Worksheet 1 (StepScan)

Topic 1: Public Foot Pressure Database (CASIA-D) – Barefoot

1) The shared Dropbox link for CASIA-D dataset is at https://www.dropbox.com/s/kbhe66gq4wim0sj/RSScanData.zip?dl=0
   There are 6 zipped files and a text file within the shared "RSScanData" zip file.
   More details about the dataset can be found in DataReadme.txt.
2) The (sub) zipped file that we would like to focus on this worksheet is "alignedPerFootDataBarefoot.zip".
   In this file, the feet are aligned (translation and rotation) to a specific foot template.
3) Within this zip file, the foot pressure data is in "AlignedFootDataBarefoot.npz" and the meta data is in "AlignedFootMetaDataBarefoot.npy".
   To read and write the NumPy's NPY format (.npy files) in MATLAB, we can use the npy-matlab toolbox (https://github.com/kwikteam/npy-matlab).
4) The main variables in meta data that we would like to focus on this topic are
   - "Subject ID": 4–103
   - "Foot classification": left (0) / right (1)
   - "A flag saying when the footstep is incomplete because it did not fall fully on the sensor space": complete (0) / incomplete (1)
5) After importing the data, the pre-processing procedure required is to remove any footstep that is incomplete. Therefore, after pre-processing, the number of footsteps reduced from 2898 to 2851 for the next topic.

Topic 2: Center of Pressure (COP) Features – Biomechanics Field

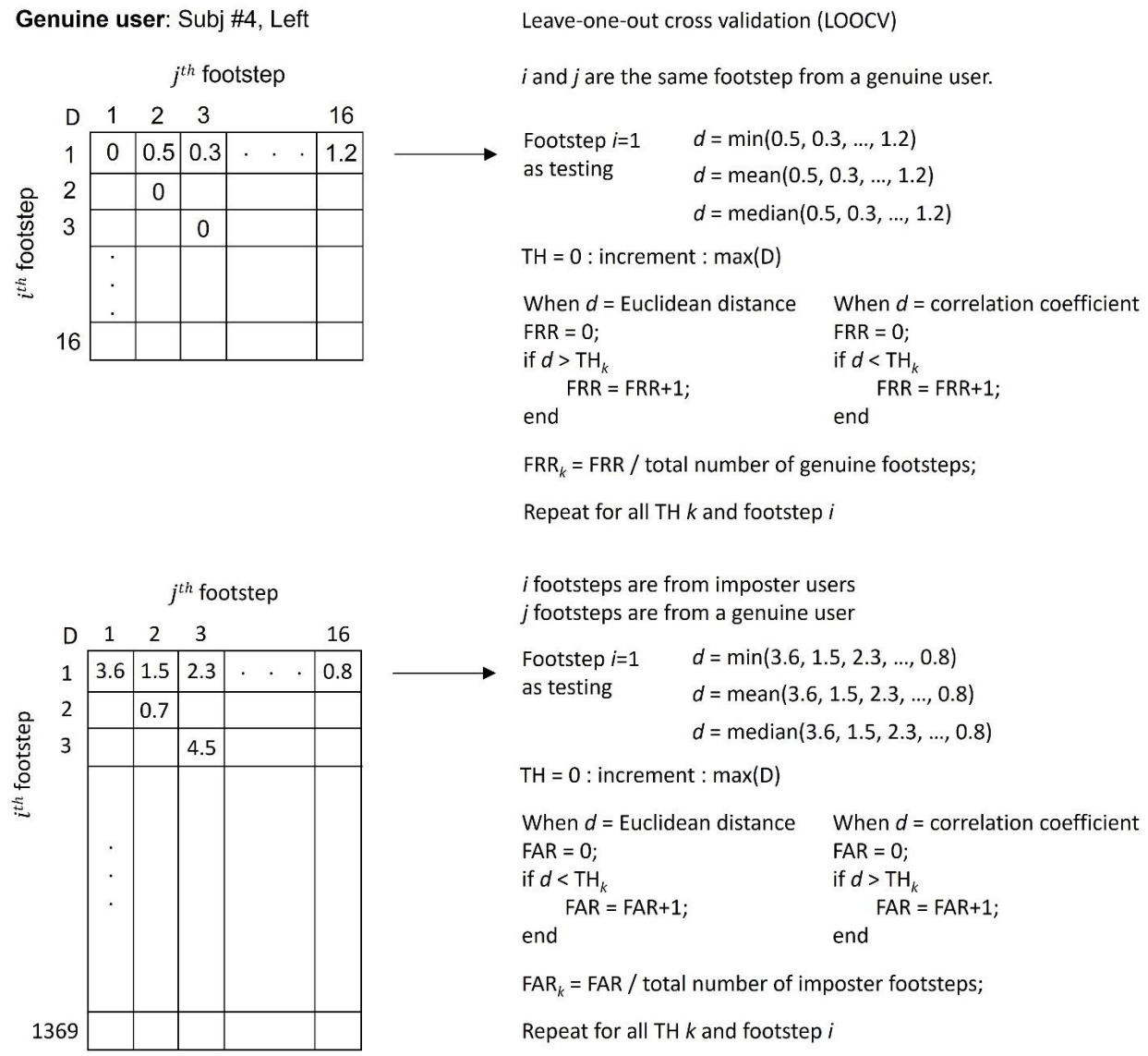
1) The paper entitled "Measures of Postural Steadiness: Differences Between Healthy Young and Elderly Adults" [1] is the main resource on this topic.
2) The first step is to compute the COP (RD, AP, and ML) time series.
   a. As some papers used Center of Area (COA) instead of COP, both COA and COP should be implemented for comparison.
   b. The mean COP (i.e., the local coordinate system) is normally used as a reference in biomechanics field [1].
   c. To create a binary image from grayscale image, we use these following conditions: if 0 then 0 (black), else 1-255 then 1 (white).
3) The second step is to compute the COP features.
   Understanding all the COP features in [1] as well as implementing them are necessary.

Topic 3: Authentication Using Multi-Template-Matching Approach – Enrollment Stage

1) First is to compute a score matrix using (I) Euclidean distance and (II) correlation coefficient for individual users, separate foot sides, and COP features. Two separate matrices may be created for each model: one for matching scores between samples enrolled into the system (genuine) and another for imposters (other users or individuals who are not enrolled in the system).

2) Second is to evaluate individual models using the key performance metrics: (I) the false acceptance rate (FAR), (II) the false rejection rate (FRR), (III) the accuracy graph (which plots the FAR and FRR as functions of the threshold), (IV) the receiver operating characteristic (ROC) curve (which plots FAR against the FRR), (V) Zero-FAR, and (VI) the equal error rate (EER).

Example Subject #4, left foot, as a genuine user



[1] Prieto et al., “Measures of Postural Steadiness: Differences Between Healthy Young and Elderly Adults”, IEEE Trans Biomed Eng, 43(9), pp. 956-966, Sept. 1996.

Checkpoint

Please show the key performance metrics for Subject #4 (as a genuine user), Left side, MDIST features, and minimum distance among templates (training footsteps).