# Gait Representation Using Flow Fields

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# The Problem

- Performance of Gait Recognition under different **Covariate Conditions**.
- What?
  - Gait recognition is recognizing people by the way they walk.
- Why?
  - Gait recognition is non intrusive
  - Operates at a distance without subject cooperation.

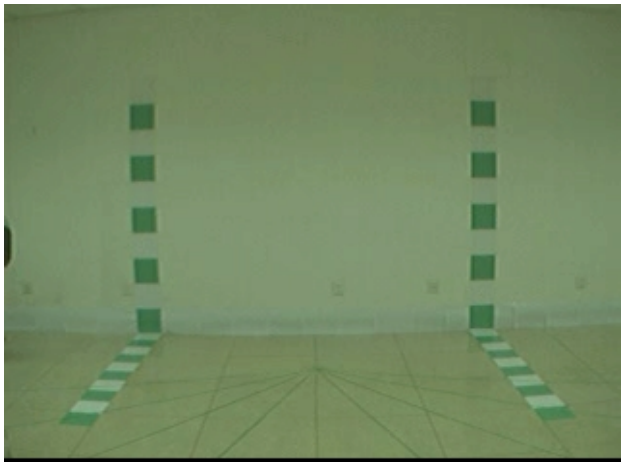
# Covariate Conditions?

- Conditions that effect gait.
- Can be divided into two catagories

1) Effecting features extracted from gait
   - Carrying Condition, Clothing Condition, View etc
2) Effecting gait itself
   - Shoes, Time, Injury, Speed etc

# Examples

Normal



Carrying Condition

Clothing Condition

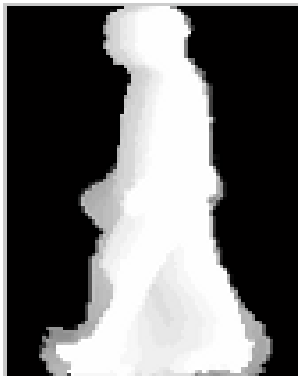
Bare Feet

Slow

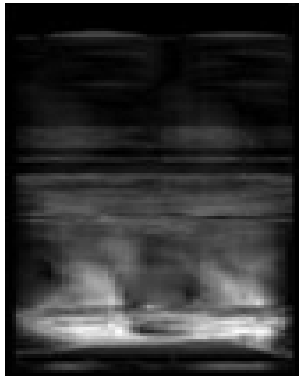
Fast

# Existing Work

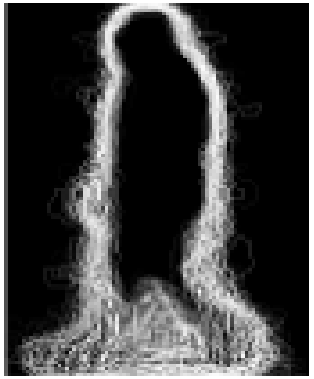
GEI
PAMI 06



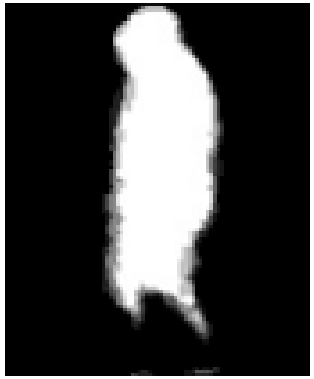
MSI
ICB 06



SVB
CVPR 07



MSCT +



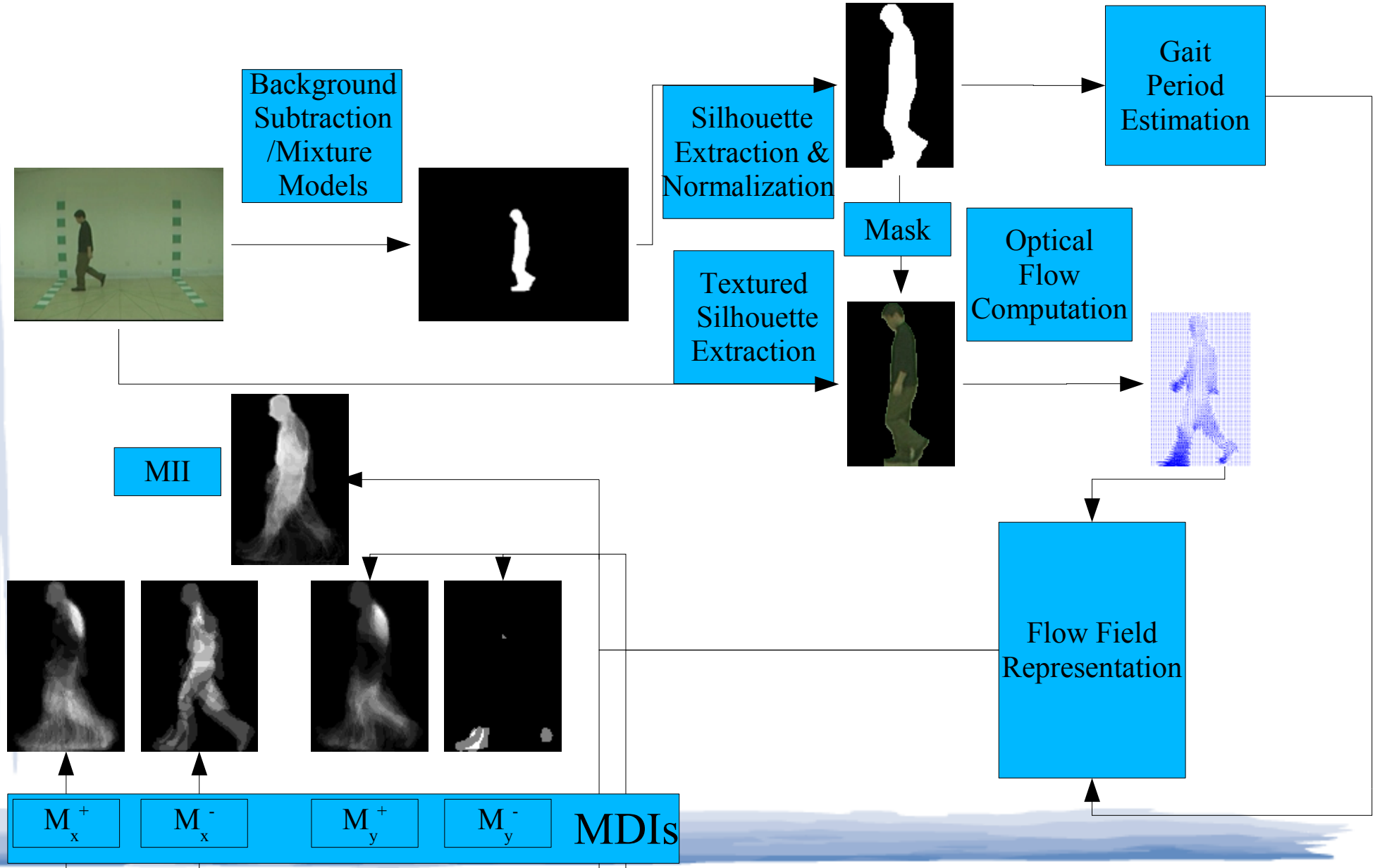
SST
PR 07

- Based on Motion Intensity
  - No Motion Direction
  - Not Enough Descriptive Power

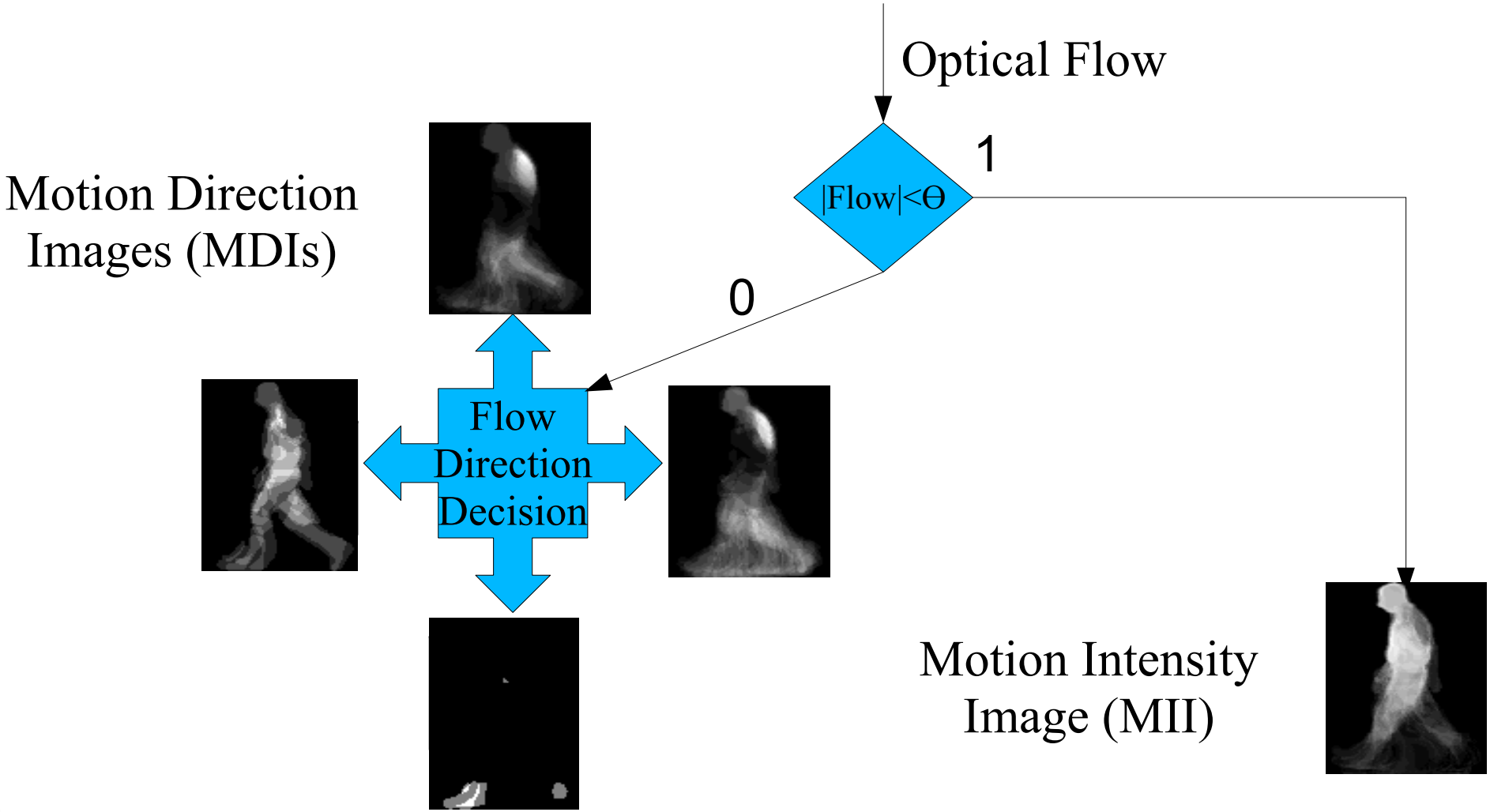
# Our Solution

- A novel representation of gait
- Constructed from optical flow computations
- Gait represented in a set of descriptors
  - Shape Descriptor
  - Motion Direction Descriptors

# Our Approach! Flow Field Representation of Gait



# Discretization of Flow

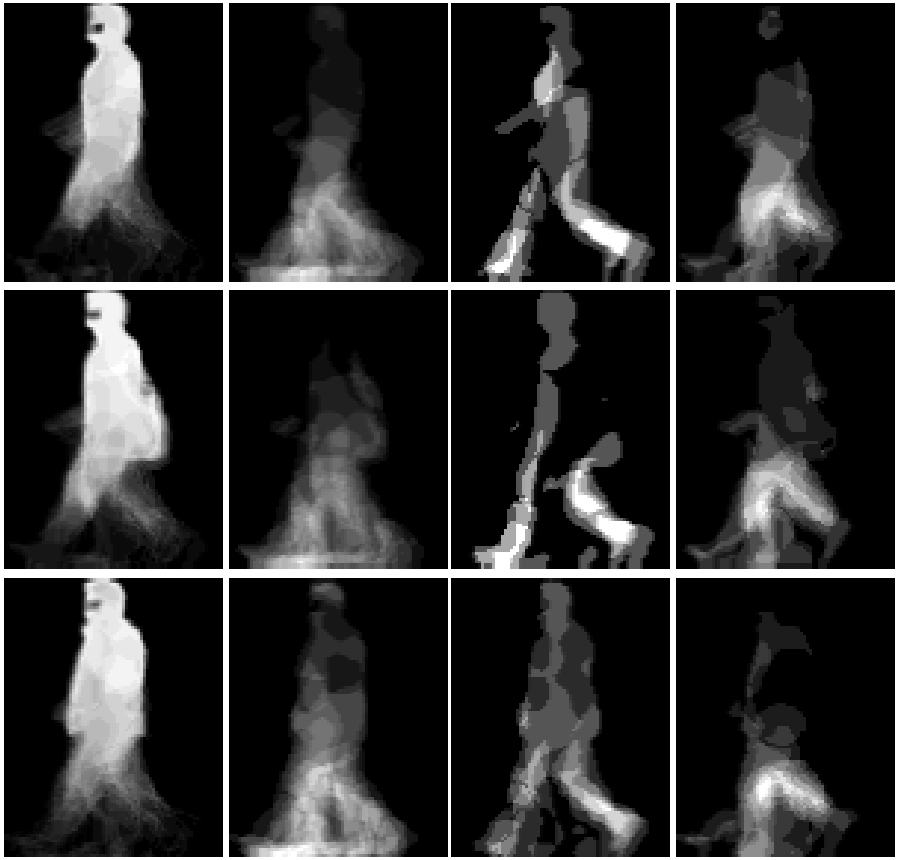


# MII and MDIs under different conditions

Normal

Carrying Condition

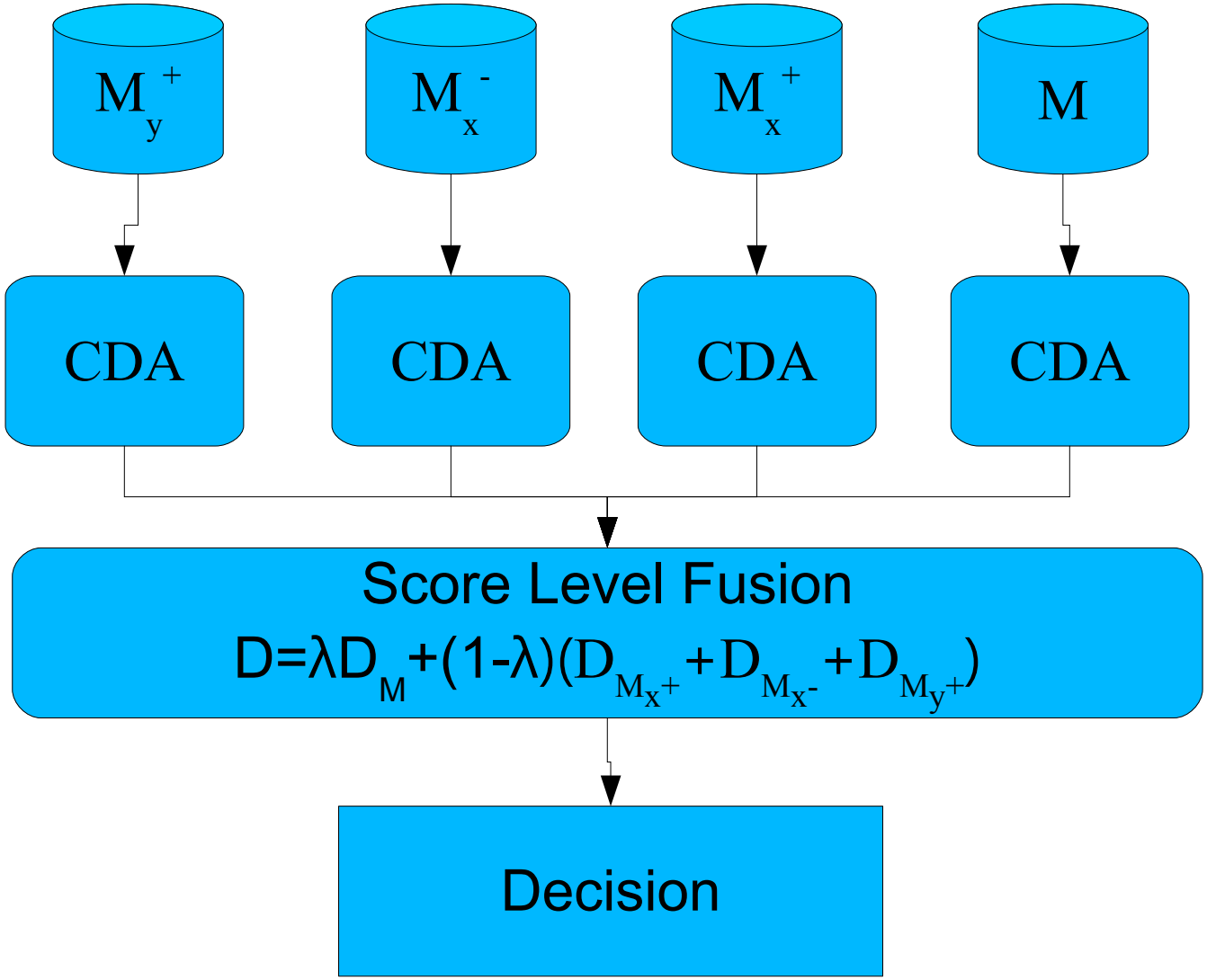
Clothing Condition



MII

MDIs

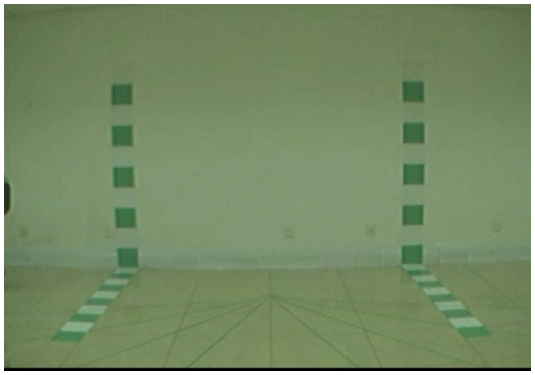
# Recognition



# Results (CASIA)

| Probe Set | TM | GEI | M | $M_x^+$ | $M_x^-$ | $M_y^+$ | Fusion |
|---|---|---|---|---|---|---|---|
| CASIASetA2 | 97.6% | 99.4% | 99.4% | 96.3% | 84.9% | 93.4% | 97.5% |
| CASIASetB | 52.0% | 60.2% | 56.6% | 57.3% | 32.8% | 46.7% | 83.6% |
| CASIASetC | 32.7% | 30.0% | 14.8% | 50.9% | 29.1% | 24.6% | 48.8% |
| Overall | 60.2% | 62.8% | 56.7% | 68.2% | 48.9% | 54.9% | 76.6% |

Normal



Carrying Condition

Clothing Condition

# Results (SOTON Large Set A & E)

| Probe Set | M | $M_x^+$ | $M_x^-$ | $M_y^+$ | Fusion |
|---|---|---|---|---|---|
| SotonSetA | 99.1% | 96.5% | 96.5% | 93.1% | 99.1% |

| Probe Set | MSI | Frieze | SVB Frieze | MSCT+SST | GEI | Fusion |
|---|---|---|---|---|---|---|
| SotonSetA | 84.8% | 96.0% | 84.0% | 84.0% | 99.1% | 99.1% |

| Probe Set | Wagg | M | $M_x^+$ | $M_x^-$ | $M_y^+$ | Fusion |
|---|---|---|---|---|---|---|
| SotonSetE | 67.0% | 100.0% | 93.1% | 93.9% | 93.9% | 97.4% |

Soton Set A

Soton Set E

# Results (SOTON Small Set A)

| Probe Set | GEI | M | $M_x^+$ | $M_x^-$ | $M_y^+$ | Fusion |
|---|---|---|---|---|---|---|
| SotonSmallSetN | 100% | 100% | 100% | 100% | 100% | 100% |
| SotonSmallSetB | 86.3% | 76.2% | 76.2% | 66.7% | 61.9% | 90.4% |
| SotonSmallSetC | 72.7% | 54.6% | 81.8% | 63.6% | 72.7% | 90.9% |
| SotonSmallSetSh | 100% | 100% | 92.3% | 82.1% | 87.2% | 100% |
| SotonSmallSetS | 100% | 100% | 85.7% | 76.1% | 76.2% | 100% |
| Overall | 94.2 | 90.3% | 87.3% | 77.6% | 79.6% | 97.1% |

Normal

Carrying Condition

Clothing Condition

Shoes

Speed

# Summary

- Gait representation based on optical flow computations
- Information captured in a set of motion descriptors
- Descriptors have different sensitivity to different conditions
- Fusion gives a representation that is
  - Discriminative
  - Less sensitive to covariate condition changes

# Thanks

- Questions?