a short introduction to (gait) biometrics

Jeffrey E. Boyd
pattern recognition

object → measure → feature vector

object class → classify

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feature vector

person → measure
- iris,
gait,
finger prints
...

biometric signature
- feature vector

identity → classify

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metric

- feature vectors can vary in type
  - continuous versus discrete
  - ordinal versus categorical
- need a way to compare
  - metric
biometric system

unknown person → measure

compare

data base

classifier

best match gives identity

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computer vision

- computer vision gives
  - image-based measurement of feature vector
  - metric for comparison
shape of motion

image sequence
(n+1 frames)

optical flow

time-varying scalars

scalar sequences

phases

phase features

feature vector

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example data
optical flow
scalar features
scalar to phase
database

- several people walked in a circuit around a camera
- recorded approximately 20 min.
- used 6 people
- 7 examples of each
results
results

- metric
  - cartesian distance
- used k-way cross-validation testing
- tested
  - nearest neighbor
  - k-nearest neighbor
- nearest mean exemplar
- approximate recognition rate was 90%
cross validation

- you need two sets of data to test the system
  - training set (forms database) - aka gallery
  - test set - aka probe
  - cannot overlap
  - trivial for system to identify training data correctly

- cross validation partitions your data into the two sets
  - k-way repeats for different partitions
  - ensures statistical validity
classifiers (NN)
classifiers (k-NN)

? = ▲
classifiers (exemplar)

? = ○
biometric tasks

- two biometric tasks
  - recognition
    - no information
    - match from database
  - verification
    - claim of identity
    - e.g., passport
    - verify the claim

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performance

- for recognition use
- recognition rate
- decreases with $n$
- cumulative match curve

\[
P(\text{correct})
\]

0% 100%

\[n\]

match

rank

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performance

- for verification use
- receiver operating characteristic (ROC) curve
another example

phase locked loop

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feature vector
feature vector
metric

- treat magnitude/phase information as complex shape data
- use Procrustes analysis to manipulate and compare
plug it in
results

A good match to a sequence for the same person, but not on an incline, while avoiding potential matches to similar subjects that are on an incline. The ANOVA clearly indicates that the configurations have a strong dependence on individual gaits.

Biometric benchmarks. Creators of the Mobo database recommend a set of benchmarks for evaluation of biometric algorithms with their data. We report a subset of these benchmarks here. The benchmarks partition the data into probe and gallery sets, and report recognition results in the form of CMC plots to investigate variates of interest for biometrics. We deviate from the Mobo recommendations only in specific selection of images within a sequence to accommodate the continuous operation of the vPLL.

Fig. 6A shows the results when recognizing a person from data within the same sequence from camera vr03. Fig. 6B shows results for recognizing a person from data within the same sequence, always for a slow walk, but from camera angles vr03, vr05, or vr07. Fig. 6C shows the results for recognizing an individual doing a fast walk or walking with a ball from a gallery of slow walks, from camera vr07. Fig. 6 shows CMC curves for a subset of recommended biometric benchmarks on the Mobo and Southampton databases: (A) Mobo within sequence, varying activity, vr03, (B) Mobo within sequence, varying camera, slow walk, (C) Mobo match from different sequence, vr07, and (D) k-fold cross-validation on the Southampton database. Mobo results are for with-phase only.
sign-up

• current projects
  • gait sonification
  • harbour surveillance
  • interactive art
  • UVS
NSERC USRA

- good clean fun for the summer
- modest pay
- great experience
  - especially for grad school
  - great for the CV
- NSERC pays $4500
- supervisor tops up
- selection based on GPA

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