GAIT ANALYSIS

Progress Report – August 5, 2015
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INTRODUCTION

▶ GAIT ANALYSIS IS THE STUDY OF ANIMAL LOCOMOTION

▶ IT CAN HELP IN MANY SYSTEMS INCLUDING SECURITY, DIAGNOSIS, COACHING, THERAPY & MOTION PREDICTION

▶ THE AIM OF THIS PROJECT IS TO EXTRACT DIFFERENT INFORMATION FROM GAITS & DESIGN A HIGH EFFICIENCY SYSTEM THAT IS PORTABLE.

TECHNIQUES

- ## HISTOGRAM SIMILARITY

  - USED AS A PROOF OF CONCEPT

  - SIMPLE AND FAIRLY EFFICIENT FOR RECOGNITION

- ## AVERAGE GAIT CYCLE

  - EFFICIENT FEATURE MATCHING USING DTW ALGORITHM FOR IDENTIFICATION

  - CAN ALSO BE USED FOR AUTHENTICATION (WHICH REQUIRES HIGHLY EFFICIENCT SYSTEM)

HISTOGRAM SIMILARITY

- MAKES A PROBABILITY DISTRIBUTION OF ALL THE DATA POINTS.

- SIMILARITY SCORE IS THEN CALCULATED BY MEASURING THE DIFFERENCE BETWEEN THE TEMPLATE AND TEST PROBABILITY DISTRIBUTION HISTOGRAMS.
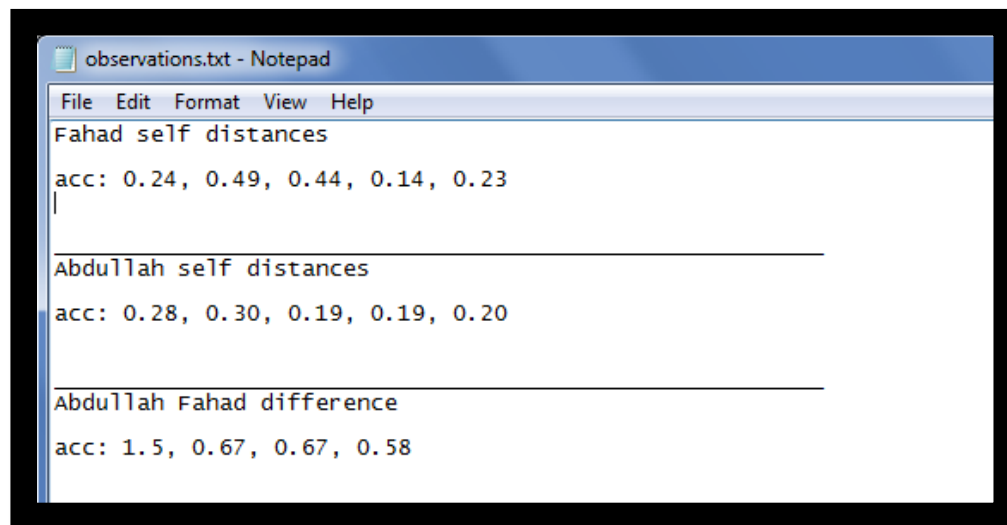
HISTOGRAM SIMILARITY - Steps
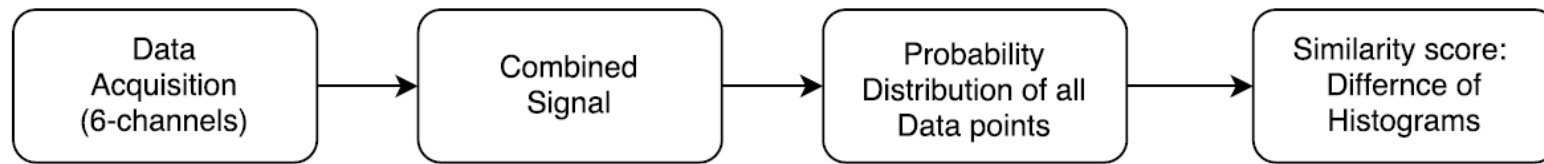
$$R_i = arcsin(\frac{Z_i}{\sqrt{X_i^2 + Y_i^2 + Z_i^2}}), i = 1, ..., k$$

HISTOGRAM SIMILARITY - Results

► RESULTS SHOW THAT THIS METHOD WORKS GOOD AS A PROOF OF CONCEPT BUT IS NOT VERY RELIABLE

► SUITABLE FOR IDENTIFICATION NOT AUTHENTICATION

► SIMPLE ALGORITH

► EFFICIENY INCREASES WITH DATA SIZE

AVERAGE GAIT CYCLE

▶ IN THIS TECHNIQUE, AN AVERAGE GAIT CYCLE IS EXTRACTED FROM THE DATA OF EACH INDIVIDUAL TEST SUBJECT

▶ THE TEMPLATE (CONTAINING SIX AVERAGE CYCLES: aX, aY, aX, gX, gY, gZ) IS THEN STORED IN THE LIBRARY ALONG WITH THE SUBJECT'S ID

▶ SIMILARLY FOR TEST CASE, EACH OF THE SIX AVERAGE CYCLES ARE COMPARED WITH THE TEMPLATE CYCLES USING THE DYNAMIC TIME WARPING ALGORITHM

▶ DECISION IS MADE ON THE BASIS OF DTW DISTANCE

AVERAGE GAIT CYCLE - Steps
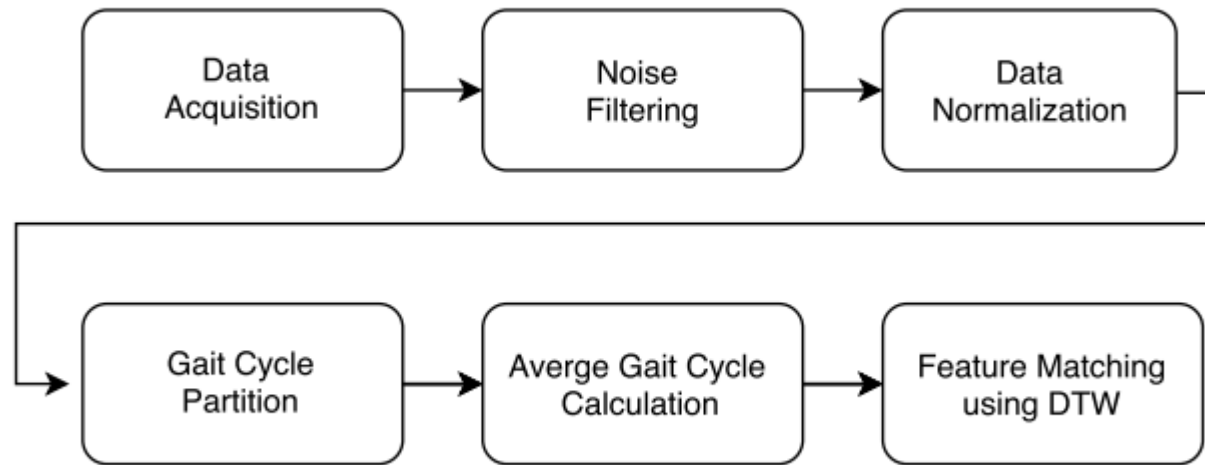
AVERAGE GAIT CYCLE - Filtering

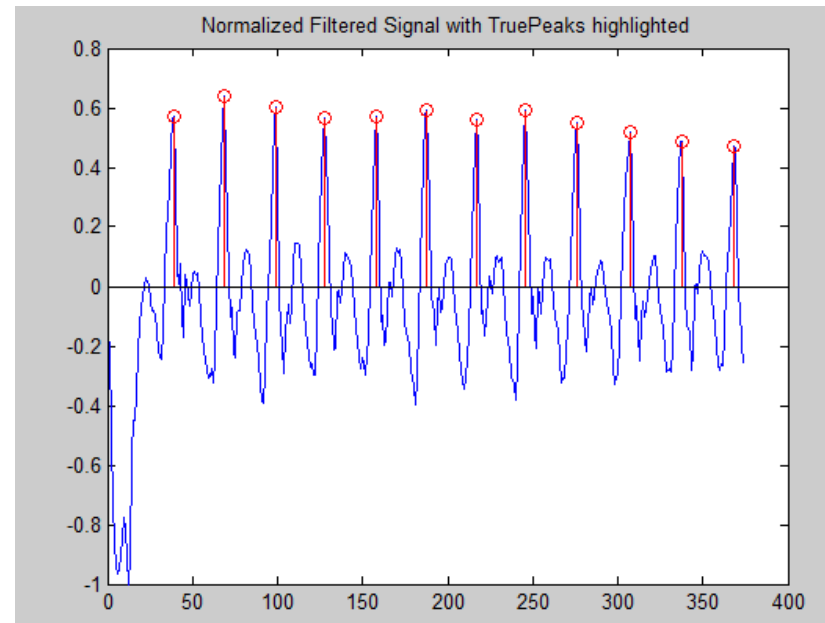▶ BUTTERWORTH FILTER IS APPLIED TO THE ORIGINAL SIGNAL TO REDUCE NOISE
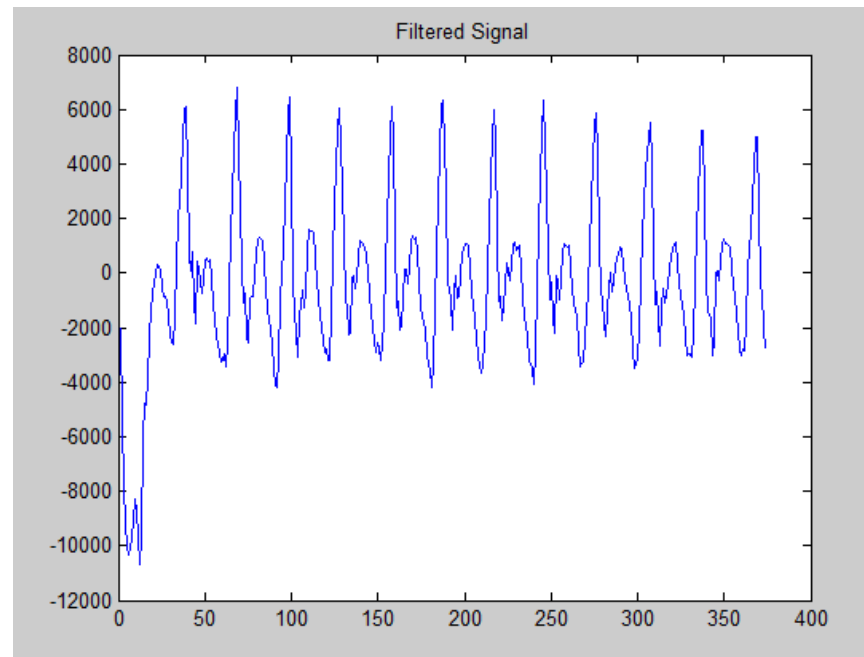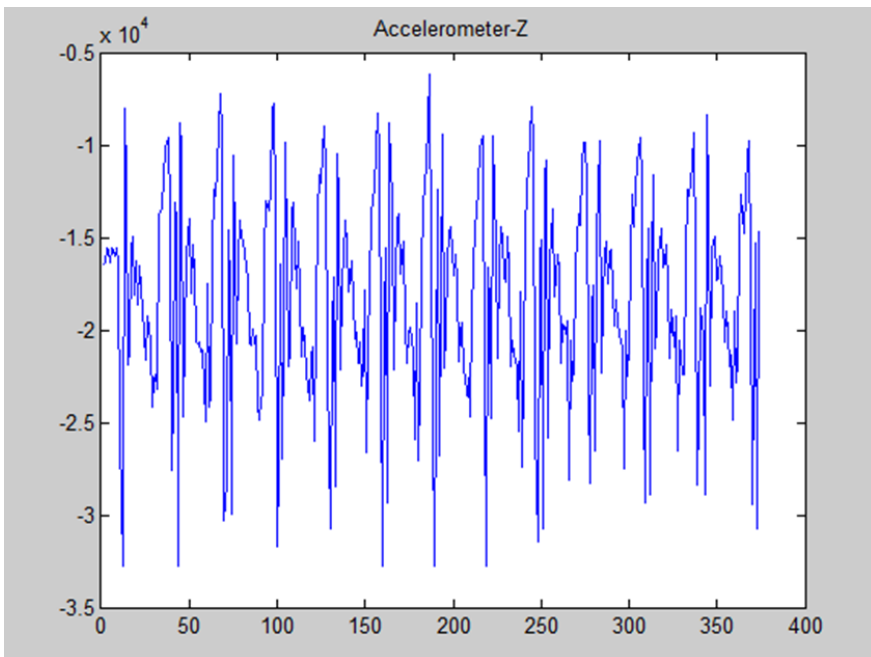
AVERAGE GAIT CYCLE – Cycle Detection

▶ PEAKS MARK THE END POINTS OF EACH GAIT CYCLE

▶ THEY ARE IDENTIFIED USING THIS THRESHOLD FORMULA:

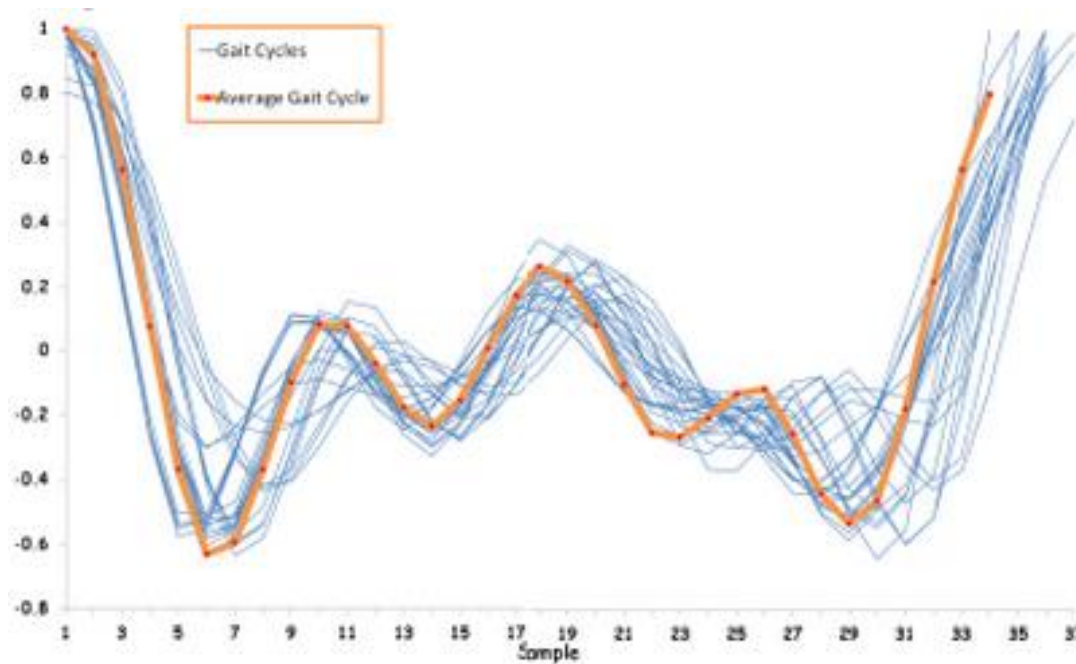$$P = \{d_i \mid d_i > d_{i+1} \wedge d_i > d_{i-1}\} \text{ with } i \in [1 \dots n]$$

$$T = \mu + k\sigma$$

$$R = \{d_i \in P \mid d_i \geq T\}$$

Normalized Filtered Signal with TruePeaks highlighted

AVERAGE GAIT CYCLE – AGC Calculation

- ▶ A CYCLE IS CALLED AN AVERAGE GAIT CYCLE IF IT IS THE MOST SIMILAR TO OTHER GAIT CYCLES

- ▶ IT IS CALCUATED USING DTW

AVERAGE GAIT CYCLE – Results

- ACCURACY RATE- 80%
- EFFICIENCY SHOULD INCREASE BY USING MORE SENSORS
- EXCELLENT FEATURE MATCHING RESULTS USING DTW
- BEST FOR RECOGNITION
- AUTHENTICATION CAPABILITY ACHIEVABLE

REPORT

- TWO TECHNIQUES ANALYZED & USED FOR BIOMETRIC IDENCTIFITAION VIA GAIT ANALYSIS

- ISSUES IDENTIFIED

  - SINGLE SENSOR SETUP CAN ONLY PRODUCE SO MUCH DATA

  - LIMITED NUMBER OF TEST SUBJECTS FOR DATA ACQUISITION

- SUGGESTIONS REQUIRED FOR FURTHUR RESEARCH