MYO Evaluation

Bernd Schmidt

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```
require(dplyr)
require(ggplot2)
require(reshape2)
```

Computation of the raw EMG values

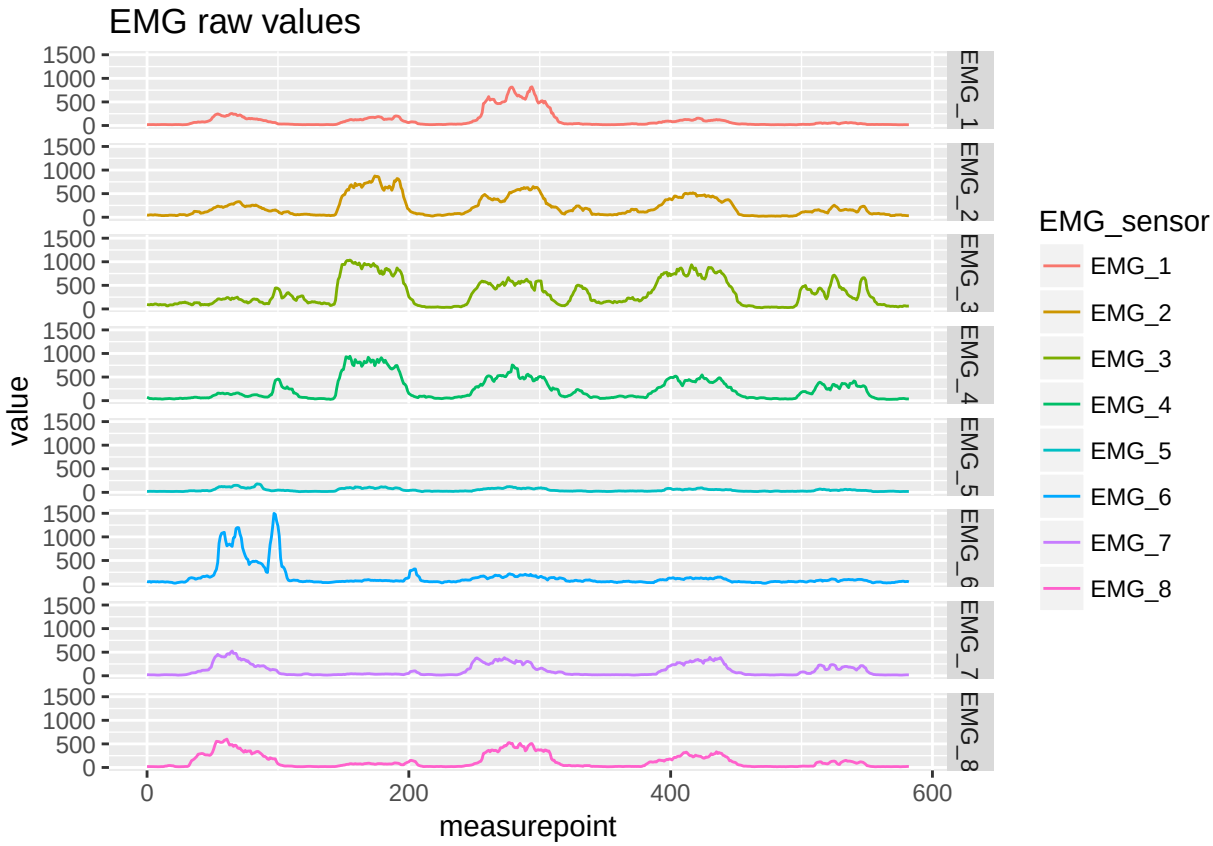
The MYO armband offers 8 values (one for each sensor) of EMG data. Those values are not preprocessed and also not sorted according to the orientation of the armband.

```
emg <- read.table("EMG_gestures.dat", header=TRUE, sep=",")
```

The gestures were performed in the following order: Wave In - Wave Out - Fist - Spread Fingers - Double Tap

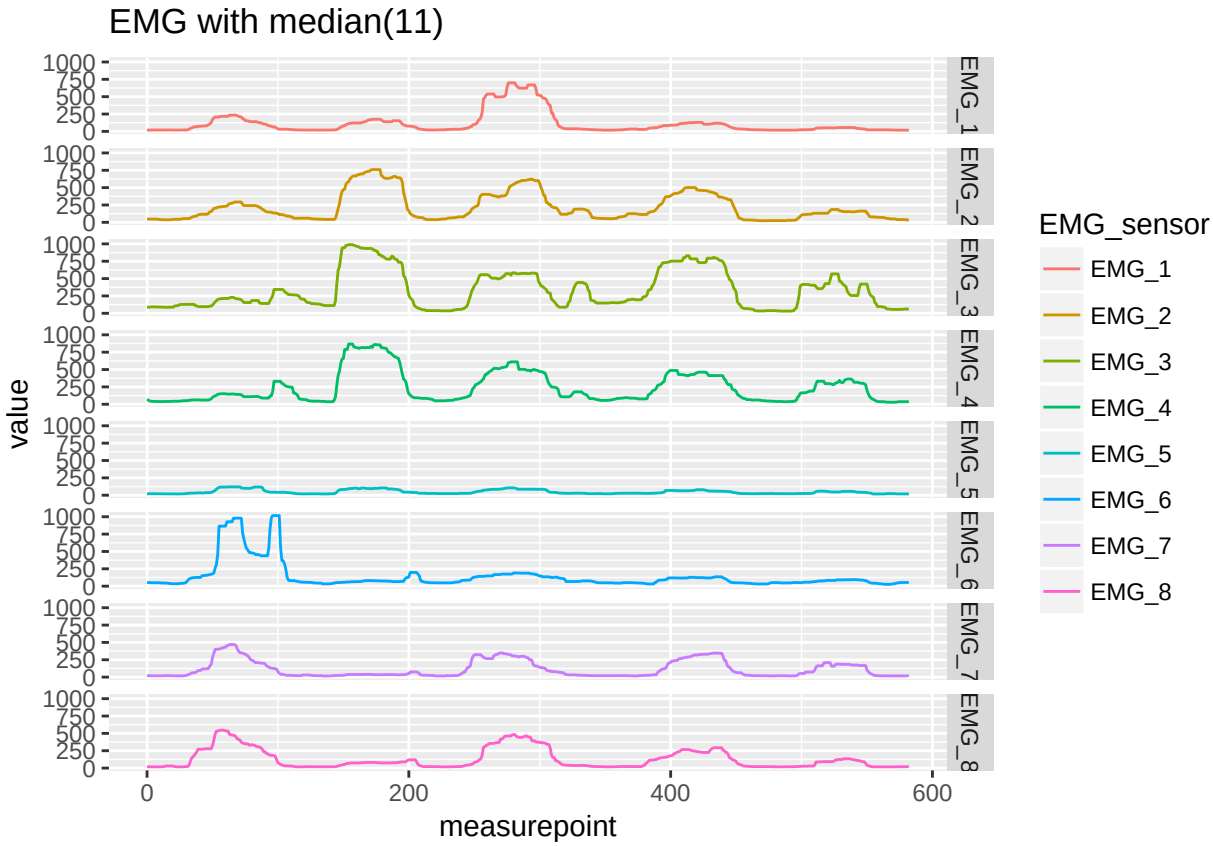
According to this, the raw values are not very useable to detect gestures or movements.

```
# transform to plotable format
emg_t <- melt(emg, id.vars='measurepoint', variable.name='EMG_sensor')
# plot to multiple graphs
emg_plot <- ggplot(
  emg_t,
  aes(
    measurepoint,
    value,
    group="EMG_sensor",
    colour = EMG_sensor
    )
  ) + geom_line() + facet_grid(EMG_sensor ~ .) + labs(title = "EMG raw values")
plot(emg_plot)
```



To make a better plot, generate the running median over 11 values from the retreived data

```
# calculate running median over 11 vlaues
emg_med <- emg %>% mutate_each(funs(runmed(., 11)))
# melt into plotable format
emg_med_t <- melt(emg_med, id.vars='measurepoint', variable.name='EMG_sensor')

# plot to multiple graphs
emg_med_plot <- ggplot(
  emg_med_t,
  aes(
    measurepoint,
    value,
    group="EMG_sensor",
    colour=EMG_sensor
  )
) + geom_line() + facet_grid(EMG_sensor ~ .) + labs(title = "EMG with median(11)")
plot(emg_med_plot)
```



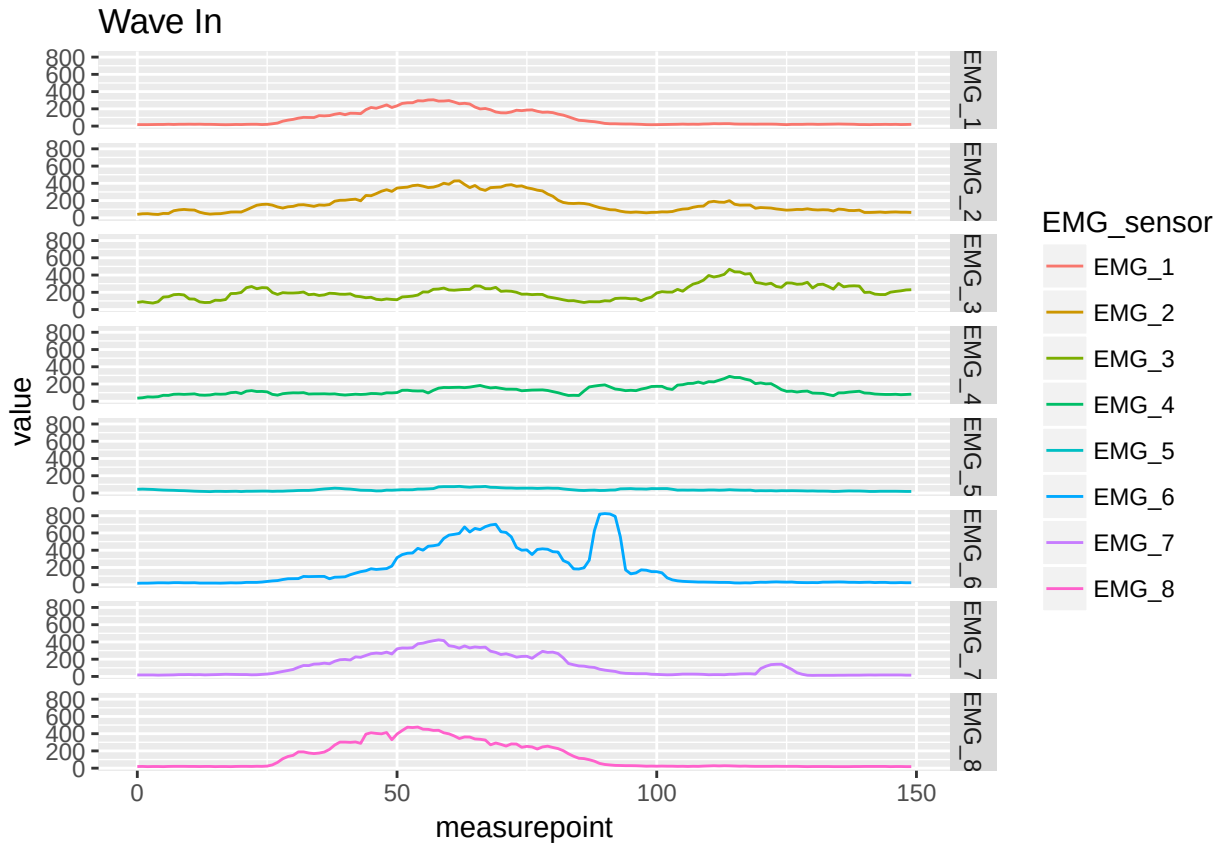
Those values are more convenient to analyze. Ther is a data loss due to the normalization but the rate of the sensors data with around 200MHz compensates this loss, because no gesture can be made that fast, so the recognition will detect it.

Signal values for each gesture

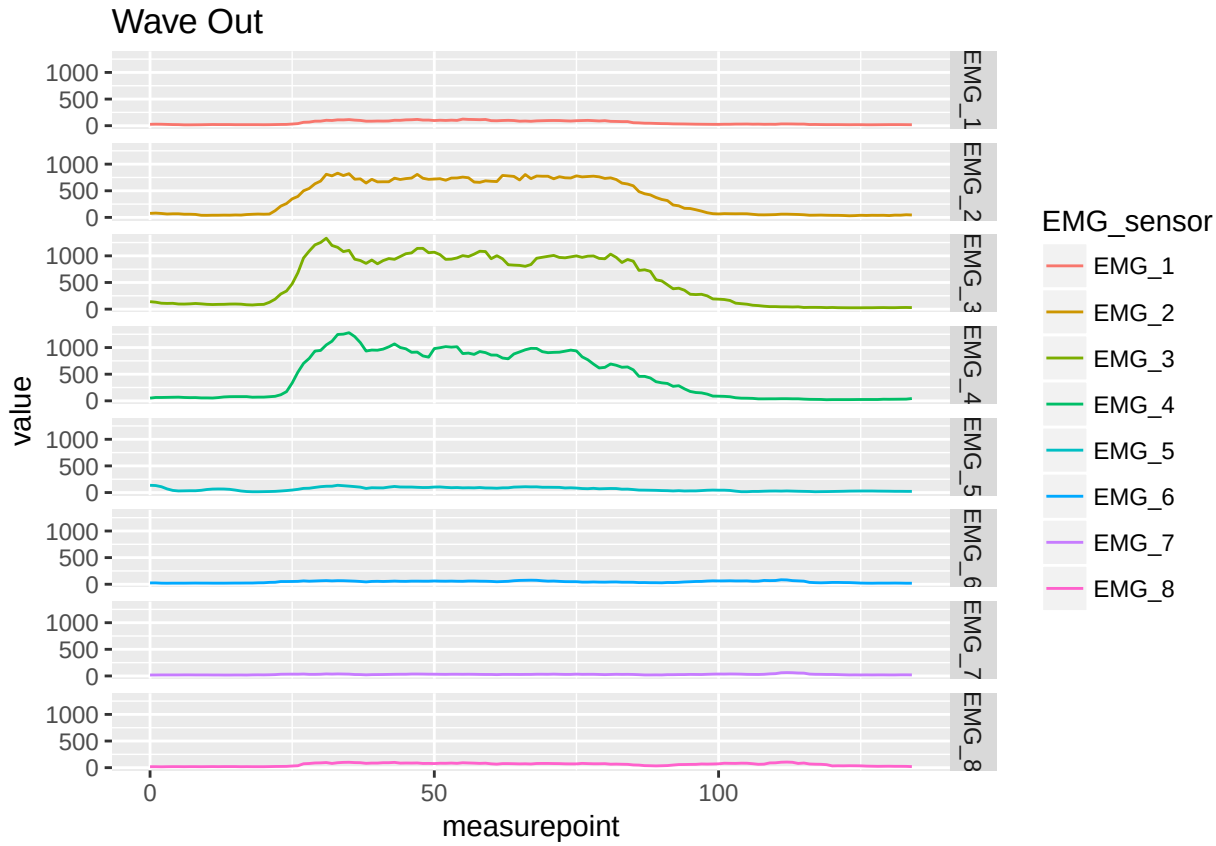
To make a better detection, each gesture was detected on it own. They were also computed like the complete before.

```
# read all gesures
emg_wave_in <- read.table("EMG_gesture_wave.in.dat", header=TRUE, sep=",")
emg_wave_out <- read.table("EMG_gesture_wave.out.dat", header=TRUE, sep=",")
emg_fist <- read.table("EMG_gesture_fist.dat", header=TRUE, sep=",")
emg_spread_fingers <- read.table("EMG_gesture_spread.fingers.dat", header=TRUE, sep=",")
emg_double_tap <- read.table("EMG_gesture_double.tap.dat", header=TRUE, sep=",")

# melt to plotable format
emg_wave_in_t <- melt(emg_wave_in, id.vars='measurepoint', variable.name='EMG_sensor')
emg_wave_out_t <- melt(emg_wave_out, id.vars='measurepoint', variable.name='EMG_sensor')
emg_fist_t <- melt(emg_fist, id.vars='measurepoint', variable.name='EMG_sensor')
emg_spread_fingers_t <- melt(emg_spread_fingers, id.vars='measurepoint', variable.name='EMG_sensor')
emg_double_tab_t <- melt(emg_double_tap, id.vars='measurepoint', variable.name='EMG_sensor')

# plot all gestures
emg_plot <- ggplot(
  emg_wave_in_t,
  aes(
```

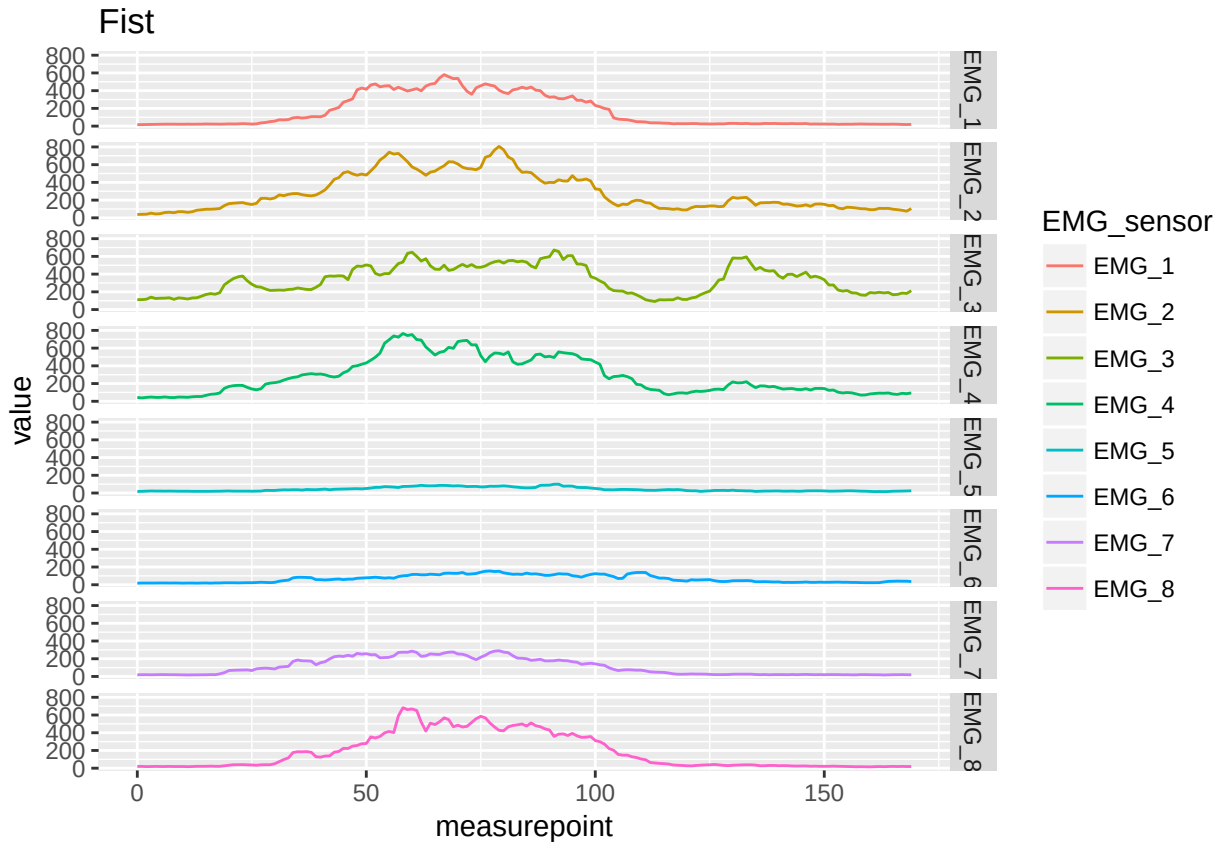
```
    measurepoint,
    value,
    group="EMG_sensor",
    colour = EMG_sensor
    )
  ) + geom_line() + facet_grid(EMG_sensor ~ .) + labs(title = "Wave In")
plot(emg_plot)
```



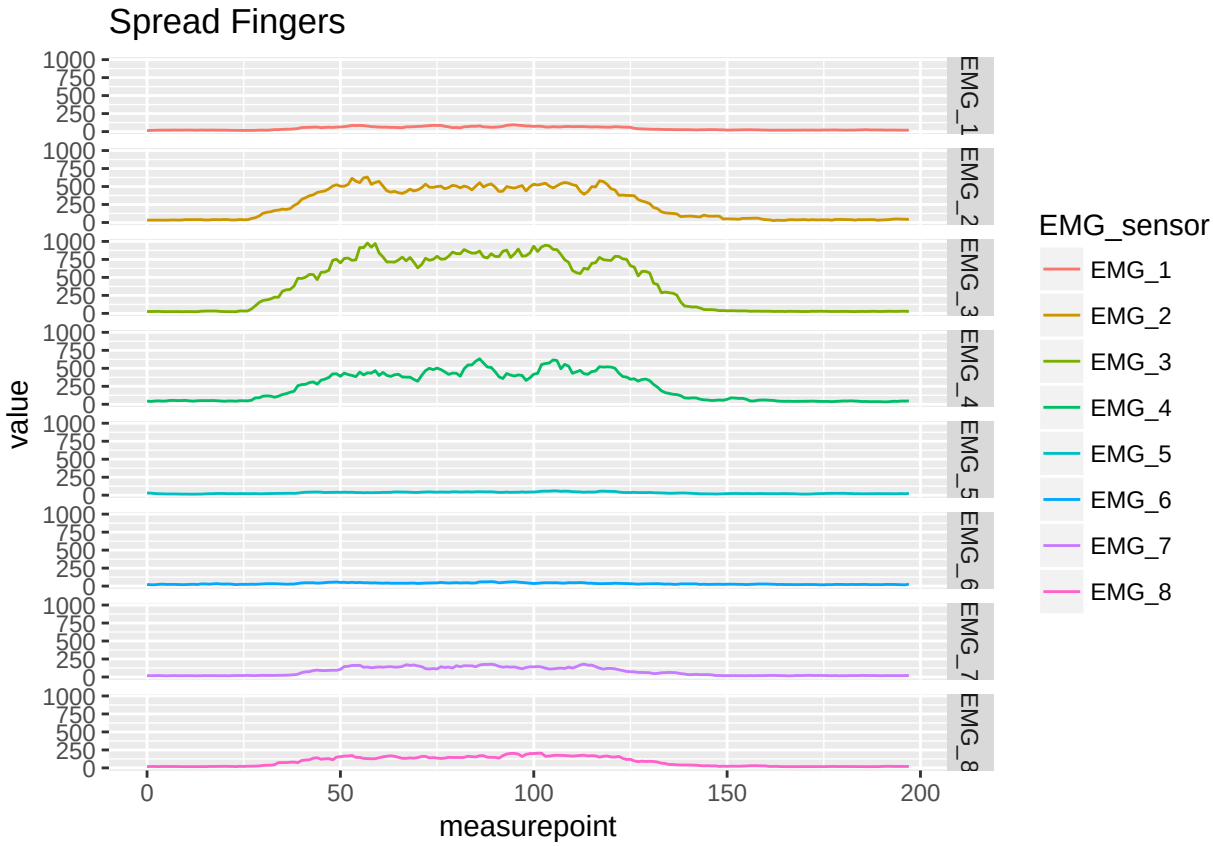

```
emg_plot <- ggplot(
  emg_wave_out_t,
  aes(
    measurepoint,
    value,
    group="EMG_sensor",
    colour = EMG_sensor
    )
  ) + geom_line() + facet_grid(EMG_sensor ~ .) + labs(title = "Wave Out")
plot(emg_plot)
```



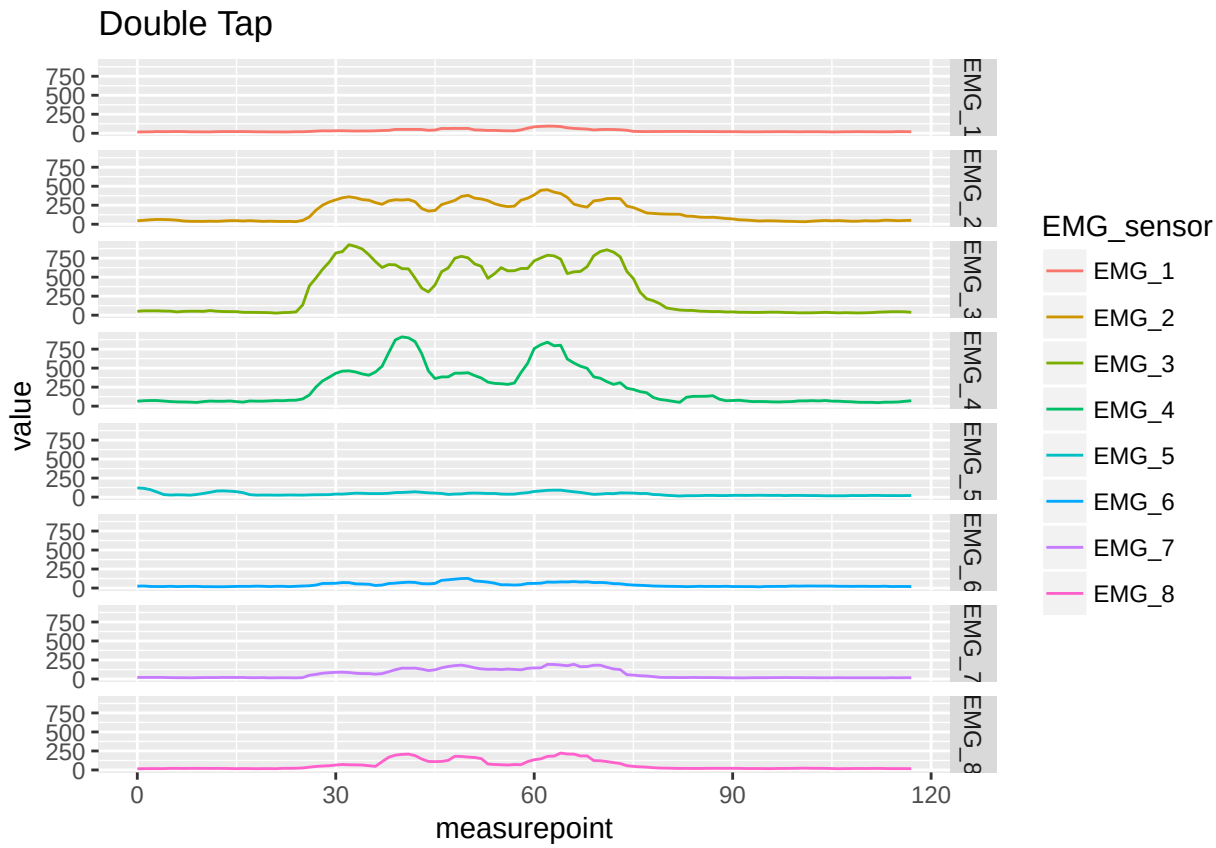

```
emg_plot <- ggplot(
  emg_fist_t,
  aes(
    measurepoint,
    value,
    group="EMG_sensor",
    colour = EMG_sensor
    )
  ) + geom_line() + facet_grid(EMG_sensor ~ .) + labs(title = "Fist")
plot(emg_plot)
```



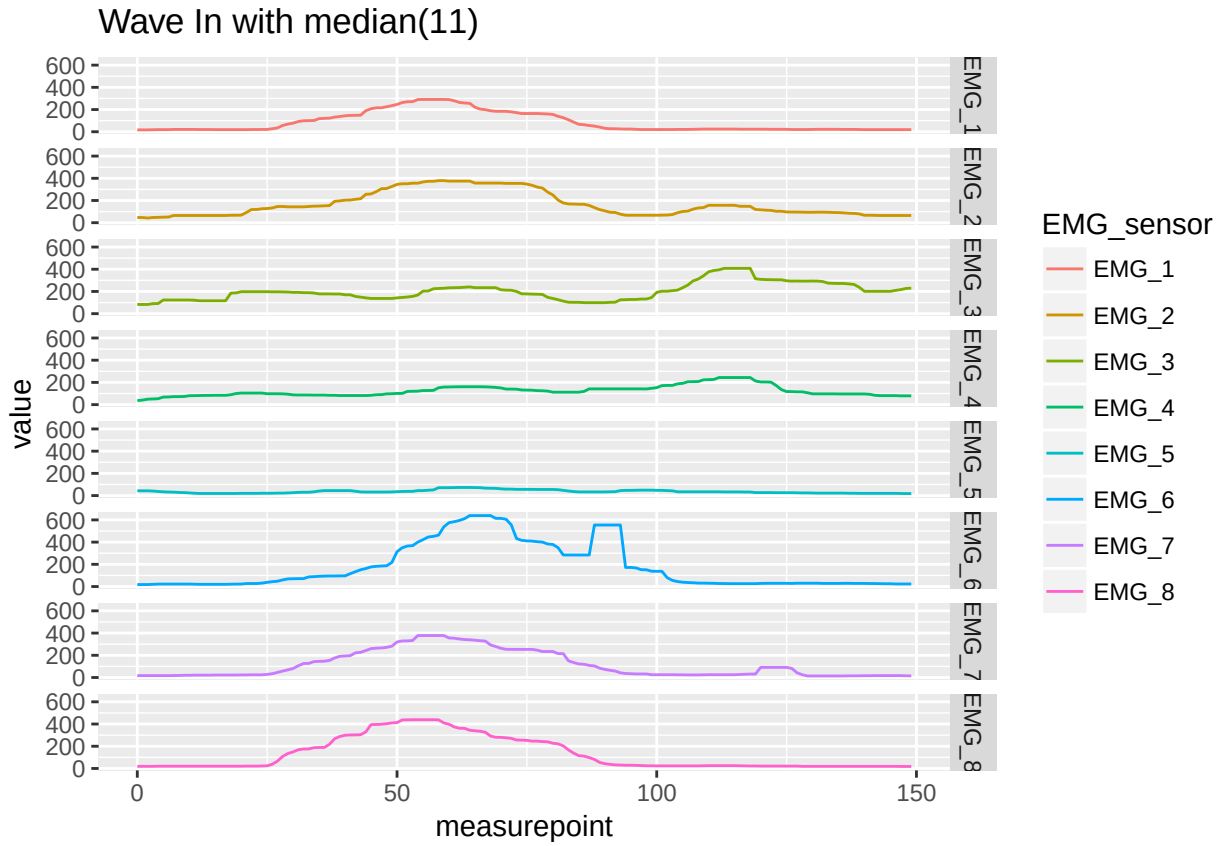

```
emg_plot <- ggplot(
  emg_spread_fingers_t,
  aes(
    measurepoint,
    value,
    group="EMG_sensor",
    colour = EMG_sensor
    )
  ) + geom_line() + facet_grid(EMG_sensor ~ .) + labs(title = "Spread Fingers")
plot(emg_plot)
```



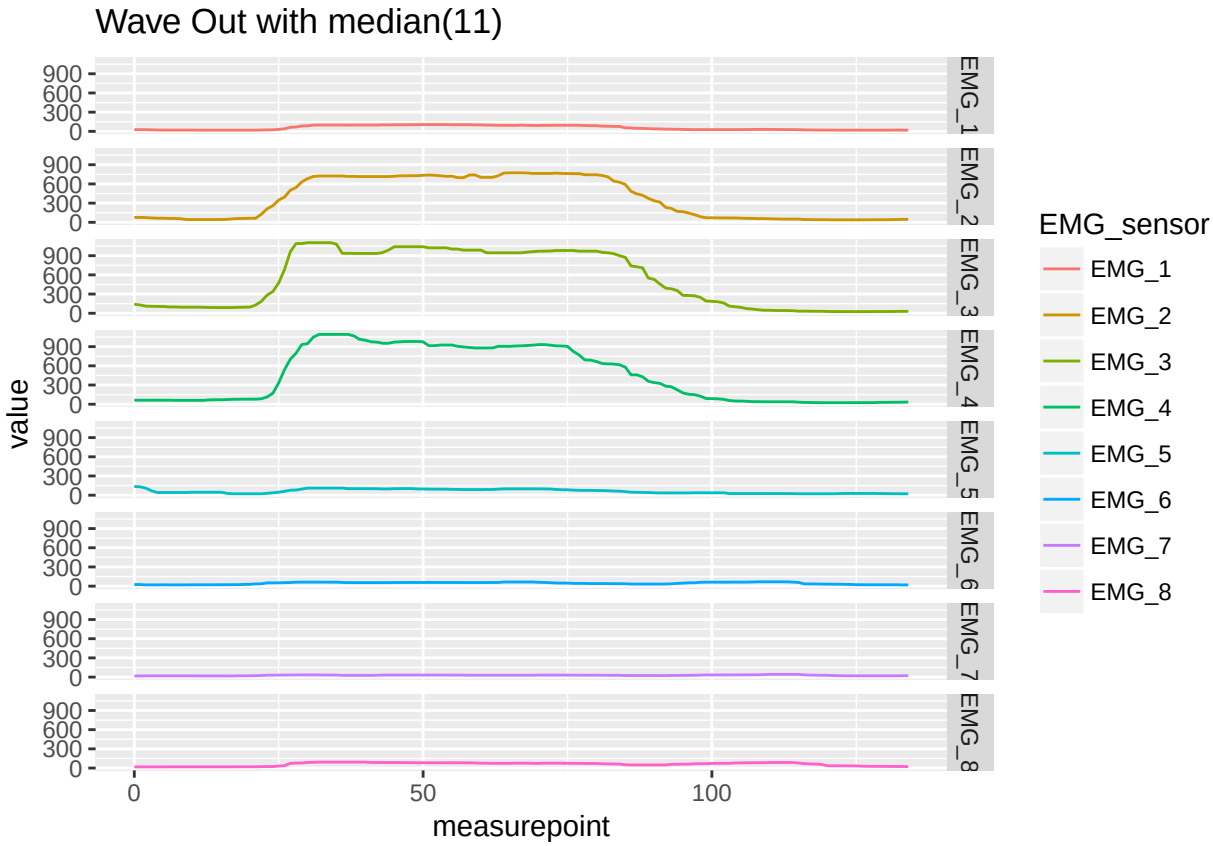

```
emg_plot <- ggplot(
  emg_double_tab_t,
  aes(
    measurepoint,
    value,
    group="EMG_sensor",
    colour = EMG_sensor
    )
  ) + geom_line() + facet_grid(EMG_sensor ~ .) + labs(title = "Double Tap")
plot(emg_plot)
```



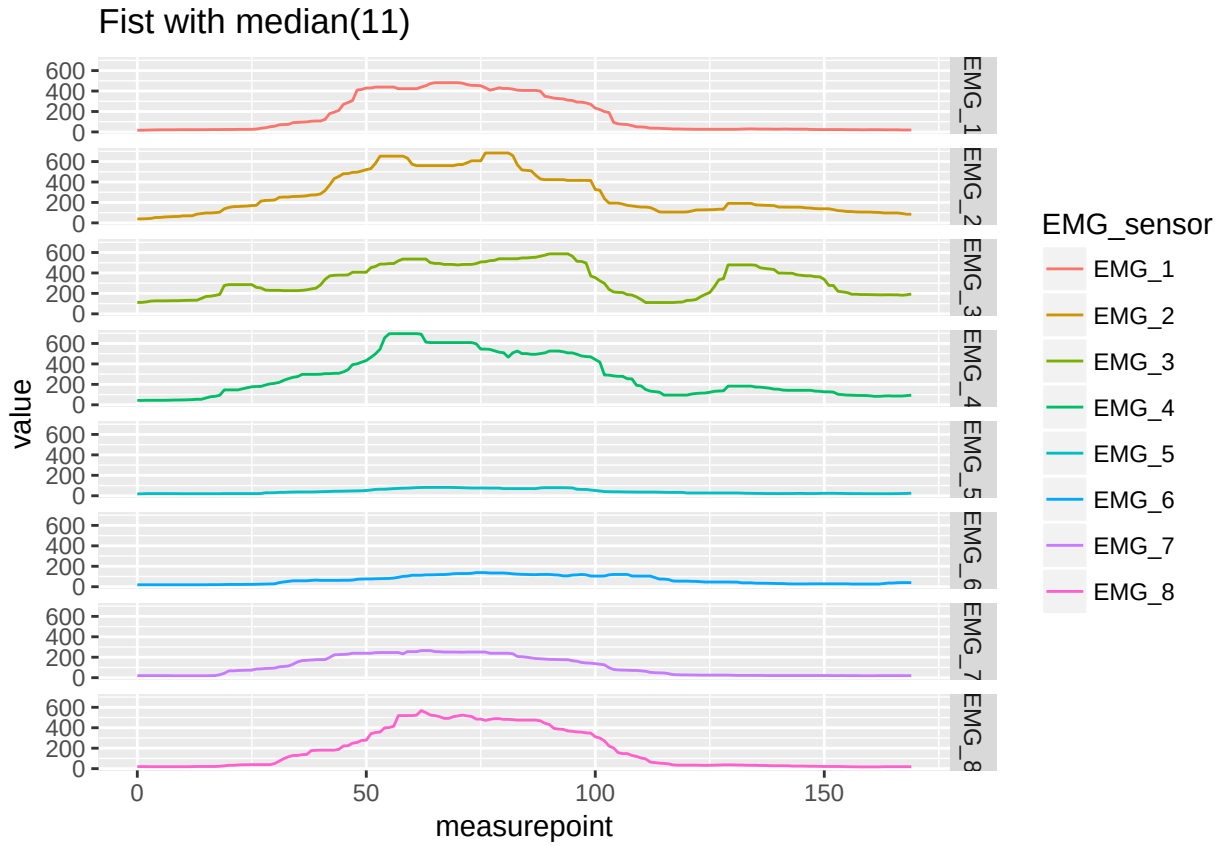

```
# calculate running median over 11 vlaues
emg_wave_in_med <- emg_wave_in %>% mutate_each(funs(runmed(., 11)))
emg_wave_out_med <- emg_wave_out %>% mutate_each(funs(runmed(., 11)))
emg_fist_med <- emg_fist %>% mutate_each(funs(runmed(., 11)))
emg_spread_fingers_med <- emg_spread_fingers %>% mutate_each(funs(runmed(., 11)))
emg_double_tap_med <- emg_double_tap %>% mutate_each(funs(runmed(., 11)))

# melt into plotable format
emg_wave_in_med_t <- melt(emg_wave_in_med, id.vars='measurepoint', variable.name='EMG_sensor')
emg_wave_out_med_t <- melt(emg_wave_out_med, id.vars='measurepoint', variable.name='EMG_sensor')
emg_fist_med_t <- melt(emg_fist_med, id.vars='measurepoint', variable.name='EMG_sensor')
emg_spread_fingers_med_t <- melt(emg_spread_fingers_med, id.vars='measurepoint', variable.name='EMG_sens
emg_double_tap_med_t <- melt(emg_double_tap_med, id.vars='measurepoint', variable.name='EMG_sensor')

# plot to multiple graphs
emg_med_plot <- ggplot(
  emg_wave_in_med_t,
  aes(
    measurepoint,
    value,
    group="EMG_sensor",
    colour=EMG_sensor
    )
  ) + geom_line() + facet_grid(EMG_sensor ~ .) + labs(title = "Wave In with median(11)")
plot(emg_med_plot)
```



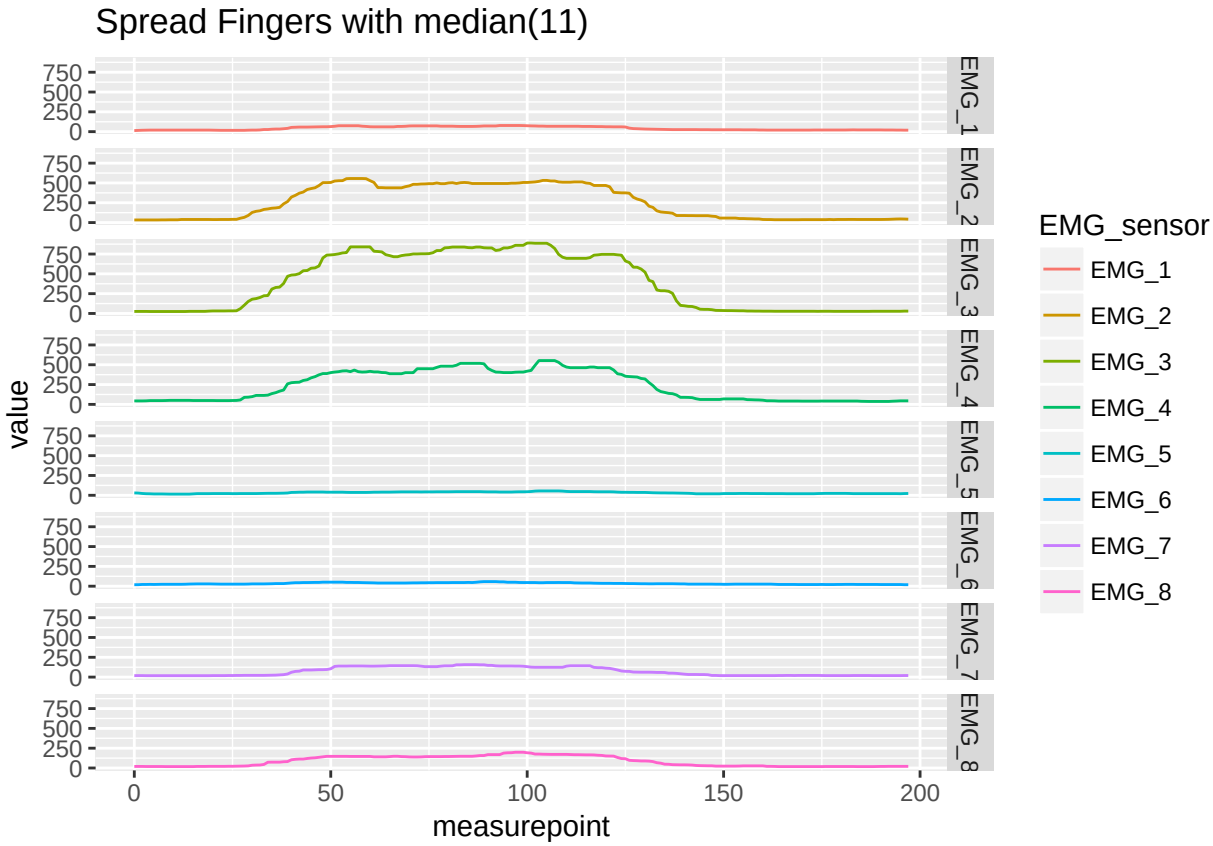

```
emg_med_plot <- ggplot(
  emg_wave_out_med_t,
  aes(
    measurepoint,
    value,
    group="EMG_sensor",
    colour=EMG_sensor
    )
  ) + geom_line() + facet_grid(EMG_sensor ~ .) + labs(title = "Wave Out with median(11)")
plot(emg_med_plot)
```



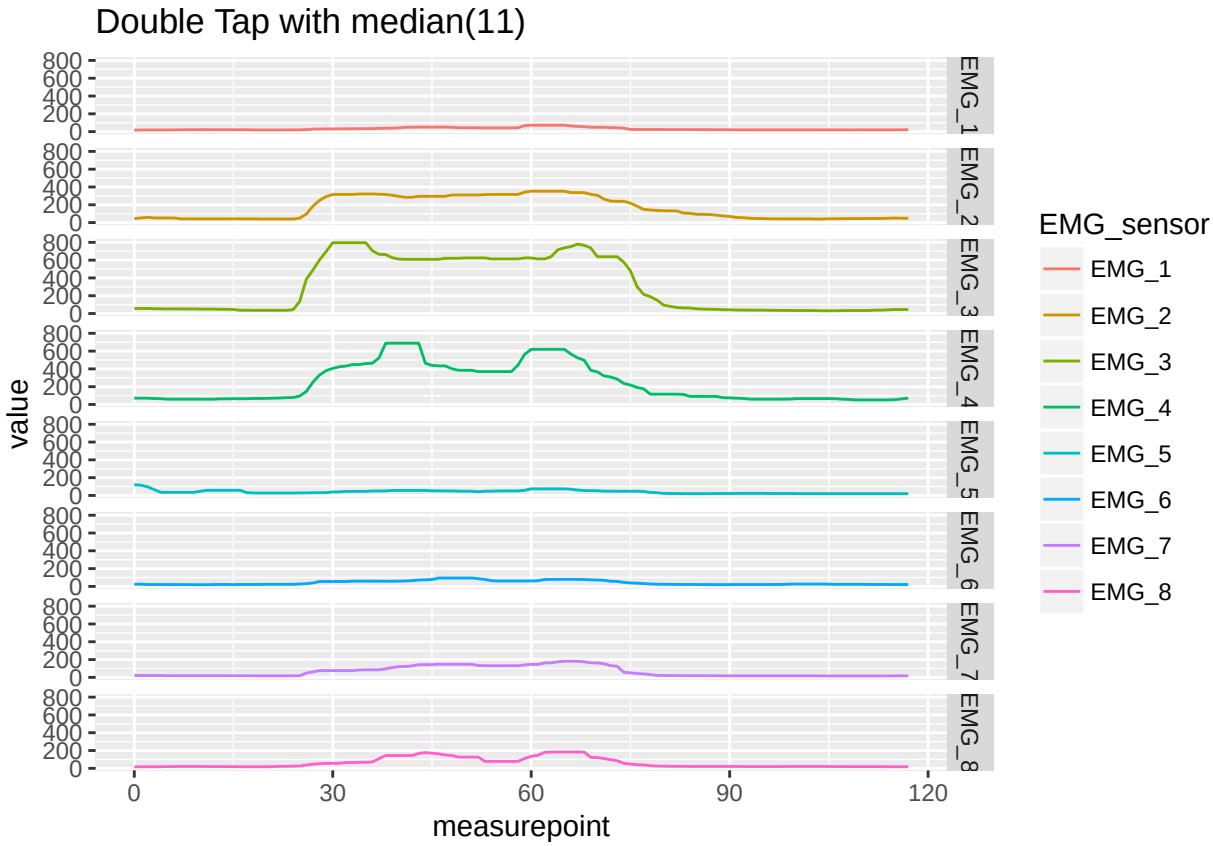

```
emg_med_plot <- ggplot(
  emg_fist_med_t,
  aes(
    measurepoint,
    value,
    group="EMG_sensor",
    colour=EMG_sensor
    )
  ) + geom_line() + facet_grid(EMG_sensor ~ .) + labs(title = "Fist with median(11)")
plot(emg_med_plot)
```




```
emg_med_plot <- ggplot(
  emg_spread_fingers_med_t,
  aes(
    measurepoint,
    value,
    group="EMG_sensor",
    colour=EMG_sensor
    )
  ) + geom_line() + facet_grid(EMG_sensor ~ .) + labs(title = "Spread Fingers with median(11)")
plot(emg_med_plot)
```



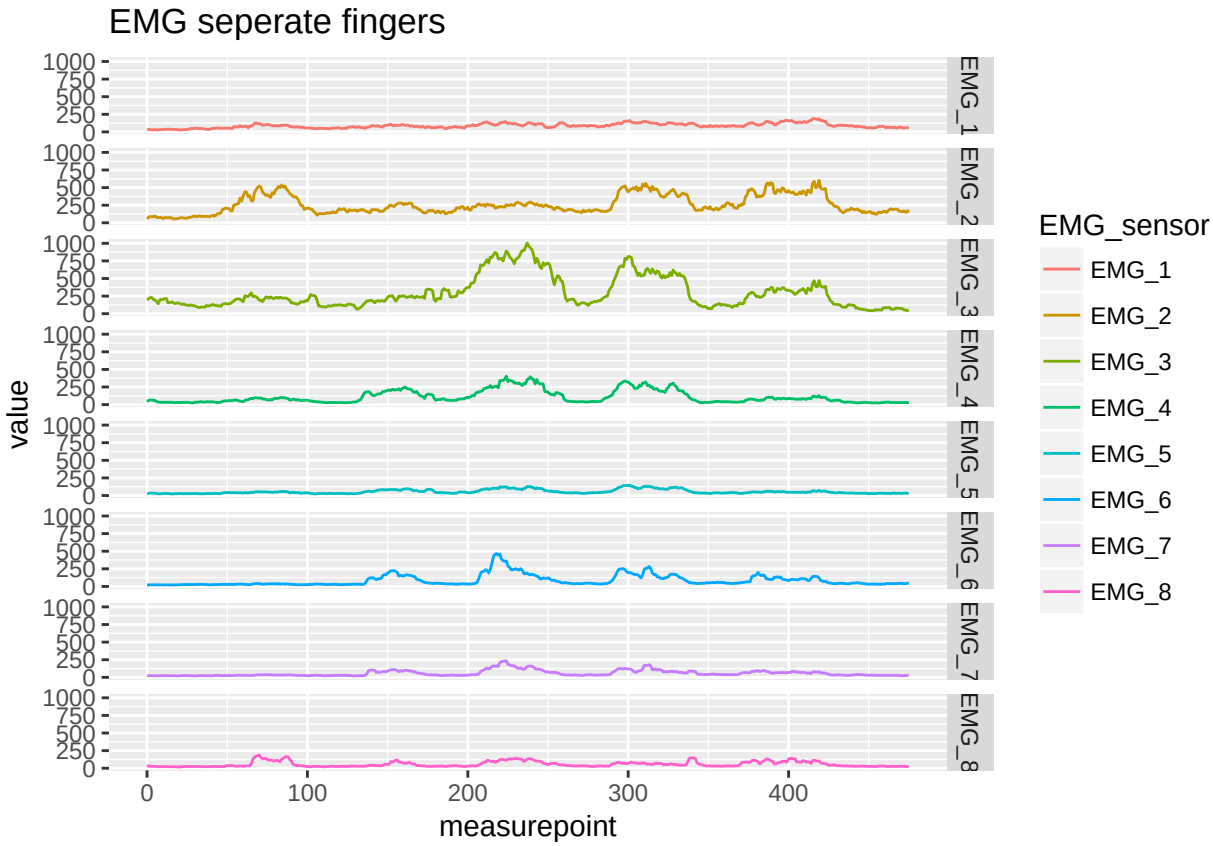

```
emg_med_plot <- ggplot(
  emg_double_tap_med_t,
  aes(
    measurepoint,
    value,
    group="EMG_sensor",
    colour=EMG_sensor
    )
  ) + geom_line() + facet_grid(EMG_sensor ~ .) + labs(title = "Double Tap with median(11)")
plot(emg_med_plot)
```



Plot the movement of single fingers

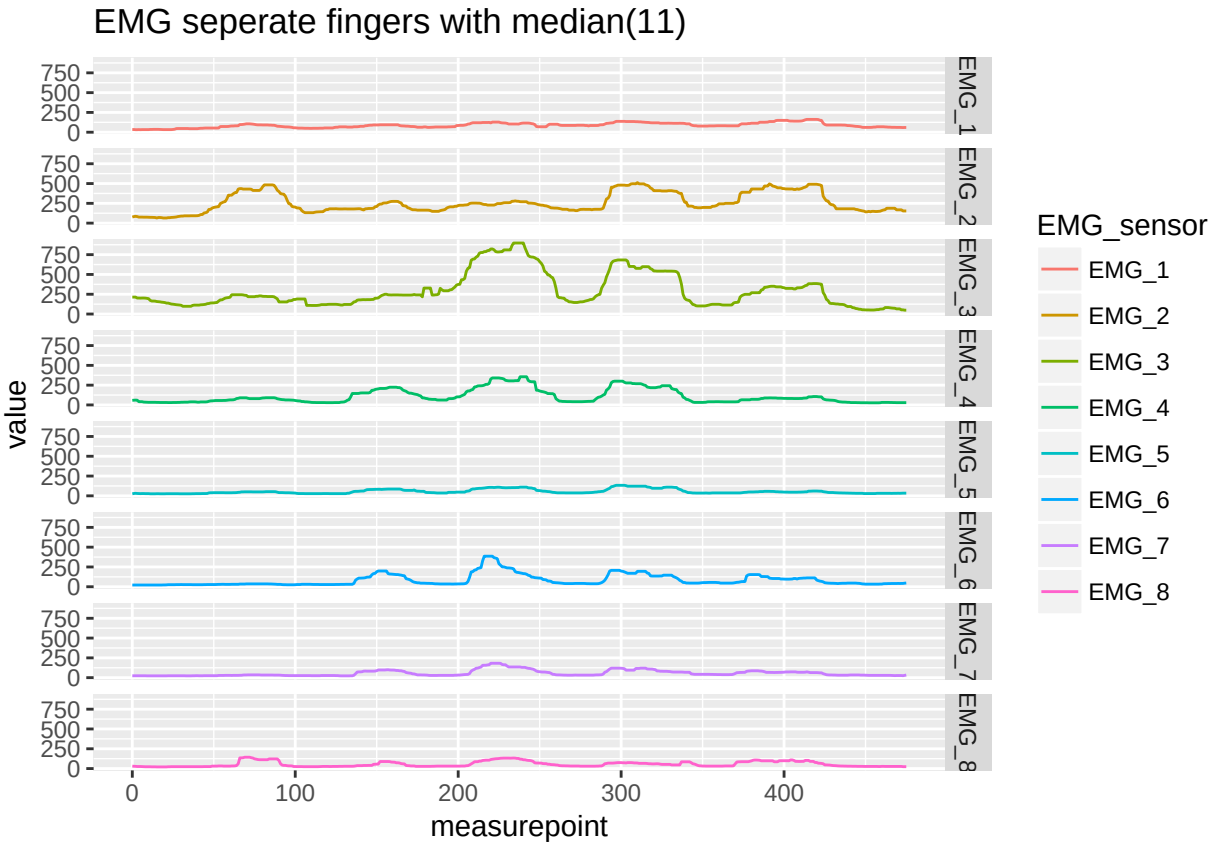
For further implementation there was also a recording of single finger movements. The finders were moved in the following order: Thumb - Index finger - Middle finger - annulary - auricular

```
# read
emg_fingers <- read.table("EMG_seperate_fingers.dat", header=TRUE, sep=",")
# transform
emg_fingers_t <- melt(emg_fingers, id.vars='measurepoint', variable.name='EMG_sensor')
# plot
emg_plot <- ggplot(
  emg_fingers_t,
  aes(
    measurepoint,
    value,
    group="EMG_sensor",
    colour = EMG_sensor
    )
  ) + geom_line() + facet_grid(EMG_sensor ~ .) + labs(title = "EMG seperate fingers")
plot(emg_plot)
```



And also calculated the running median over eleven values.

```
# calcualte the running median
emg_fingers_med <- emg_fingers %>% mutate_each(funs(runmed(.,11)))
# melt to plotable format
emg_fingers_med_t <- melt(emg_fingers_med, id.vars='measurepoint', variable.name='EMG_sensor')

# plot to multiple graphs
emg_med_plot <- ggplot(
  emg_fingers_med_t,
  aes(
    measurepoint,
    value,
    group="EMG_sensor",
    colour=EMG_sensor
  )
) + geom_line() + facet_grid(EMG_sensor ~ .) + labs(title = "EMG seperate fingers with median(11)")
plot(emg_med_plot)
```



Feature derivation

Feature detection

Feature computation

Train a SVM

Final result