Expressiveness of time domain features for detecting different types of human movements

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Abstract – **The usage of wireless activity recognition systems is significant in many applications. The aim of this paper is to show the expressive power of time domain features based on the case study of correlation coefficient feature for detection of the following types of movement: hopping, running, jumping, balancing and skipping. Time domain analyses were applied to acceleration data and a confusion matrix was established as movement classification method.**

Keywords – **Time domain feature analyses, Training data, Test data, Confusion matrix.**

I. INTRODUCTION

Movement-based activity recognition has been investigated extensively [1,2,3]. In [2] the authors show that the recognition rates can be improved by selecting individual features for each activity and the window length over which the feature is computed. In [3] different time domain features in order to optimize movement's classification method are studied. But the paper does not consider correlation coefficient tool. The correlation coefficient of human motion types and of car movements is investigated in [4].

The primary goal of this paper is to show the expressive power of time domain features based on the case study of correlation coefficient tool for recognition of the following types of movements: jumping, hopping, running, skipping and balancing. The detection of above mentioned activity tasks can be applicable in mobile healthcare applications such as monitoring of children's motor skills. That is the reason why exactly these types of movements are considered.

The focus is made on time domain features because they do not require the complexity of preprocessing. They avoid laborious tasks of framing, filtering, Fourier transformation, liftering [4].

II. EXPERIMENT DESIGN AND METHODS

Five Mica2 sensor nodes, Mib 510 serial-based programming board and personal computer (PC) are used for creating wireless sensor network. Four Mica2 sensor nodes are equipped with low cost and low power 2-axial ADXL 202JE accelerometer sensors.

Four physically fit subjects (3 women and 1 man) volunteered in the experiment number 1. Four sensors were attached to the subjects' arms (2 sensors) and thighs (2 sensors). Each subject had to do 3 repetitions of 5 types of movements. 12 measurements for each activity were obtained in result.

Then for each type of movement over all window lengths mean and standard deviation of correlation coefficient are computed. Based on this results from the experiment number 1 the model (training data) for activity recognition of 5 types of movements is created.

All 4 sensors were measuring the acceleration data at a sampling rate of 100 Hz during the time of 5 seconds. Computation and feature analyses are executed, using Microsoft Office Exel 2007.

Time domain features based on the case study of correlation coefficient were analyzed Eg1.

$$\rho(X,Y)\frac{\operatorname{cov}(X,Y)}{\sqrt{\operatorname{var}(X)\operatorname{var}(Y)}} \quad (1)$$

A confusion matrix for evaluating 5 types of movements was established during the movement classification phase.

III. RESULTS

The correlation coefficient feature appeared to be highly expressive for determining the following types of movements hopping, ranging from 0,9 to 0,99, jumping(0,83-0,9), skipping(0,75-0,9). Less expressive this feature appeared to be for recognition of running (0,5 -0,8) and balancing (0,3 – 0,4).

The activities hopping, jumping and skipping were identified correctly in 100%, running and balancing in 11 cases of 12.

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