Working_Document

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October 10, 2015

Question

Weight Lifting Exercises Dataset

This human activity recognition research has traditionally focused on discriminating between different activities, i.e. to predict "which" activity was performed at a specific point in time (like with the Daily Living Activities dataset above). The approach we propose for the Weight Lifting Exercises dataset is to investigate "how (well)" an activity was performed by the wearer. The "how (well)" investigation has only received little attention so far, even though it potentially provides useful information for a large variety of applications,such as sports training.

In this work (see the paper) we first define quality of execution and investigate three aspects that pertain to qualitative activity recognition: the problem of specifying correct execution, the automatic and robust detection of execution mistakes, and how to provide feedback on the quality of execution to the user. We tried out an on-body sensing approach (dataset here), but also an "ambient sensing approach" (by using Microsoft Kinect - dataset still unavailable)

Six young health participants were asked to perform one set of 10 repetitions of the Unilateral Dumbbell Biceps Curl in five different fashions: exactly according to the specification (Class A), throwing the elbows to the front (Class B), lifting the dumbbell only halfway (Class C), lowering the dumbbell only halfway (Class D) and throwing the hips to the front (Class E).

Class A corresponds to the specified execution of the exercise, while the other 4 classes correspond to common mistakes. Participants were supervised by an experienced weight lifter to make sure the execution complied to the manner they were supposed to simulate. The exercises were performed by six male participants aged between 20-28 years, with little weight lifting experience. We made sure that all participants could easily simulate the mistakes in a safe and controlled manner by using a relatively light dumbbell (1.25kg).

Please, cite this paper to refer the WLE dataset

Velloso, E.; Bulling, A.; Gellersen, H.; Ugulino, W.; Fuks, H. Qualitative Activity Recognition of Weight Lifting Exercises. Proceedings of 4th International Conference in Cooperation with SIGCHI (Augmented Human '13) . Stuttgart, Germany: ACM SIGCHI, 2013.

Read more: http://groupware.les.inf.puc-rio.br/har#ixzz3oBl7KBCe

Data Exploration

```
require(dplyr)
```

```
## Loading required package: dplyr
##
## Attaching package: 'dplyr'
##
## The following objects are masked from 'package:stats':
##
##     filter, lag
##
```

```
## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union

require(ggplot2)

## Loading required package: ggplot2

require(tidyr)

## Loading required package: tidyr

require(reshape2)

## Loading required package: reshape2

train1_df <- read.csv("./Data/pml-training.csv")

base_df <- select(train1_df, one_of("X","user_name","classe"))
# keep only the index id, user_name, class, and accelarometer data
accel_df <-  cbind(base_df, select(train1_df, contains("accel")))

summary(accel_df)

##        X              user_name      classe   total_accel_belt
##  Min.   :    1    adelmo  :3892   A:5580   Min.   : 0.00
##  1st Qu.: 4906    carlitos:3112   B:3797   1st Qu.: 3.00
##  Median : 9812    charles :3536   C:3422   Median :17.00
##  Mean   : 9812    eurico  :3070   D:3216   Mean   :11.31
##  3rd Qu.:14717    jeremy  :3402   E:3607   3rd Qu.:18.00
##  Max.   :19622    pedro   :2610            Max.   :29.00
##
##  var_total_accel_belt  accel_belt_x       accel_belt_y
##  Min.   : 0.000      Min.   :-120.000   Min.   :-69.00
##  1st Qu.: 0.100      1st Qu.: -21.000   1st Qu.:  3.00
##  Median : 0.200      Median : -15.000   Median : 35.00
##  Mean   : 0.926      Mean   :  -5.595   Mean   : 30.15
##  3rd Qu.: 0.300      3rd Qu.:  -5.000   3rd Qu.: 61.00
##  Max.   :16.500      Max.   :  85.000   Max.   :164.00
##  NA's   :19216
##   accel_belt_z     total_accel_arm var_accel_arm     accel_arm_x
##  Min.   :-275.00   Min.   : 1.00   Min.   :  0.00   Min.   :-404.00
##  1st Qu.:-162.00   1st Qu.:17.00   1st Qu.:  9.03   1st Qu.:-242.00
##  Median :-152.00   Median :27.00   Median : 40.61   Median : -44.00
##  Mean   : -72.59   Mean   :25.51   Mean   : 53.23   Mean   : -60.24
##  3rd Qu.:  27.00   3rd Qu.:33.00   3rd Qu.: 75.62   3rd Qu.:  84.00
##  Max.   : 105.00   Max.   :66.00   Max.   :331.70   Max.   : 437.00
##                                    NA's   :19216
##   accel_arm_y      accel_arm_z     total_accel_dumbbell
##  Min.   :-318.0   Min.   :-636.00   Min.   : 0.00
##  1st Qu.: -54.0   1st Qu.:-143.00   1st Qu.: 4.00
```

```
##  Median :  14.0   Median : -47.00   Median :10.00
##  Mean   :  32.6   Mean   : -71.25   Mean   :13.72
##  3rd Qu.: 139.0   3rd Qu.:  23.00   3rd Qu.:19.00
##  Max.   : 308.0   Max.   : 292.00   Max.   :58.00
##
##  var_accel_dumbbell accel_dumbbell_x  accel_dumbbell_y  accel_dumbbell_z
##  Min.   :  0.000    Min.   :-419.00   Min.   :-189.00   Min.   :-334.00
##  1st Qu.:  0.378    1st Qu.: -50.00   1st Qu.:  -8.00   1st Qu.:-142.00
##  Median :  1.000    Median :  -8.00   Median :  41.50   Median :  -1.00
##  Mean   :  4.388    Mean   : -28.62   Mean   :  52.63   Mean   : -38.32
##  3rd Qu.:  3.434    3rd Qu.:  11.00   3rd Qu.: 111.00   3rd Qu.:  38.00
##  Max.   :230.428    Max.   : 235.00   Max.   : 315.00   Max.   : 318.00
##  NA's   :19216
##  total_accel_forearm var_accel_forearm accel_forearm_x   accel_forearm_y
##  Min.   :  0.00      Min.   :  0.000   Min.   :-498.00   Min.   :-632.0
##  1st Qu.: 29.00      1st Qu.:  6.759   1st Qu.:-178.00   1st Qu.:  57.0
##  Median : 36.00      Median : 21.165   Median : -57.00   Median : 201.0
##  Mean   : 34.72      Mean   : 33.502   Mean   : -61.65   Mean   : 163.7
##  3rd Qu.: 41.00      3rd Qu.: 51.240   3rd Qu.:  76.00   3rd Qu.: 312.0
##  Max.   :108.00      Max.   :172.606   Max.   : 477.00   Max.   : 923.0
##                      NA's   :19216
##  accel_forearm_z
##  Min.   :-446.00
##  1st Qu.:-182.00
##  Median : -39.00
##  Mean   : -55.29
##  3rd Qu.:  26.00
##  Max.   : 291.00
##
```

```r
# drop the var_ variables as they are mostly NA
accel_df <- select(accel_df, -starts_with("var_"))

#forearm
fore_df <-  cbind(base_df, select(accel_df, contains("fore")))
fore_pl <- ggplot(fore_df, aes(x=total_accel_forearm, fill=classe)) +
    geom_violin(aes(y=accel_forearm_x)) +
    facet_grid(.~classe)
print(fore_pl)
```
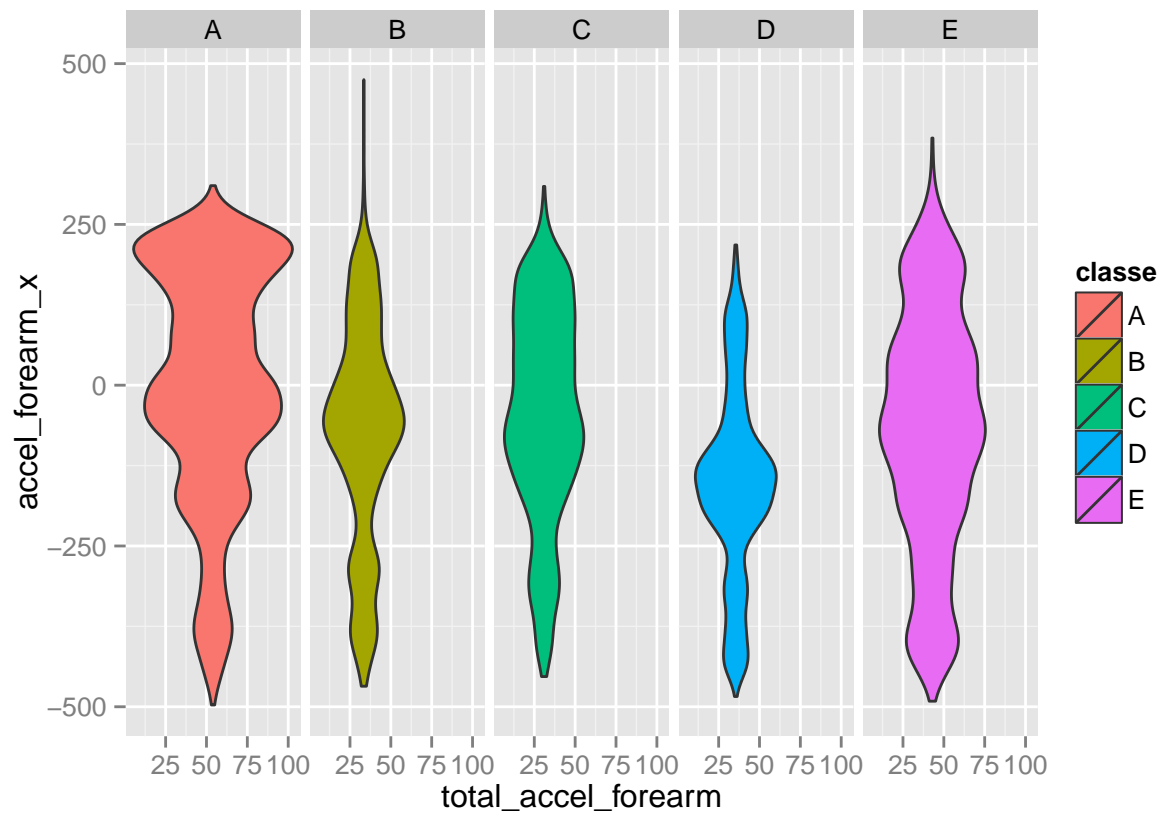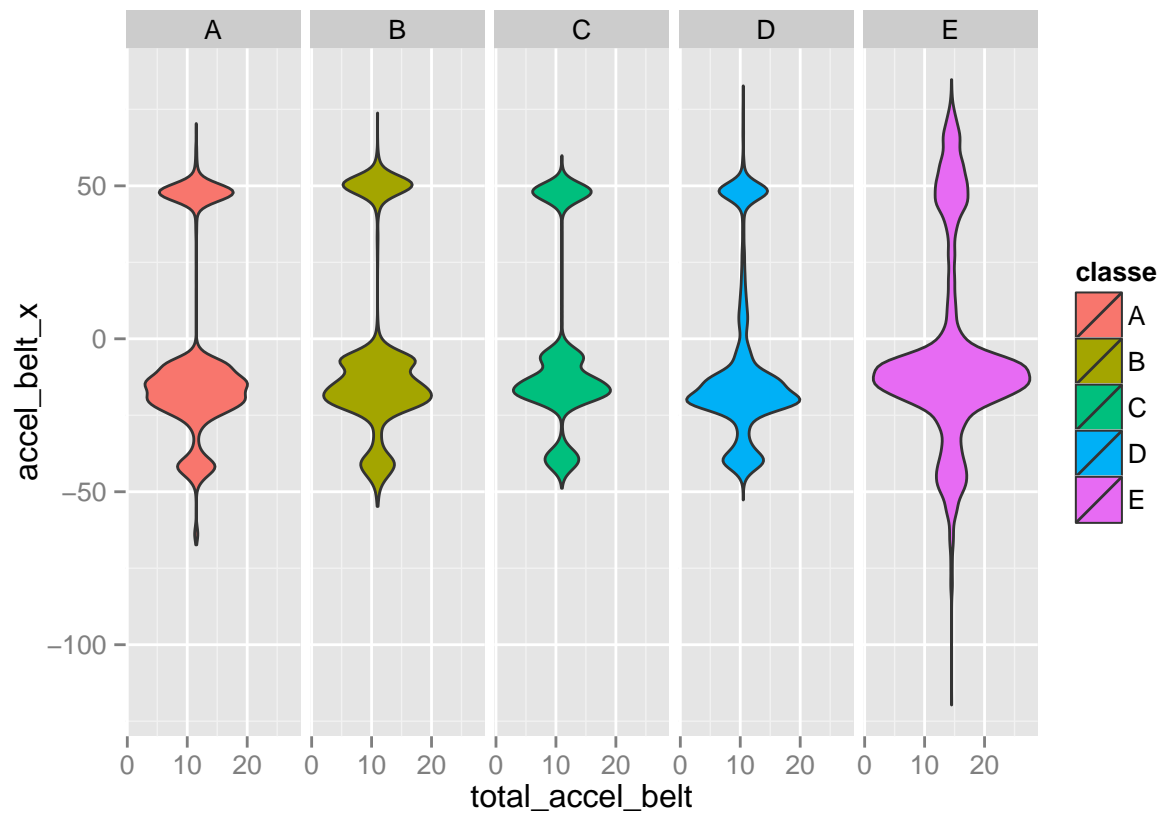
```
#arm
arm_df <-  cbind(base_df, select(accel_df, contains("_arm")))
arm_pl <- ggplot(arm_df, aes(x=total_accel_arm, fill=classe)) +
    geom_violin(aes(y=accel_arm_x)) +
    facet_grid(.~classe)
print(arm_pl)
```
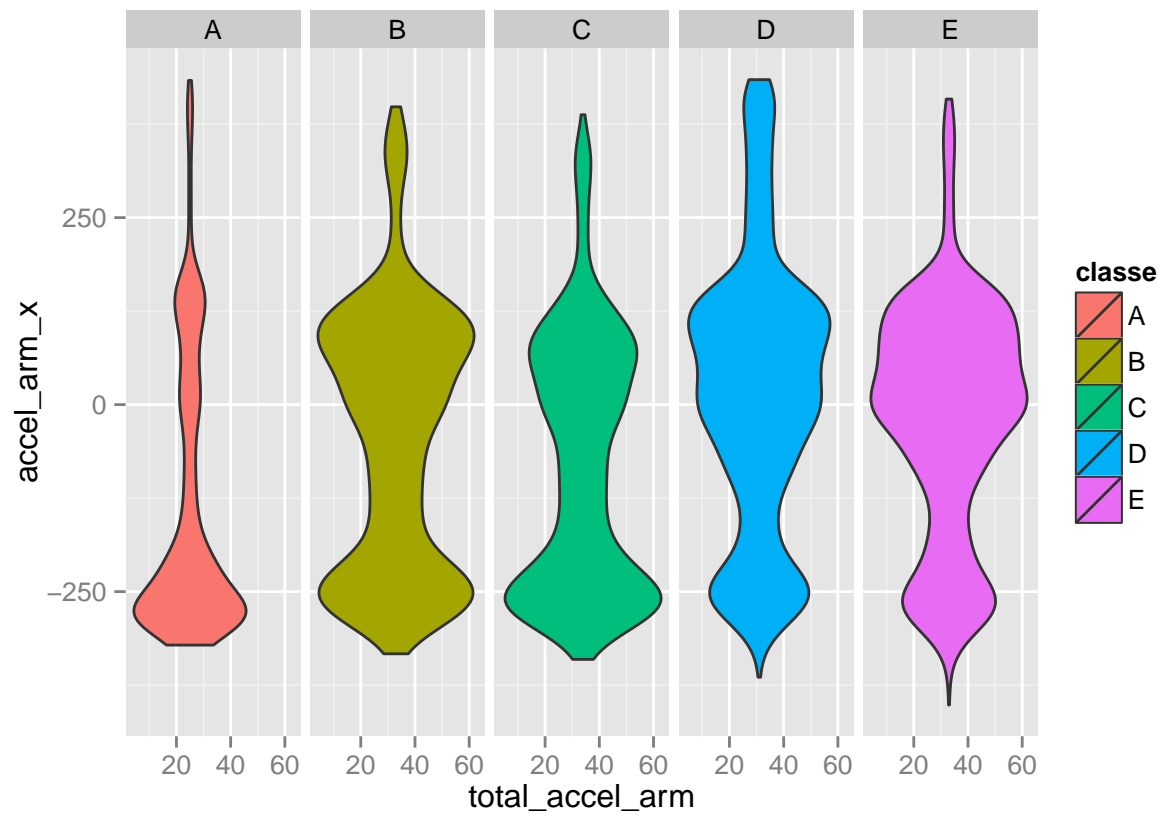
```
#belt
belt_df <-  cbind(base_df, select(accel_df, contains("belt")))
belt_pl <- ggplot(belt_df, aes(x=total_accel_belt, fill=classe)) +
    geom_violin(aes(y=accel_belt_x)) +
    facet_grid(.~classe)
print(belt_pl)
```

```
#dumbbell
dumb_df <-  cbind(base_df, select(accel_df, contains("dumbbell")))
dumb_pl <- ggplot(dumb_df, aes(x=total_accel_dumbbell, fill=classe)) +
    geom_violin(aes(y=accel_dumbbell_x)) +
    facet_grid(.~classe)
print(dumb_pl)
```
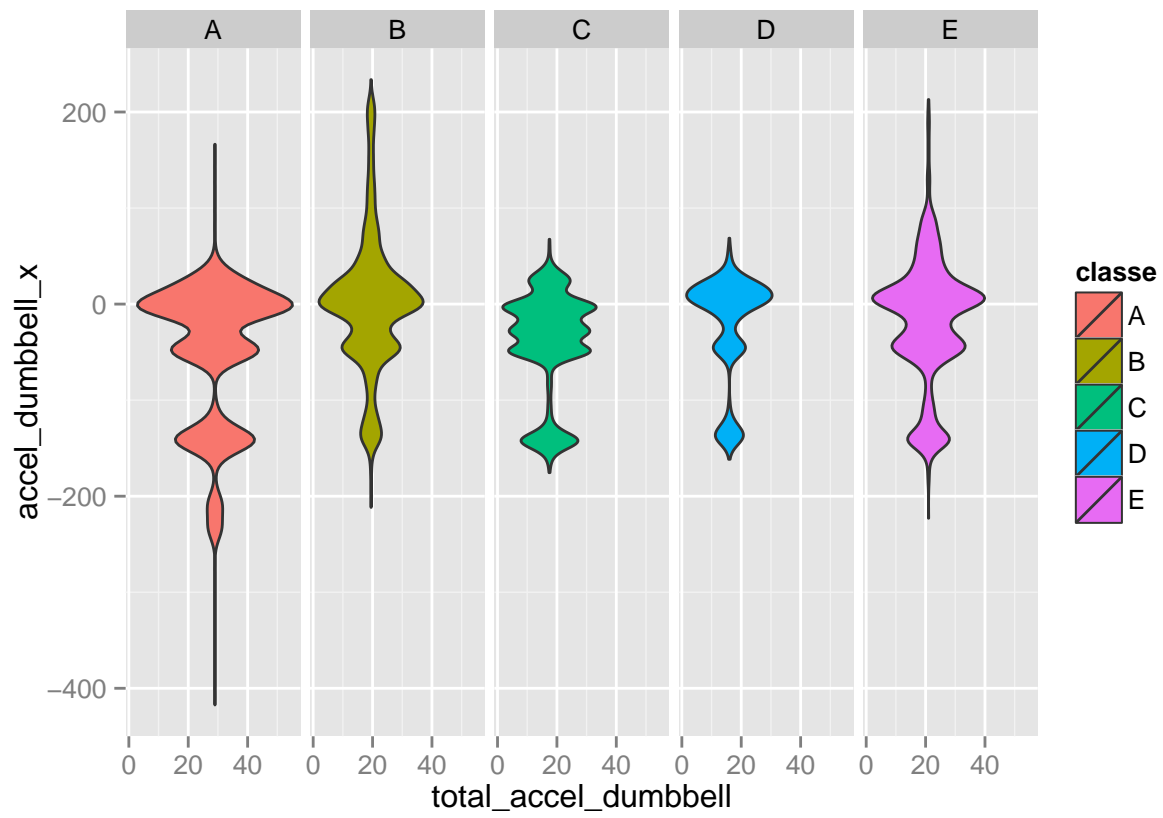
input data

features

algorithm

parameters

evaluation