Multiple human gait recognition with NMF method

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Introduction

- Multiple human recognition is based on the biometric method to identify the character of the target or human, because each person has a unique walking manner, this method is also called “gait signature identification”.
The benefits of gait recognition

- **Cryptic:** Gait recognition do not required the cooperation from the investigator and investigated person.

- **Ignored detail:** Because for gait recognition, it’s not necessary to high resolution images, by using the images extraction we can gain the silhouette of the targets.

- **Difficult to make up:** As we known that gait for each person is a kind of habit, it’s very difficult to change
Major procedures of gait recognition

1. Input video
2. Segmentation
3. Extract the features
4. Target modeling

Testing data

Training data

Target 1

Target 2

Correlation

If the result equals to 1: recognized

Otherwise: the target will be concerned as a new target
Target extraction

- The way to extract the two targets in the sample video is to subtract the background images from each frames.
the binary image after target extraction
Morphological Image Processing

- Our goal is to try to do the edge-map extraction in order to obtain the image which we can process. In MATLAB, we can use functions `strel()`, `imclose()`, `bwmorph()`.
target separation

- As long as we got the silhouette for each frame, we need do the target separation to extract each target from the image. We can use the matlab function labelmatrix to separate two matrix.
gait signature

- we need first find the central-points in each frame for each target. After that, we need plot several vectors each line has a certain angle between them. In my project, I use 45 degree for each angle, so number of vector is eight. For each line which starts from the central point \((x_0, y_0)\) the end point is the pixel \((x_i,y_j)\) value which equal to zero.

- Furthermore, we can calculate the distance from the central point to the end points for each target in each frame.

- The formula is as followed:

\[
\text{Distance or radius} = \sqrt{(x_i - x_0)^2 + (y_j - y_0)^2}
\]

- Where \(i \in [0,8], j \in [0,8]\).
radius and angle

Radius or distance between the central point and...
Base idea of NMF

- NMF (Non-negative Matrix Factorization)
  \[ V \approx WH, \ W \in R^{n\times r}, \ H \in R^{r\times m} \]

- Idea: Perception of the whole based on perception of its parts
Why use NMF?

1. Part-based representation
2. Interpretable in physical meaning
3. Compress data, reduce computational complexity and storage space
4. Good at feature extraction, identification and recognition
As long as we got the gait features of two garts we need to follow steps in order to use NMF for recognition.
In my case, H is only has two components H1 H2 which are corresponds to two the targets.

H’ has 10 components which includes the two target we want to recognize.

In order to do the recognition we just need to find which components is closest to the one of two values H1,H2. Method is do the subtraction and get absolute values.
Recognition result

![Graph showing successful rate vs. closeness]
Future Work

- In order to get more accurate result, I need to gain more gait features as my data base and using vector distance or linear regression to distinguish different targets.
- For gait features, we can use other methods like geometric symmetry, curve spreads, area-based metrics.
Any questions?

Thank you!