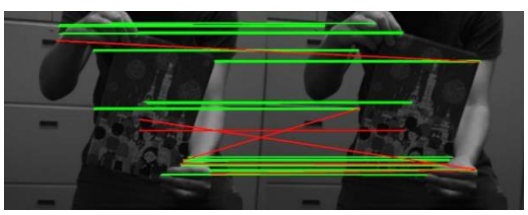

Hamming(A', B)<Threshold
True match

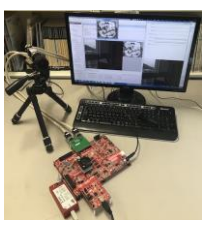
### Proposal 3: Block weighting judgement

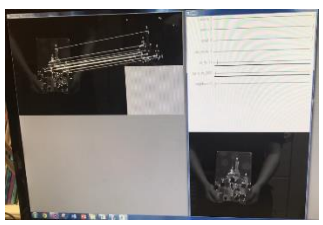



## Evaluation results: F-score

| | ORB match | RAN SAC | HPT | P1 | P1 + P3 | P1 + P2 | P1 + P2 + P3 |
|---|---|---|---|---|---|---|---|
| Average | 89.97 | 93.69 | 95.19 | 83.22 | 94.02 | 90.12 | 94.56 |







| Resource | Utilization |
|---|---|
| # LUT | 141268 (69.32%) |
| # LUTRAM | 23166 (36.20%) |
| # Flip Flop | 106314 (26.08%) |
| # BRAM | 56.50 (12.70%) |
| # DSP | 36 (4.29%) |
| Processing delay | 0.858 ms/frame |

## Conclusion

- Average F-score of P1+P2+P3 is 94.56%, increases by 4.59% than basic match, and by 0.87% than RANSAC
- The designed image processing core delay is 0.858ms/frame

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