Human Activity Recognition Using Smartphones Data Set

The experiments have been carried out with a group of 30 volunteers within an age bracket of 19-48 years. Each person performed six activities (WALKING, WALKING\_UPSTAIRS, WALKING\_DOWNSTAIRS, SITTING, STANDING, LAYING) wearing a smartphone (Samsung Galaxy S II) on the waist. Using its embedded accelerometer and gyroscope, we captured 3-axial linear acceleration and 3-axial angular velocity at a constant rate of 50Hz. The experiments have been video-recorded to label the data manually. The obtained dataset has been randomly partitioned into two sets, where 70% of the volunteers was selected for generating the training data and 30% the test data.

The sensor signals (accelerometer and gyroscope) were pre-processed by applying noise filters and then sampled in fixed-width sliding windows of 2.56 sec and 50% overlap (128 readings/window). The sensor acceleration signal, which has gravitational and body motion components, was separated using a Butterworth low-pass filter into body acceleration and gravity. The gravitational force is assumed to have only low frequency components, therefore a filter with 0.3 Hz cutoff frequency was used. From each window, a vector of features was obtained by calculating variables from the time and frequency domain.

The features selected for this database come from the accelerometer and gyroscope 3-axial raw signals tAcc-XYZ and tGyro-XYZ. These time domain signals (prefix 't' to denote time) were captured at a constant rate of 50 Hz. Then they were filtered using a median filter and a 3rd order low pass Butterworth filter with a corner frequency of 20 Hz to remove noise. Similarly, the acceleration signal was then separated into body and gravity acceleration signals (tBodyAcc-XYZ and tGravityAcc-XYZ) using another low pass Butterworth filter with a corner frequency of 0.3 Hz.

Subsequently, the body linear acceleration and angular velocity were derived in time to obtain Jerk signals (tBodyAccJerk-XYZ and tBodyGyroJerk-XYZ). Also the magnitude of these three-dimensional signals were calculated using the Euclidean norm (tBodyAccMag, tGravityAccMag, tBodyAccJerkMag, tBodyGyroMag, tBodyGyroJerkMag).

Finally a Fast Fourier Transform (FFT) was applied to some of these signals producing fBodyAcc-XYZ, fBodyAccJerk-XYZ, fBodyGyro-XYZ, fBodyAccJerkMag, fBodyGyroMag, fBodyGyroJerkMag. (Note the 'f' to indicate frequency domain signals).

These signals were used to estimate variables of the feature vector for each pattern:

'-XYZ' is used to denote 3-axial signals in the X, Y and Z directions.

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| The file "tidy-df.csv" is a table with observations (a subject performing an activity) in the rows and the variables in the columns. | |
| The variables include the subject and activity, and the averages of the sample windows for each subject/activity combination | |
| of the mean and standard deviations of the time-domain and frequency-domain measurements. | |
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| **Variable name** | **Description** |
| subject | The subject who carried out the experiment |
| activity | The type of activity |
| 1\_Time\_BodyAcc-mean-X | Average of a time-domain variable for each activity and each subject |
| 2\_Time\_BodyAcc-mean-Y | Average of a time-domain variable for each activity and each subject |
| 3\_Time\_BodyAcc-mean-Z | Average of a time-domain variable for each activity and each subject |
| 41\_Time\_GravityAcc-mean-X | Average of a time-domain variable for each activity and each subject |
| 42\_Time\_GravityAcc-mean-Y | Average of a time-domain variable for each activity and each subject |
| 43\_Time\_GravityAcc-mean-Z | Average of a time-domain variable for each activity and each subject |
| 81\_Time\_BodyAccJerk-mean-X | Average of a time-domain variable for each activity and each subject |
| 82\_Time\_BodyAccJerk-mean-Y | Average of a time-domain variable for each activity and each subject |
| 83\_Time\_BodyAccJerk-mean-Z | Average of a time-domain variable for each activity and each subject |
| 121\_Time\_BodyGyro-mean-X | Average of a time-domain variable for each activity and each subject |
| 122\_Time\_BodyGyro-mean-Y | Average of a time-domain variable for each activity and each subject |
| 123\_Time\_BodyGyro-mean-Z | Average of a time-domain variable for each activity and each subject |
| 161\_Time\_BodyGyroJerk-mean-X | Average of a time-domain variable for each activity and each subject |
| 162\_Time\_BodyGyroJerk-mean-Y | Average of a time-domain variable for each activity and each subject |
| 163\_Time\_BodyGyroJerk-mean-Z | Average of a time-domain variable for each activity and each subject |
| 201\_Time\_BodyAccMag-mean | Average of a time-domain variable for each activity and each subject |
| 214\_Time\_GravityAccMag-mean | Average of a time-domain variable for each activity and each subject |
| 227\_Time\_BodyAccJerkMag-mean | Average of a time-domain variable for each activity and each subject |
| 240\_Time\_BodyGyroMag-mean | Average of a time-domain variable for each activity and each subject |
| 253\_Time\_BodyGyroJerkMag-mean | Average of a time-domain variable for each activity and each subject |
| 266\_Freq\_BodyAcc-mean-X | Average of a frequency-domain variable for each activity and each subject |
| 267\_Freq\_BodyAcc-mean-Y | Average of a frequency-domain variable for each activity and each subject |
| 268\_Freq\_BodyAcc-mean-Z | Average of a frequency-domain variable for each activity and each subject |
| 294\_Freq\_BodyAcc-meanFreq-X | Average of a frequency-domain variable for each activity and each subject |
| 295\_Freq\_BodyAcc-meanFreq-Y | Average of a frequency-domain variable for each activity and each subject |
| 296\_Freq\_BodyAcc-meanFreq-Z | Average of a frequency-domain variable for each activity and each subject |
| 345\_Freq\_BodyAccJerk-mean-X | Average of a frequency-domain variable for each activity and each subject |
| 346\_Freq\_BodyAccJerk-mean-Y | Average of a frequency-domain variable for each activity and each subject |
| 347\_Freq\_BodyAccJerk-mean-Z | Average of a frequency-domain variable for each activity and each subject |
| 373\_Freq\_BodyAccJerk-meanFreq-X | Average of a frequency-domain variable for each activity and each subject |
| 374\_Freq\_BodyAccJerk-meanFreq-Y | Average of a frequency-domain variable for each activity and each subject |
| 375\_Freq\_BodyAccJerk-meanFreq-Z | Average of a frequency-domain variable for each activity and each subject |
| 424\_Freq\_BodyGyro-mean-X | Average of a frequency-domain variable for each activity and each subject |
| 425\_Freq\_BodyGyro-mean-Y | Average of a frequency-domain variable for each activity and each subject |
| 426\_Freq\_BodyGyro-mean-Z | Average of a frequency-domain variable for each activity and each subject |
| 452\_Freq\_BodyGyro-meanFreq-X | Average of a frequency-domain variable for each activity and each subject |
| 453\_Freq\_BodyGyro-meanFreq-Y | Average of a frequency-domain variable for each activity and each subject |
| 454\_Freq\_BodyGyro-meanFreq-Z | Average of a frequency-domain variable for each activity and each subject |
| 503\_Freq\_BodyAccMag-mean | Average of a frequency-domain variable for each activity and each subject |
| 513\_Freq\_BodyAccMag-meanFreq | Average of a frequency-domain variable for each activity and each subject |
| 516\_Freq\_BodyBodyAccJerkMag-mean | Average of a frequency-domain variable for each activity and each subject |
| 526\_Freq\_BodyBodyAccJerkMag-meanFreq | Average of a frequency-domain variable for each activity and each subject |
| 529\_Freq\_BodyBodyGyroMag-mean | Average of a frequency-domain variable for each activity and each subject |
| 539\_Freq\_BodyBodyGyroMag-meanFreq | Average of a frequency-domain variable for each activity and each subject |
| 542\_Freq\_BodyBodyGyroJerkMag-mean | Average of a frequency-domain variable for each activity and each subject |
| 552\_Freq\_BodyBodyGyroJerkMag-meanFreq | Average of a frequency-domain variable for each activity and each subject |
| 4\_Time\_BodyAcc-std-X | Standard deviation of a time-domain variable for each activity and each subject |
| 5\_Time\_BodyAcc-std-Y | Standard deviation of a time-domain variable for each activity and each subject |
| 6\_Time\_BodyAcc-std-Z | Standard deviation of a time-domain variable for each activity and each subject |
| 44\_Time\_GravityAcc-std-X | Standard deviation of a time-domain variable for each activity and each subject |
| 45\_Time\_GravityAcc-std-Y | Standard deviation of a time-domain variable for each activity and each subject |
| 46\_Time\_GravityAcc-std-Z | Standard deviation of a time-domain variable for each activity and each subject |
| 84\_Time\_BodyAccJerk-std-X | Standard deviation of a time-domain variable for each activity and each subject |
| 85\_Time\_BodyAccJerk-std-Y | Standard deviation of a time-domain variable for each activity and each subject |
| 86\_Time\_BodyAccJerk-std-Z | Standard deviation of a time-domain variable for each activity and each subject |
| 124\_Time\_BodyGyro-std-X | Standard deviation of a time-domain variable for each activity and each subject |
| 125\_Time\_BodyGyro-std-Y | Standard deviation of a time-domain variable for each activity and each subject |
| 126\_Time\_BodyGyro-std-Z | Standard deviation of a time-domain variable for each activity and each subject |
| 164\_Time\_BodyGyroJerk-std-X | Standard deviation of a time-domain variable for each activity and each subject |
| 165\_Time\_BodyGyroJerk-std-Y | Standard deviation of a time-domain variable for each activity and each subject |
| 166\_Time\_BodyGyroJerk-std-Z | Standard deviation of a time-domain variable for each activity and each subject |
| 202\_Time\_BodyAccMag-std | Standard deviation of a time-domain variable for each activity and each subject |
| 215\_Time\_GravityAccMag-std | Standard deviation of a time-domain variable for each activity and each subject |
| 228\_Time\_BodyAccJerkMag-std | Standard deviation of a time-domain variable for each activity and each subject |
| 241\_Time\_BodyGyroMag-std | Standard deviation of a time-domain variable for each activity and each subject |
| 254\_Time\_BodyGyroJerkMag-std | Standard deviation of a time-domain variable for each activity and each subject |
| 269\_Freq\_BodyAcc-std-X | Standard deviation of a frequncy-domain variable for each activity and each subject |
| 270\_Freq\_BodyAcc-std-Y | Standard deviation of a frequncy-domain variable for each activity and each subject |
| 271\_Freq\_BodyAcc-std-Z | Standard deviation of a frequncy-domain variable for each activity and each subject |
| 348\_Freq\_BodyAccJerk-std-X | Standard deviation of a frequncy-domain variable for each activity and each subject |
| 349\_Freq\_BodyAccJerk-std-Y | Standard deviation of a frequncy-domain variable for each activity and each subject |
| 350\_Freq\_BodyAccJerk-std-Z | Standard deviation of a frequncy-domain variable for each activity and each subject |
| 427\_Freq\_BodyGyro-std-X | Standard deviation of a frequncy-domain variable for each activity and each subject |
| 428\_Freq\_BodyGyro-std-Y | Standard deviation of a frequncy-domain variable for each activity and each subject |
| 429\_Freq\_BodyGyro-std-Z | Standard deviation of a frequncy-domain variable for each activity and each subject |
| 504\_Freq\_BodyAccMag-std | Standard deviation of a frequncy-domain variable for each activity and each subject |
| 517\_Freq\_BodyBodyAccJerkMag-std | Standard deviation of a frequncy-domain variable for each activity and each subject |
| 530\_Freq\_BodyBodyGyroMag-std | Standard deviation of a frequncy-domain variable for each activity and each subject |
| 543\_Freq\_BodyBodyGyroJerkMag-std | Standard deviation of a frequncy-domain variable for each activity and each subject |