

Study design

The following codebook is adapted from:

Human Activity Recognition Using Smartphones Dataset
Version 1.0

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It has been modified for the final project for the Coursera, Getting and Cleaning Data class (due date January 31, 2016).

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, the researchers 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 were selected for generating the training data and 30% the test data.

These time domain signals 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. 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 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.

Subsequently, the body linear acceleration and angular velocity were derived in time to obtain Jerk signals. Also the magnitude of these three-dimensional signals were calculated using the Euclidean norm. Finally, a Fast Fourier Transform (FFT) was applied to some of these signals producing frequency domain signals.

These features were then averaged for each person and each activity.

The dataset contains the following files:

`human_activity_recognition.txt`: The tidy dataset that was generated from the script `run_analysis.R`, and is described below.

Code book

The variables are described below. Note the variables starting with “time” are in the time domain, while variables starting with “frequency” are in the frequency domain.

`ActivityName`: Name of activity the person is doing (WALKING, WALKING_UPSTAIRS, WALKING_DOWNSTAIRS, SITTING, STANDING, LAYING)

`SubjectID`: ID of person under consideration

`timeBodyAccelerationMeanXMean`: Average linear acceleration of the smartphone in the x-direction, averaged for each activity for each person (gravitational units)

`timeBodyAccelerationMeanYMean`: Average linear acceleration of the smartphone in the y-direction, averaged for each activity for each person (gravitational units)

`timeBodyAccelerationMeanZMean`: Average linear acceleration of the smartphone in the z-direction, averaged for each activity for each person (gravitational units)

`timeBodyAccelerationStandardDeviationXMean`: Standard deviation of linear acceleration of the smartphone in x-direction, averaged for each activity for each person (gravitational units)

`timeBodyAccelerationStandardDeviationYMean`: Standard deviation of linear acceleration of the smartphone in y-direction, averaged for each activity for each person (gravitational units)

`timeBodyAccelerationStandardDeviationZMean`: Standard deviation of linear acceleration of the smartphone in z-direction, averaged for each activity for each person (gravitational units)

`timeGravityAccelerationMeanXMean`: Average gravitational acceleration in the x-direction, averaged for each activity for each person (gravitational units)

`timeGravityAccelerationMeanYMean`: Average gravitational acceleration in the y-direction, averaged for each activity for each person (gravitational units)

timeGravityAccelerationMeanZMean: Average gravitational acceleration in the z-direction, averaged for each activity for each person (gravitational units)

timeGravityAccelerationStandardDeviationXMean: Standard deviation of gravitational acceleration in the x-direction, averaged for each activity for each person (gravitational units)

timeGravityAccelerationStandardDeviationYMean: Standard deviation of gravitational acceleration in the y-direction, averaged for each activity for each person (gravitational units)

timeGravityAccelerationStandardDeviationZMean: Standard deviation of gravitational acceleration in the z-direction, averaged for each activity for each person (gravitational units)

timeBodyAccelerationJerkMeanXMean: Average derivative of the linear acceleration of the smartphone in the x-direction, averaged for each activity for each person (gravitational units/second)

timeBodyAccelerationJerkMeanYMean: Average derivative of the linear acceleration of the smartphone in the y-direction, averaged for each activity for each person (gravitational units/second)

timeBodyAccelerationJerkMeanZMean: Average derivative of the linear acceleration of the smartphone in the z-direction, averaged for each activity for each person (gravitational units/second)

timeBodyAccelerationJerkStandardDeviationXMean: Standard deviation of the derivative of the linear acceleration of the smartphone in the x-direction, averaged for each activity for each person (gravitational units/second)

timeBodyAccelerationJerkStandardDeviationYMean: Standard deviation of the derivative of the linear acceleration of the smartphone in the y-direction, averaged for each activity for each person (gravitational units/second)

timeBodyAccelerationJerkStandardDeviationZMean: Standard deviation of the derivative of the linear acceleration of the smartphone in the z-direction, averaged for each activity for each person (gravitational units/second)

timeBodyGyroscopicMeanXMean: Average angular velocity of the smartphone in the x-direction, averaged for each activity for each person (radians/second)

timeBodyGyroscopicMeanYMean: Average angular velocity of the smartphone in the y-direction, averaged for each activity for each person (radians/second)

timeBodyGyroscopicMeanZMean: Average angular velocity of the smartphone in the z-direction, averaged for each activity for each person (radians/second)

timeBodyGyroscopicStandardDeviationXMean: Standard deviation of the angular velocity of the smartphone in the x-direction, averaged for each activity for each person (radians/second)

timeBodyGyroscopicStandardDeviationYMean: Standard deviation of the angular velocity of the smartphone in the y-direction, averaged for each activity for each person (radians/second)

timeBodyGyroscopicStandardDeviationZMean: Standard deviation of the angular velocity of the smartphone in the z-direction, averaged for each activity for each person (radians/second)

timeBodyGyroscopicJerkMeanXMean: Average of the angular jerk of the smartphone in the x-direction, averaged for each activity for each person (radians/second²)

timeBodyGyroscopicJerkMeanYMean: Average of the angular jerk of the smartphone in the y-direction, averaged for each activity for each person (radians/second²)

timeBodyGyroscopicJerkMeanZMean: Average of the angular jerk of the smartphone in the z-direction, averaged for each activity for each person (radians/second²)

timeBodyGyroscopicJerkStandardDeviationXMean: Standard deviation of the angular jerk of the smartphone in the x-direction, averaged for each activity for each person (radians/second²)

timeBodyGyroscopicJerkStandardDeviationYMean: Standard deviation of the angular jerk of the smartphone in the y-direction, averaged for each activity for each person (radians/second²)

timeBodyGyroscopicJerkStandardDeviationZMean: Standard deviation of the angular jerk of the smartphone in the z-direction, averaged for each activity for each person (radians/second²)

timeBodyAccelerationMagnitudeMeanMean: Average Euclidean norm of the linear acceleration of the smartphone, averaged for each activity for each person (gravitational units)

timeBodyAccelerationMagnitudeStandardDeviationMean: Standard deviation of the Euclidean norm of the linear acceleration of the smartphone, averaged for each activity for each person (gravitational units)

timeGravityAccelerationMagnitudeMeanMean: Average Euclidean norm of the gravitational acceleration, averaged for each activity for each person (gravitational units)

timeGravityAccelerationMagnitudeStandardDeviationMean: Standard deviation of the Euclidean norm of the gravitational acceleration, averaged for each activity for each person (gravitational units)

timeBodyAccelerationJerkMagnitudeMeanMean: Average of the Euclidean norm of the derivative of the acceleration of the smartphone, averaged for each activity for each person (gravitational units/second)

timeBodyAccelerationJerkMagnitudeStandardDeviationMean: Standard deviation of the Euclidean norm of the derivative of the acceleration of the smartphone, averaged for each activity for each person (gravitational units/second)

timeBodyGyroscopicMagnitudeMeanMean: Average of the Euclidean norm of the angular velocity of the smartphone, averaged for each activity for each person (radians/second)

timeBodyGyroscopicMagnitudeStandardDeviationMean: Standard deviation of the Euclidean norm of the angular velocity of the smartphone, averaged for each activity for each person (radians/second)

timeBodyGyroscopicJerkMagnitudeMeanMean: Average of the Euclidean norm of the angular jerk of the smartphone, averaged for each activity for each person (radians/second)

timeBodyGyroscopicJerkMagnitudeStandardDeviationMean: Standard deviation of the Euclidean norm of the angular jerk of the smartphone, averaged for each activity for each person (radians/second)

frequencyBodyAccelerationMeanXMean: Average frequency of the linear acceleration of the smartphone in the x-direction, averaged for each activity for each person (gravitational units*seconds)

frequencyBodyAccelerationMeanYMean: Average frequency of the linear acceleration of the smartphone in the y-direction, averaged for each activity for each person (gravitational units*seconds)

frequencyBodyAccelerationMeanZMean: Average frequency of the linear acceleration of the smartphone in the z-direction, averaged for each activity for each person (gravitational units*seconds)

frequencyBodyAccelerationStandardDeviationXMean: Standard deviation of the frequency of the linear acceleration of the smartphone in the x-direction, averaged for each activity for each person (gravitational units*seconds)

frequencyBodyAccelerationStandardDeviationYMean: Standard deviation of the frequency of the linear acceleration of the smartphone in the y-direction, averaged for each activity for each person (gravitational units*seconds)

frequencyBodyAccelerationStandardDeviationZMean: Standard deviation of the frequency of the linear acceleration of the smartphone in the z-direction, averaged for each activity for each person (gravitational units*seconds)

frequencyBodyAccelerationJerkMeanXMean: Average of the frequency of the derivative of the linear acceleration of the smartphone in the x-direction, averaged for each activity for each person (gravitational units)

frequencyBodyAccelerationJerkMeanYMean: Average of the frequency of the derivative of the linear acceleration of the smartphone in the y-direction, averaged for each activity for each person (gravitational units)

frequencyBodyAccelerationJerkMeanZMean: Average of the frequency of the derivative of the linear acceleration of the smartphone in the z-direction, averaged for each activity for each person (gravitational units)

frequencyBodyAccelerationJerkStandardDeviationXMean: Standard deviation of the frequency of the derivative of the linear acceleration of the smartphone in the x-direction, averaged for each activity for each person (gravitational units)

frequencyBodyAccelerationJerkStandardDeviationYMean: Standard deviation of the frequency of the derivative of the linear acceleration of the smartphone in the y-direction, averaged for each activity for each person (gravitational units)

frequencyBodyAccelerationJerkStandardDeviationZMean: Standard deviation of the frequency of the derivative of the linear acceleration of the smartphone in the z-direction, averaged for each activity for each person (gravitational units)

frequencyBodyGyroscopicMeanXMean: Average of the frequency of the angular velocity of the smartphone in the x-direction, averaged for each activity for each person (radians)

frequencyBodyGyroscopicMeanYMean: Average of the frequency of the angular velocity of the smartphone in the y-direction, averaged for each activity for each person (radians)

frequencyBodyGyroscopicMeanZMean: Average of the frequency of the angular velocity of the smartphone in the z-direction, averaged for each activity for each person (radians)

frequencyBodyGyroscopicStandardDeviationXMean: Standard deviation of the frequency of the angular velocity of the smartphone in the x-direction, averaged for each activity for each person (radians)

frequencyBodyGyroscopicStandardDeviationYMean: Standard deviation of the frequency of the angular velocity of the smartphone in the y-direction, averaged for each activity for each person (radians)

frequencyBodyGyroscopicStandardDeviationZMean: Standard deviation of the frequency of the angular velocity of the smartphone in the z-direction, averaged for each activity for each person (radians)

frequencyBodyAccelerationMagnitudeMeanMean: Average of the Euclidean norm of the frequency of the linear acceleration of the smartphone, averaged for each activity for each person (gravitational units*seconds)

frequencyBodyAccelerationMagnitudeStandardDeviationMean: Standard deviation of the Euclidean norm of the frequency of the linear acceleration of the smartphone, averaged for each activity for each person (gravitational units*seconds)

frequencyBodyBodyAccelerationJerkMagnitudeMeanMean: Average of the Euclidean norm of the frequency of the time derivative of the body-body acceleration, averaged for each activity for each person (gravitational units)

frequencyBodyBodyAccelerationJerkMagnitudeStandardDeviationMean: Standard deviation of the Euclidean norm of the frequency of the time derivative of the body-body acceleration, averaged for each activity for each person (gravitational units)

frequencyBodyBodyGyroscopicMagnitudeMeanMean: Average of the Euclidean norm of the frequency of the angular velocity of the bodies, averaged for each activity for each person (radians)

frequencyBodyBodyGyroscopicMagnitudeStandardDeviationMean: Standard deviation of the Euclidean norm of the frequency of the angular velocity of the bodies, averaged for each activity for each person (radians)

frequencyBodyBodyGyroscopicJerkMagnitudeMeanMean: Average of the Euclidean norm of the frequency of the body-body angular jerk, averaged for each activity for each person (radians/second)

frequencyBodyBodyGyroscopicJerkMagnitudeStandardDeviationMean:
Average of the Euclidean norm of the frequency of the body-body angular jerk, averaged for each activity for each person (radians/second)

- Note that all features are normalized and bounded within $[-1,1]$.

License

Use of this dataset in publications must be acknowledged by referencing the following publication [1]

[1] Davide Anguita, Alessandro Ghio, Luca Oneto, Xavier Parra and Jorge L. Reyes-Ortiz. Human Activity Recognition on Smartphones using a Multiclass Hardware-Friendly Support Vector Machine. International Workshop of Ambient Assisted Living (IWAAL 2012). Vitoria-Gasteiz, Spain. Dec 2012

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