Codebook

Human Activity Recognition Using Smartphones Dataset

Version 1.0

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The data is based on the work of

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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. See 'features_info.txt' for more details.

For each record it is provided:

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- Triaxial acceleration from the accelerometer (total acceleration) and the estimated body acceleration.

- Triaxial Angular velocity from the gyroscope.

- A 79-feature vector with time and frequency domain variables.

- Its activity label.

- An identifier of the subject who carried out the experiment.

The features selected for this database come from the accelerometer and Gyroscope 3-axial raw signals Time.Acceleration-XYZ and Time.AVelocity-XYZ. 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.

Similarly, the acceleration signal was then separated into body and gravity acceleration signals (Time.Body.Acceleration-XYZ and Time.Gravity.Acceleration-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 (Time.Body.Acceleration.Jerk-XYZ and Time.Body.AVelocity.Jerk-XYZ).

Also the magnitude of these three-dimensional signals was calculated using the Euclidean norm (Time.Body.Acceleration.Magnitude, Time.Gravity.Acceleration.Magnitude, Time.Body.Acceleration.Jerk.Magnitude, Time.Body.AVelocity.Magnitude, and Time.Body.AVelocity.Jerk.Magnitude).

Finally a Fast Fourier Transform (FFT) was applied to some of these signals producing

Frequency.Body.Acceleration-XYZ, Frequency.Body.Acceleration.Jerk-XYZ, Frequency.Body.AVelocity-XYZ, Frequency.Body.Acceleration.Jerk.Magnitude, Frequency.Body.AVelocity.Magnitude, Frequency.Body.AVelocity.Jerk.Magnitude

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.

The set of variables that were estimated from these signals are:

AVG: Mean value

STD: Standard deviation

AVG.Frequency : Weighted average of the frequency components to obtain a mean frequency

AVelocity :Angular velocity from the Gyroscope

Jerk : http://en.wikipedia.org/wiki/Jerk_(physics)

Column Index	Column Label	Range
1	Subject.Id	(1,2,3…30)
2	Train.Test.Group	(Train, Test)
3	Activity.Labels	WALKING WALKING_UPSTAIRS WALKING_DOWNSTAIRS SITTING STANDING LAYING
4	Time.Body.Acceleration.AVG.X	(-1, 1)
5	Time.Body.Acceleration.AVG.Y	(-1, 1)
6	Time.Body.Acceleration.AVG.Z	(-1, 1)
7	Time.Body.Acceleration.STD.X	(-1, 1)
8	Time.Body.Acceleration.STD.Y	(-1, 1)
9	Time.Body.Acceleration.STD.Z	(-1, 1)
10	Time.Gravity.Acceleration.AVG.X	(-1, 1)
11	Time.Gravity.Acceleration.AVG.Y	(-1, 1)
12	Time.Gravity.Acceleration.AVG.Z	(-1, 1)
13	Time.Gravity.Acceleration.STD.X	(-1, 1)
14	Time.Gravity.Acceleration.STD.Y	(-1, 1)
15	Time.Gravity.Acceleration.STD.Z	(-1, 1)
16	Time.Body.Acceleration.Jerk.AVG.X	(-1, 1)
17	Time.Body.Acceleration.Jerk.AVG.Y	(-1, 1)
18	Time.Body.Acceleration.Jerk.AVG.Z	(-1, 1)
19	Time.Body.Acceleration.Jerk.STD.X	(-1, 1)
20	Time.Body.Acceleration.Jerk.STD.Y	(-1, 1)
21	Time.Body.Acceleration.Jerk.STD.Z	(-1, 1)
22	Time.Body.AVelocity.AVG.X	(-1, 1)
23	Time.Body.AVelocity.AVG.Y	(-1, 1)
24	Time.Body.AVelocity.AVG.Z	(-1, 1)
25	Time.Body.AVelocity.STD.X	(-1, 1)
26	Time.Body.AVelocity.STD.Y	(-1, 1)
27	Time.Body.AVelocity.STD.Z	(-1, 1)
28	Time.Body.AVelocity.Jerk.AVG.X	(-1, 1)
29	Time.Body.AVelocity.Jerk.AVG.Y	(-1, 1)
30	Time.Body.AVelocity.Jerk.AVG.Z	(-1, 1)
31	Time.Body.AVelocity.Jerk.STD.X	(-1, 1)
32	Time.Body.AVelocity.Jerk.STD.Y	(-1, 1)
33	Time.Body.AVelocity.Jerk.STD.Z	(-1, 1)
34	Time.Body.Acceleration.Magnitude.AVG	(-1, 1)
35	Time.Body.Acceleration.Magnitude.STD	(-1, 1)
36	Time.Gravity.Acceleration.Magnitude.AVG	(-1, 1)
37	Time.Gravity.Acceleration.Magnitude.STD	(-1, 1)
38	Time.Body.Acceleration.Jerk.Magnitude.AVG	(-1, 1)

39	Time.Body.Acceleration.Jerk.Magnitude.STD	(-1, 1)
40	Time.Body.AVelocity.Magnitude.AVG	(-1, 1)
41	Time.Body.AVelocity.Magnitude.STD	(-1, 1)
42	Time.Body.AVelocity.Jerk.Magnitude.AVG	(-1, 1)
43	Time.Body.AVelocity.Jerk.Magnitude.STD	(-1, 1)
44	Frequency.Body.Acceleration.AVG.X	(-1, 1)
45	Frequency.Body.Acceleration.AVG.Y	(-1, 1)
46	Frequency.Body.Acceleration.AVG.Z	(-1, 1)
47	Frequency.Body.Acceleration.STD.X	(-1, 1)
48	Frequency.Body.Acceleration.STD.Y	(-1, 1)
49	Frequency.Body.Acceleration.STD.Z	(-1, 1)
50	Frequency.Body.Acceleration.AVG.Frequency.X	(-1, 1)
51	Frequency.Body.Acceleration.AVG.Frequency.Y	(-1, 1)
52	Frequency.Body.Acceleration.AVG.Frequency.Z	(-1, 1)
53	Frequency.Body.Acceleration.Jerk.AVG.X	(-1, 1)
54	Frequency.Body.Acceleration.Jerk.AVG.Y	(-1, 1)
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61	Frequency.Body.Acceleration.Jerk.AVG.Frequency.Z	(-1, 1)
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63	Frequency.Body.AVelocity.AVG.Y	(-1, 1)
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76	Frequency.Body.Body.Acceleration.Jerk.Magnitude.AVG.Frequency	(-1, 1)
77	Frequency.Body.Body.AVelocity.Magnitude.AVG	(-1, 1)
78	Frequency.Body.Body.AVelocity.Magnitude.STD	(-1, 1)
79	Frequency.Body.Body.AVelocity.Magnitude.AVG.Frequency	(-1, 1)
80	Frequency.Body.Body.AVelocity.Jerk.Magnitude.AVG	(-1, 1)
81	Frequency.Body.Body.AVelocity.Jerk.Magnitude.STD	(-1, 1)

82	Frequency.Body.Body.AVelocity.Jerk.Magnitude.AVG.Frequency	(-1, 1)