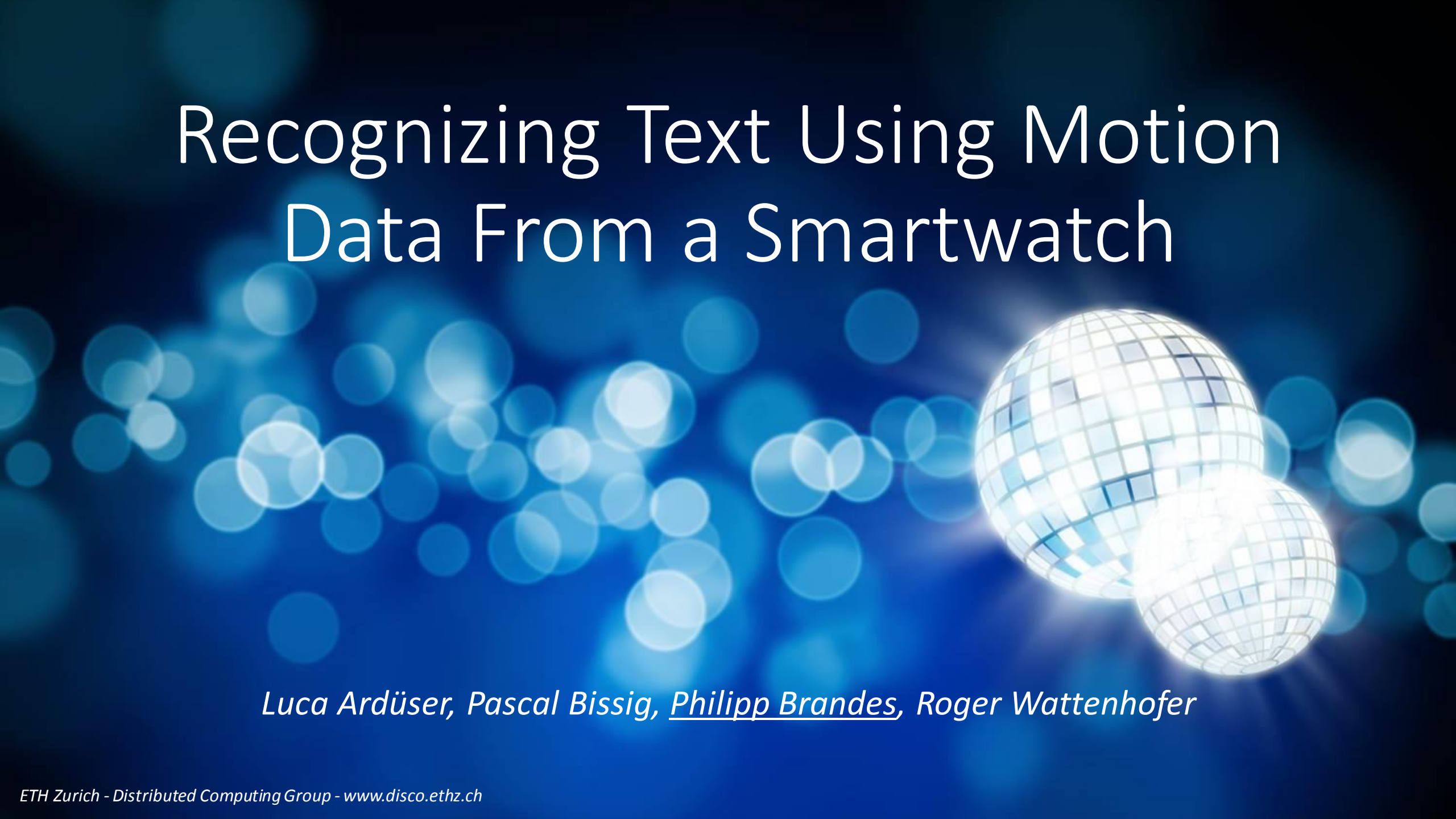
Recognizing Text Using Motion Data From a Smartwatch



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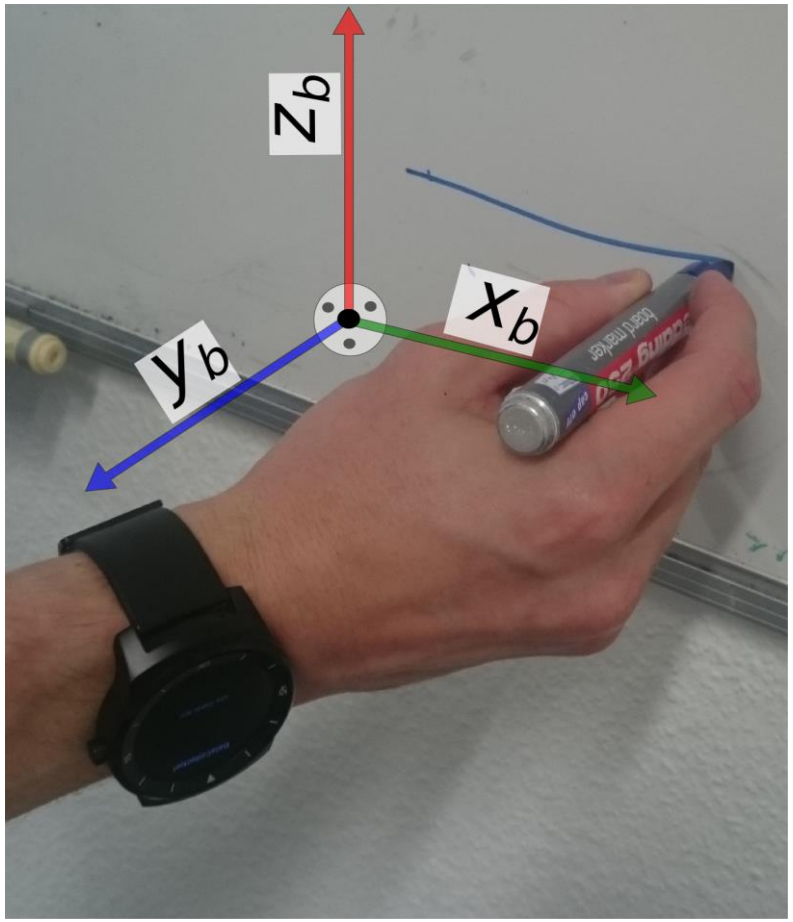
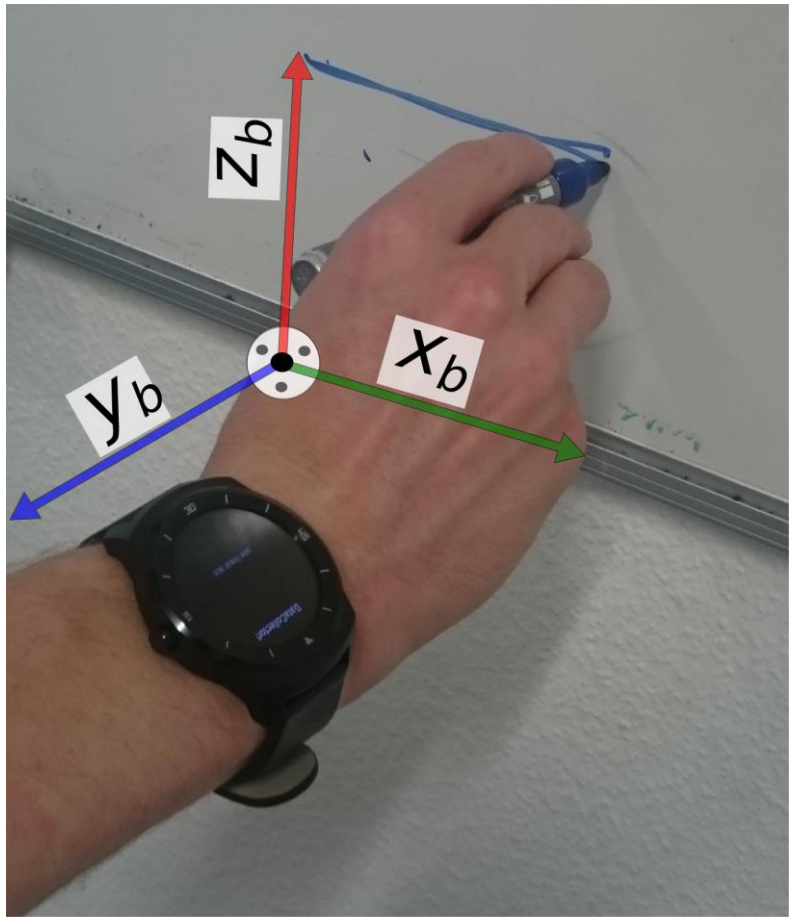
ETH Zurich - Distributed Computing Group - www.disco.ethz.ch

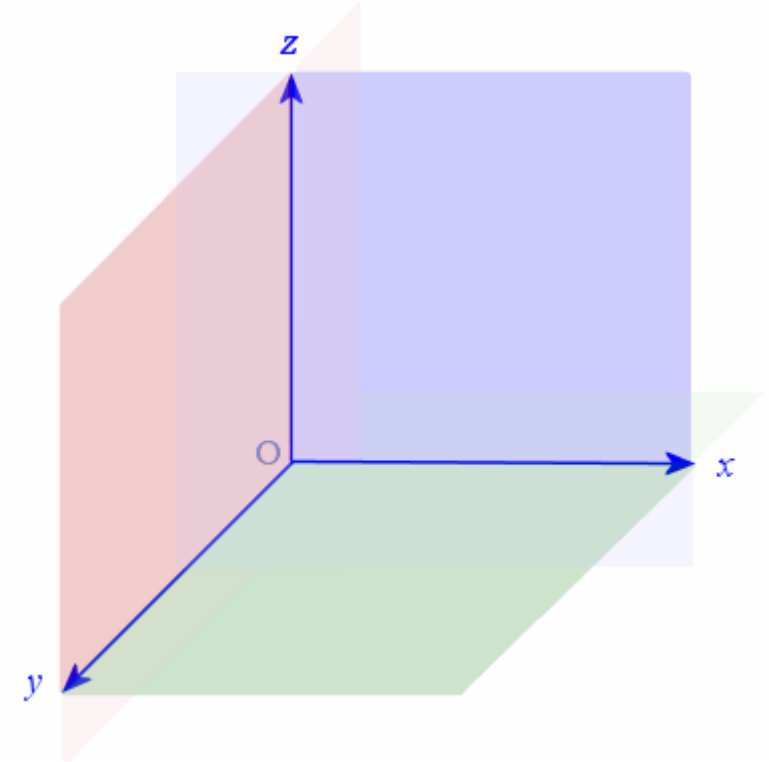
)n this paper, we show how motion data collected with a smartwatch can be used to infer text written on a whiteboard.

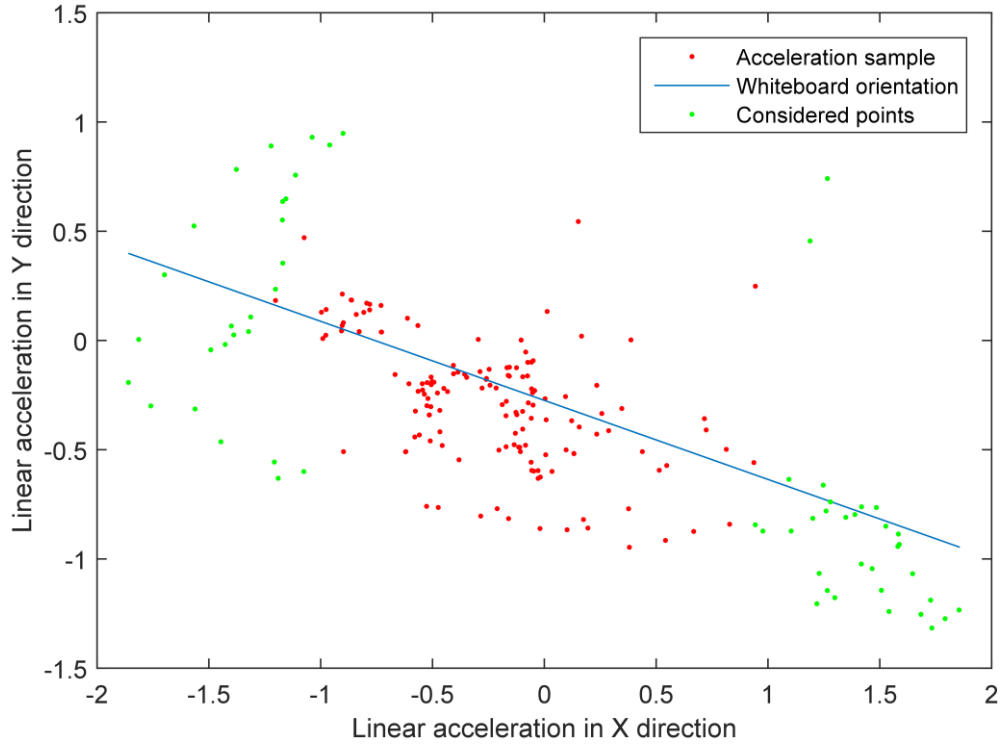
HELLO AUSTRALIA :)

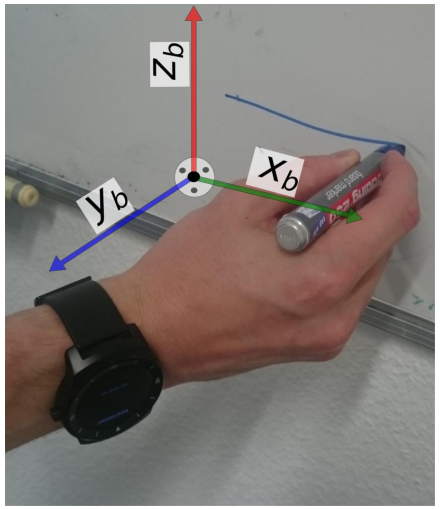

z_b
x_b
y_b

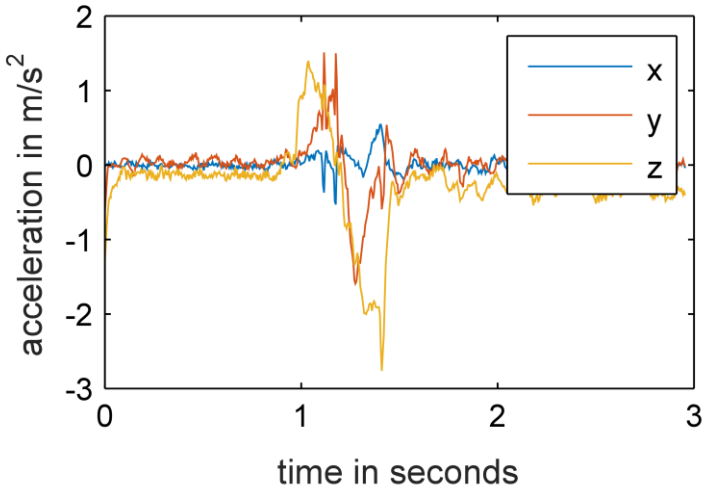

z_b
x_b
y_b

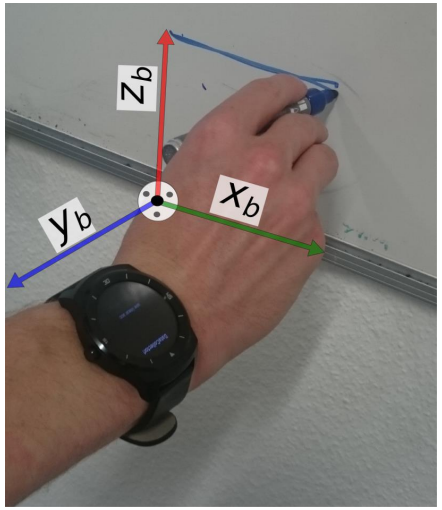
Transform to Whiteboard Coordinates

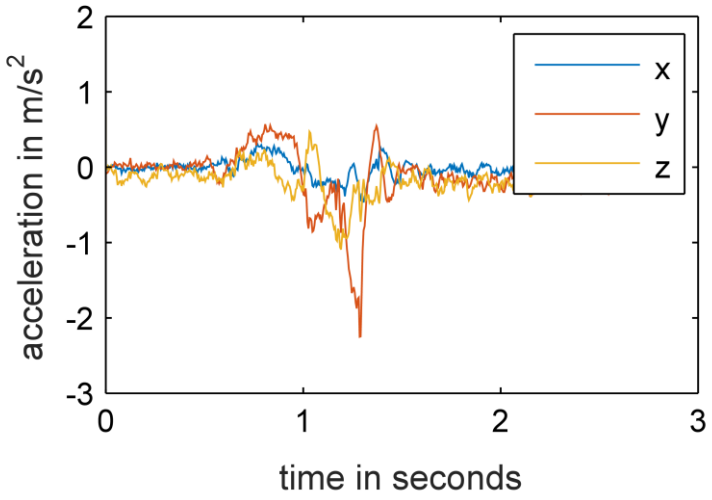


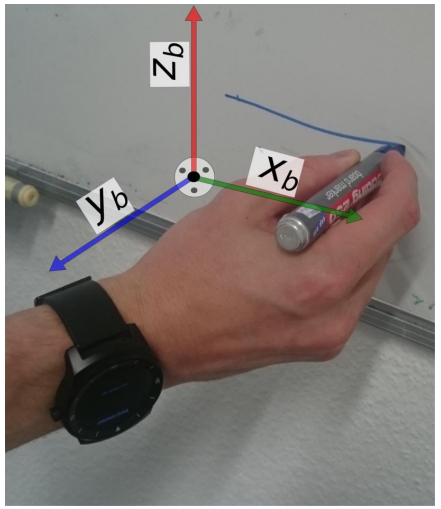


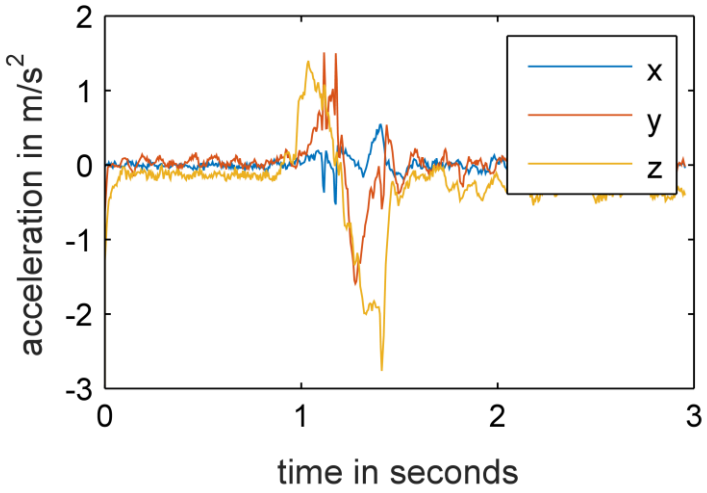

z_b
x_b
y_b

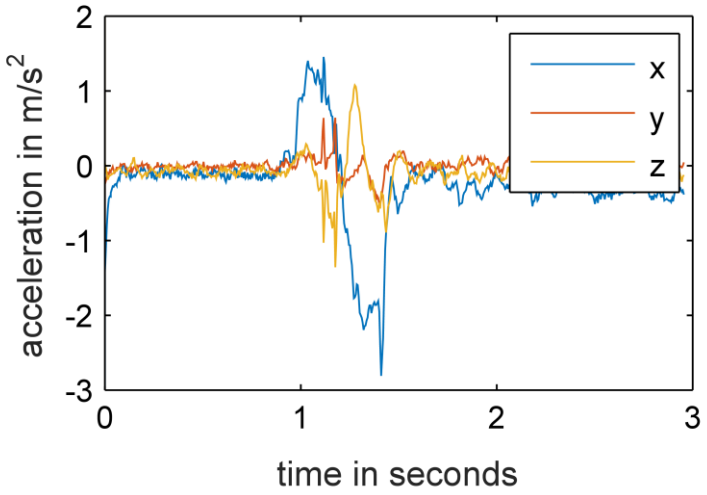

acceleration in m/s^2
time in seconds
x
y
z
2
1
0
-1
-2
-3
0
1
2
3

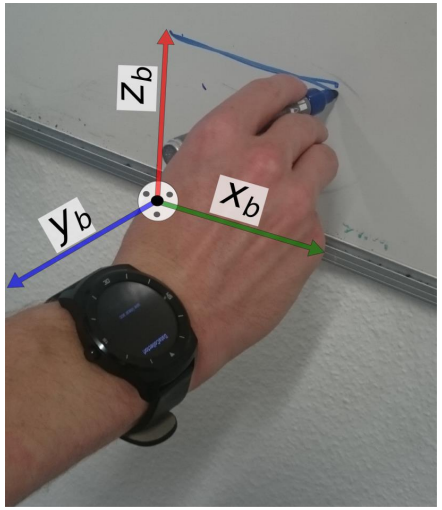

z_b
x_b
y_b

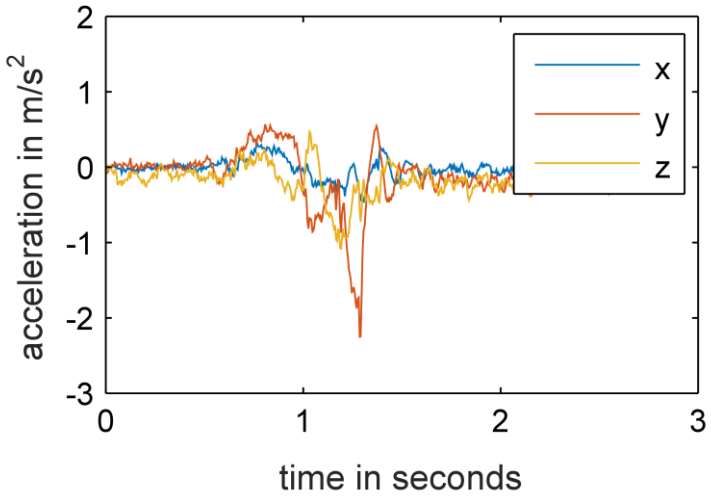

acceleration in m/s^2
time in seconds
x
y
z
2
1
0
-1
-2
-3
0
1
2
3

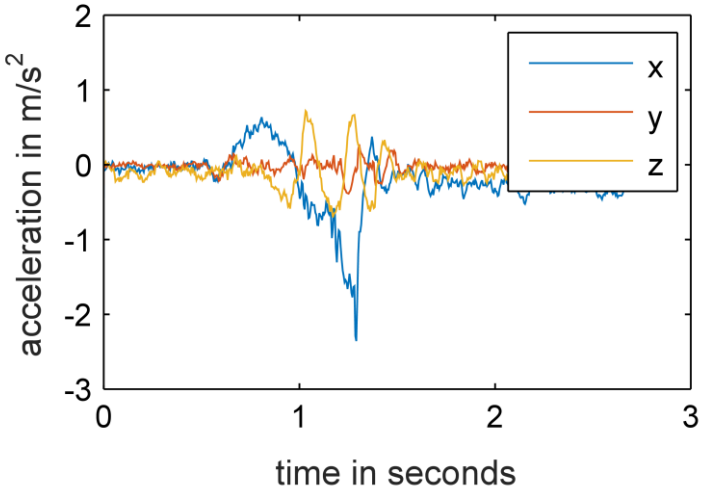

z_b
x_b
y_b


acceleration in m/s^2
time in seconds
x
y
z

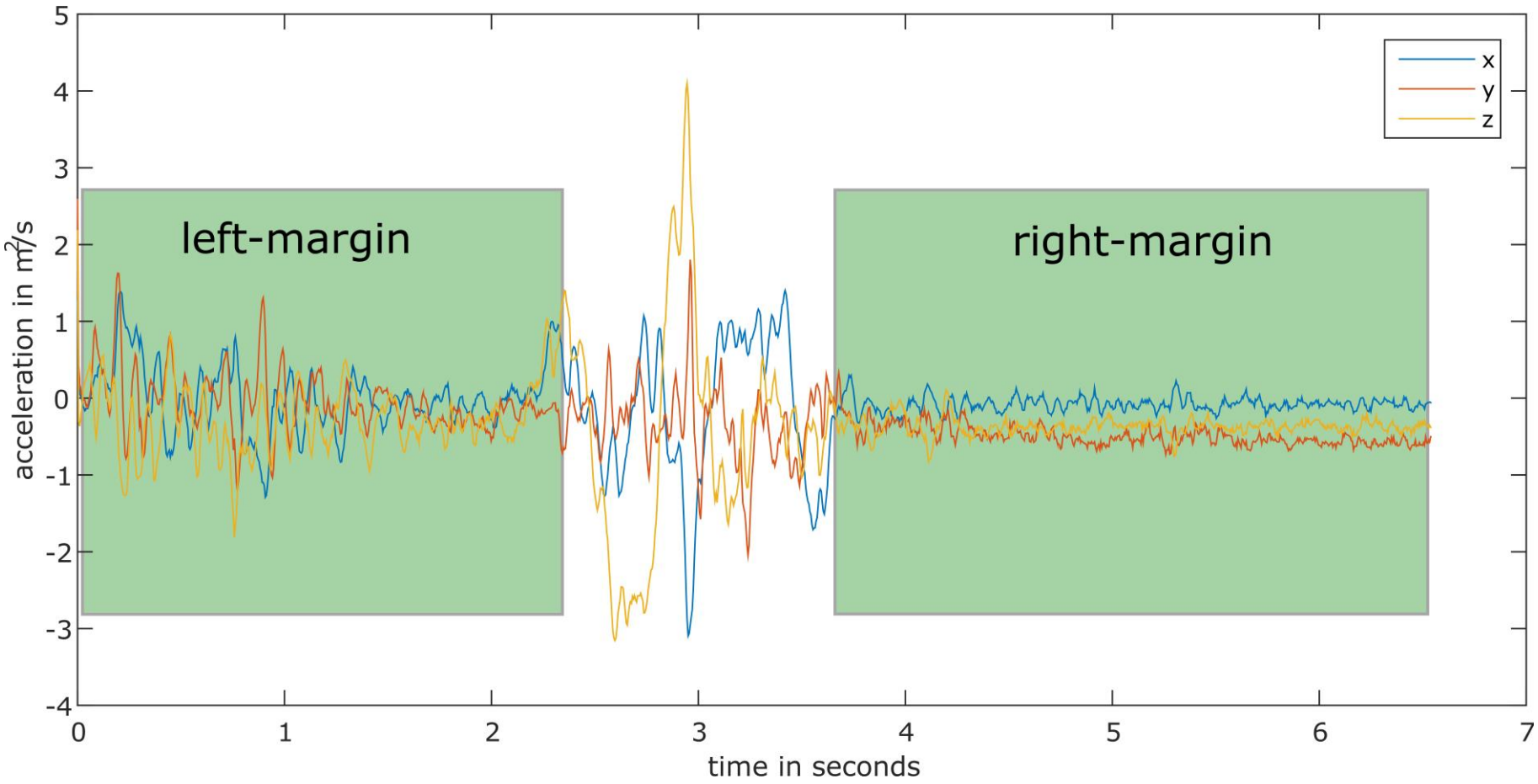

acceleration in m/s^2
time in seconds
x
y
z


z_b
x_b
y_b

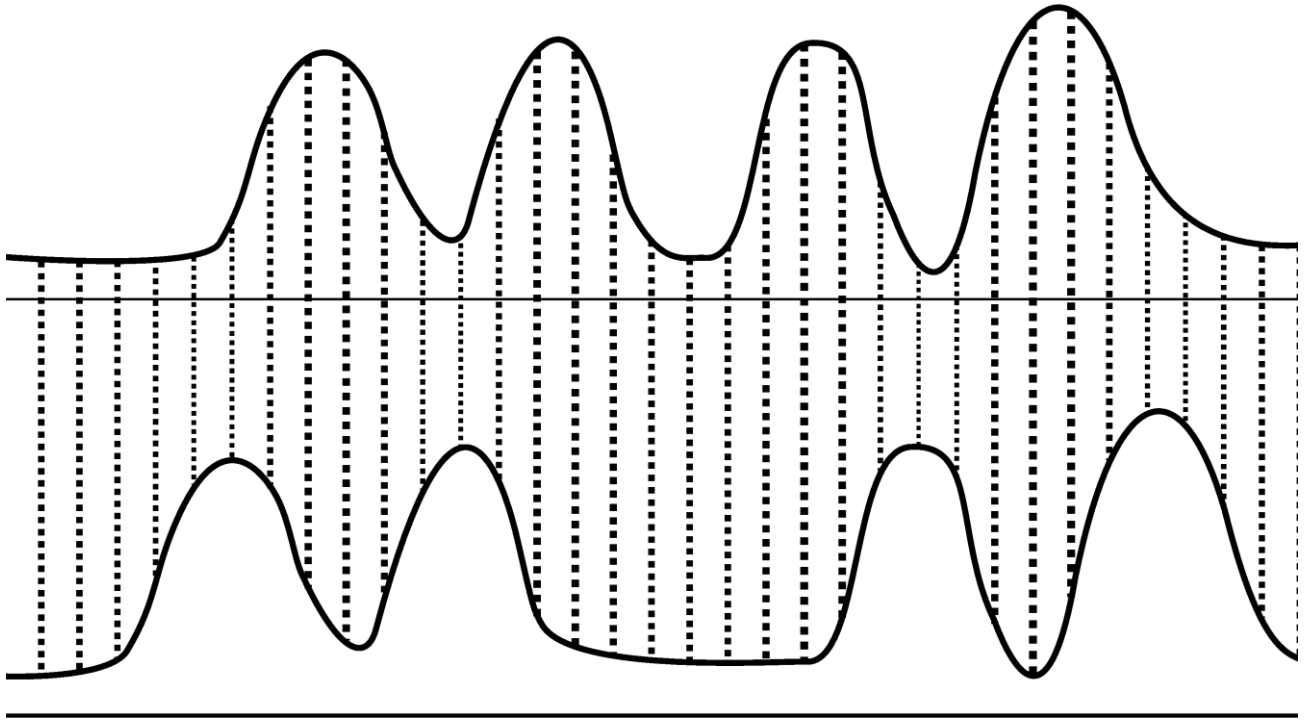

acceleration in m/s^2
time in seconds
x
y
z


acceleration in m/s^2
time in seconds
x
y
z

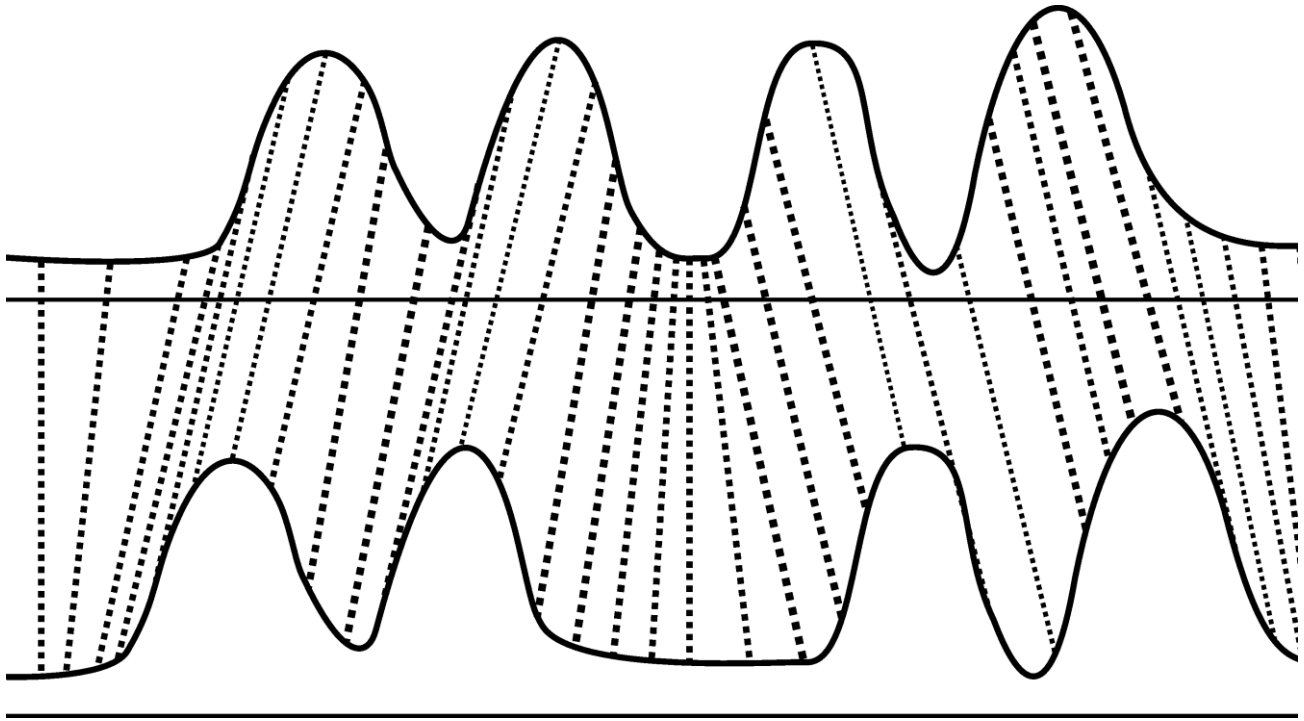
Segmentation



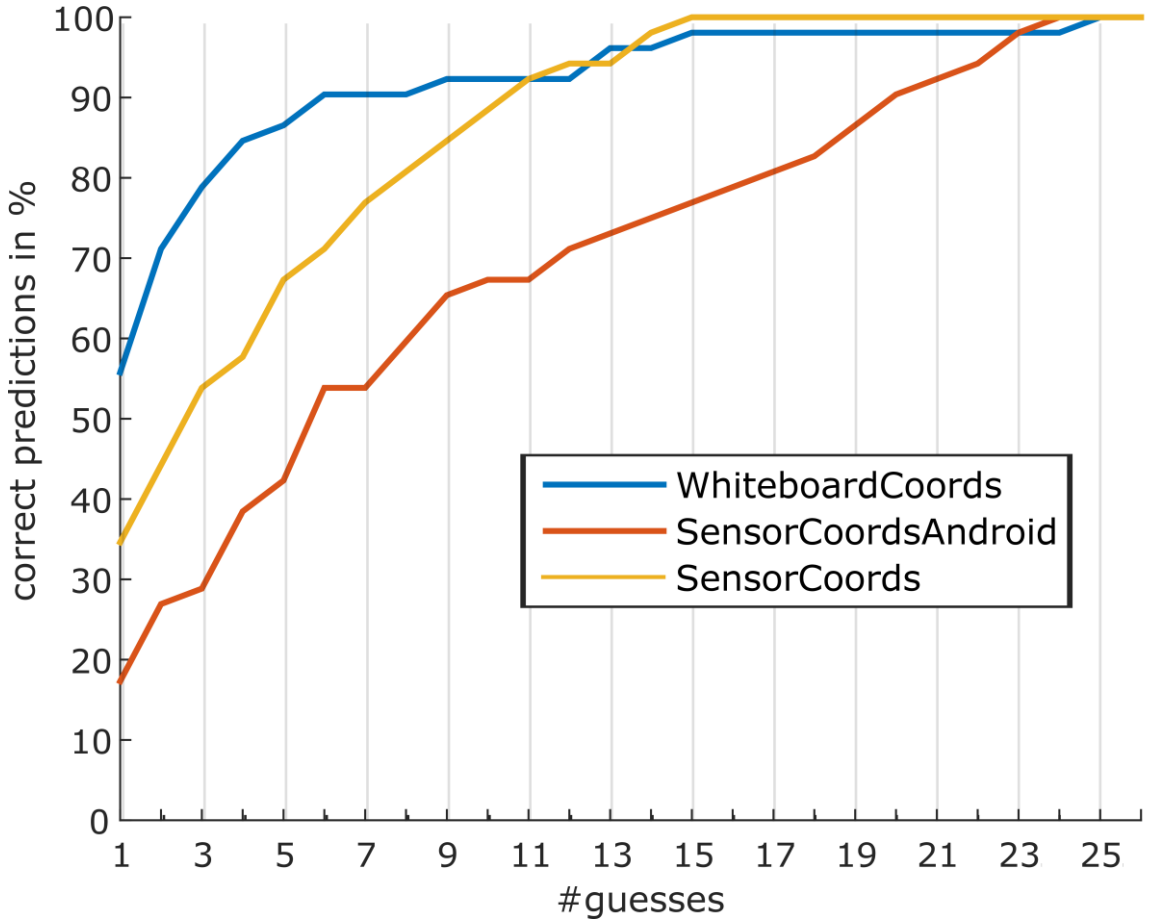
Algorithm: Dynamic Time Warping



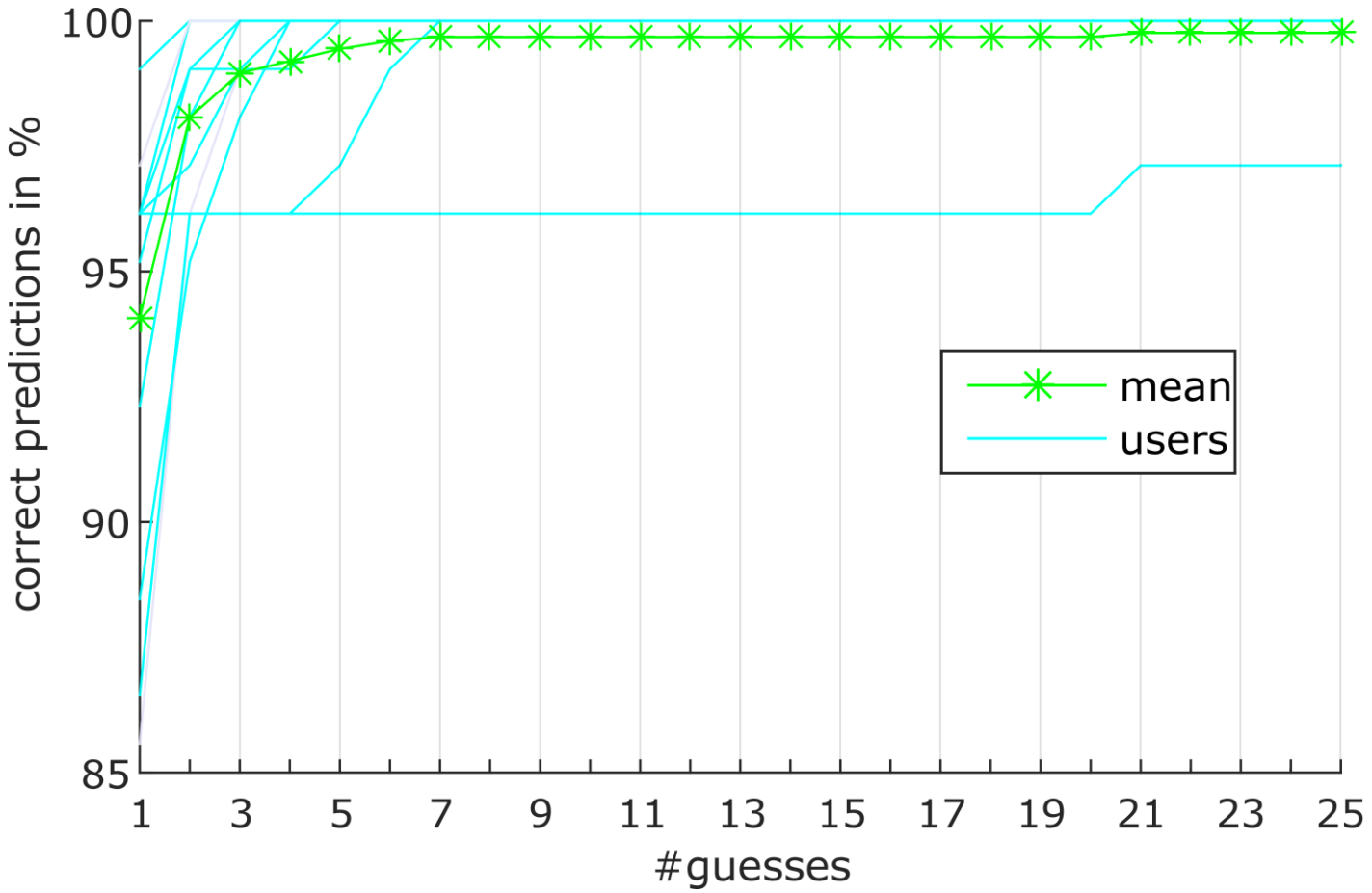
Algorithm: Dynamic Time Warping



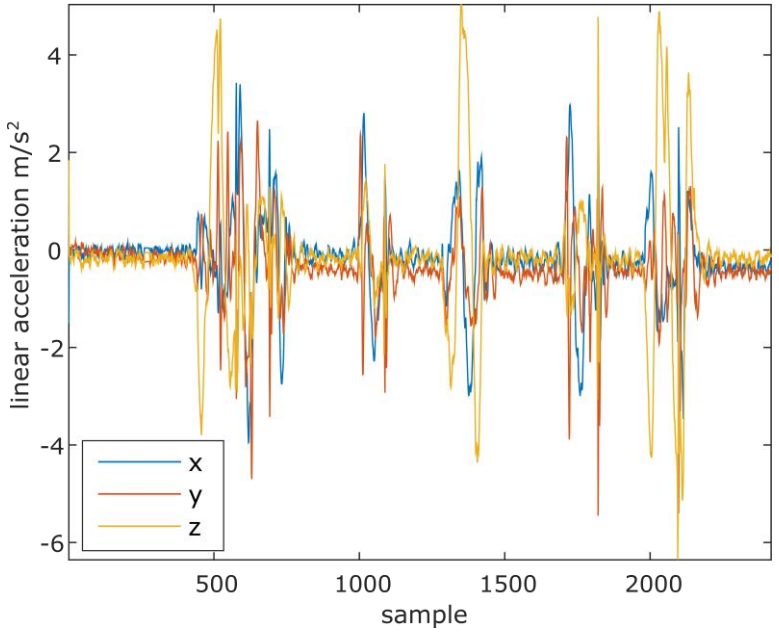
Top vs Bottom Edge

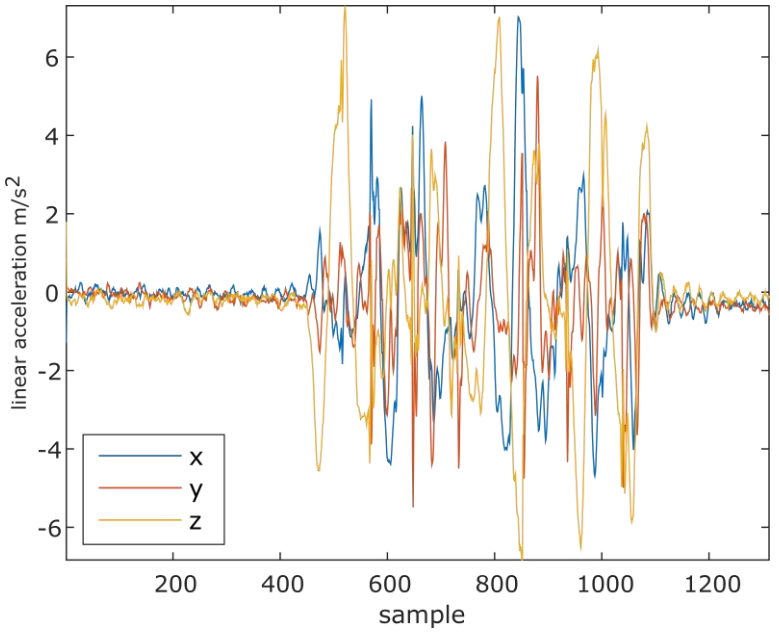


Letter Results

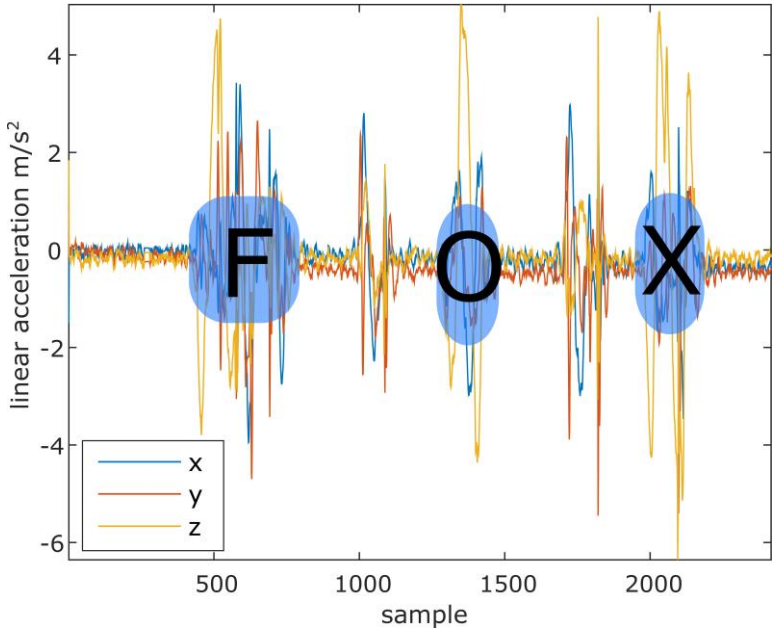


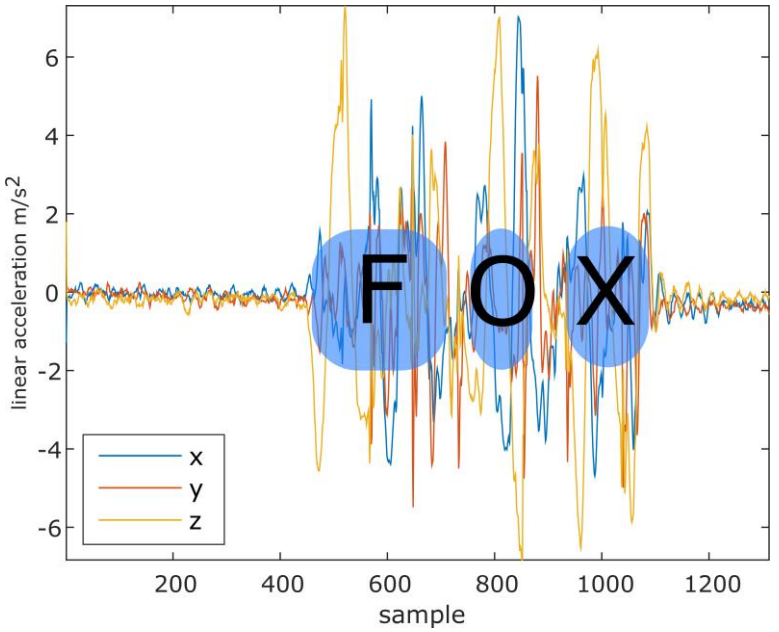
Words Are a Problem



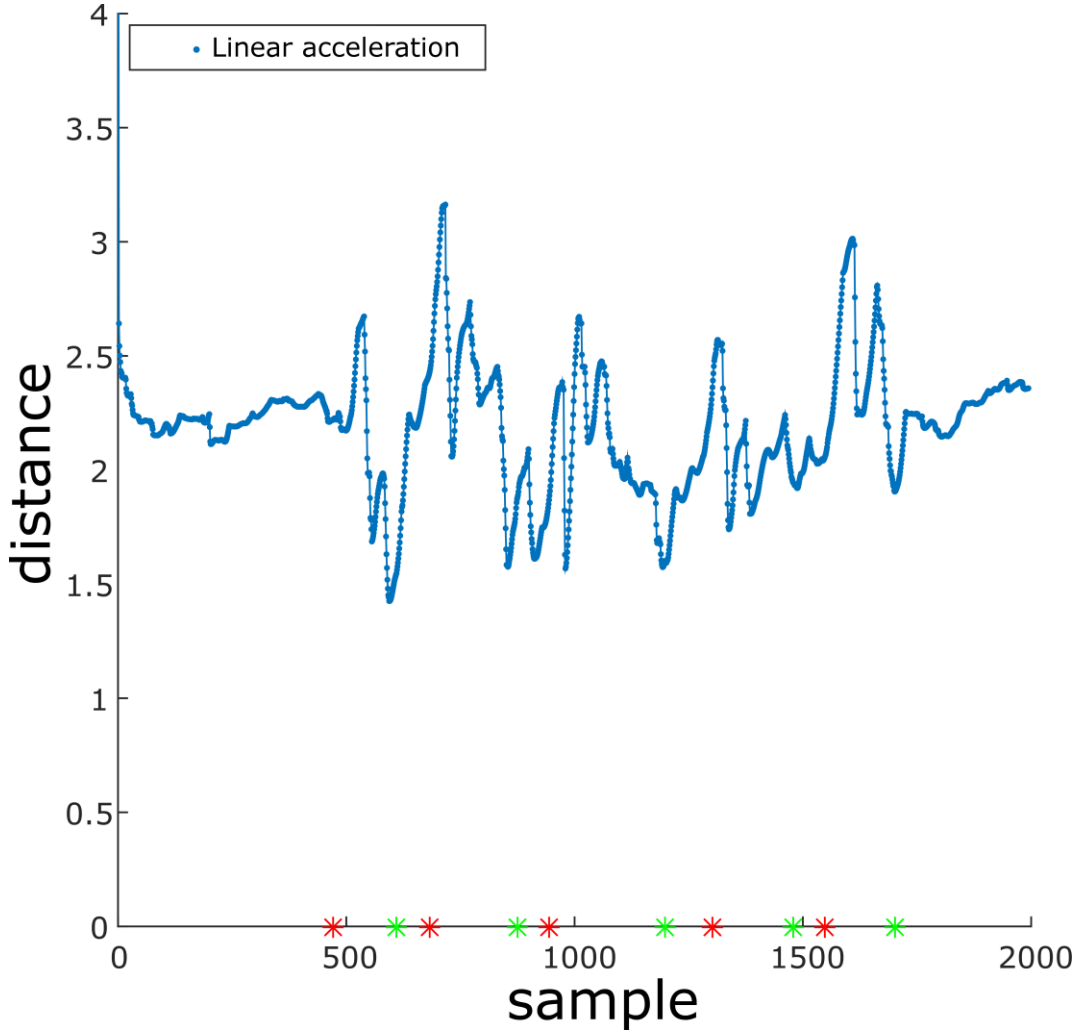


Words Are a Problem



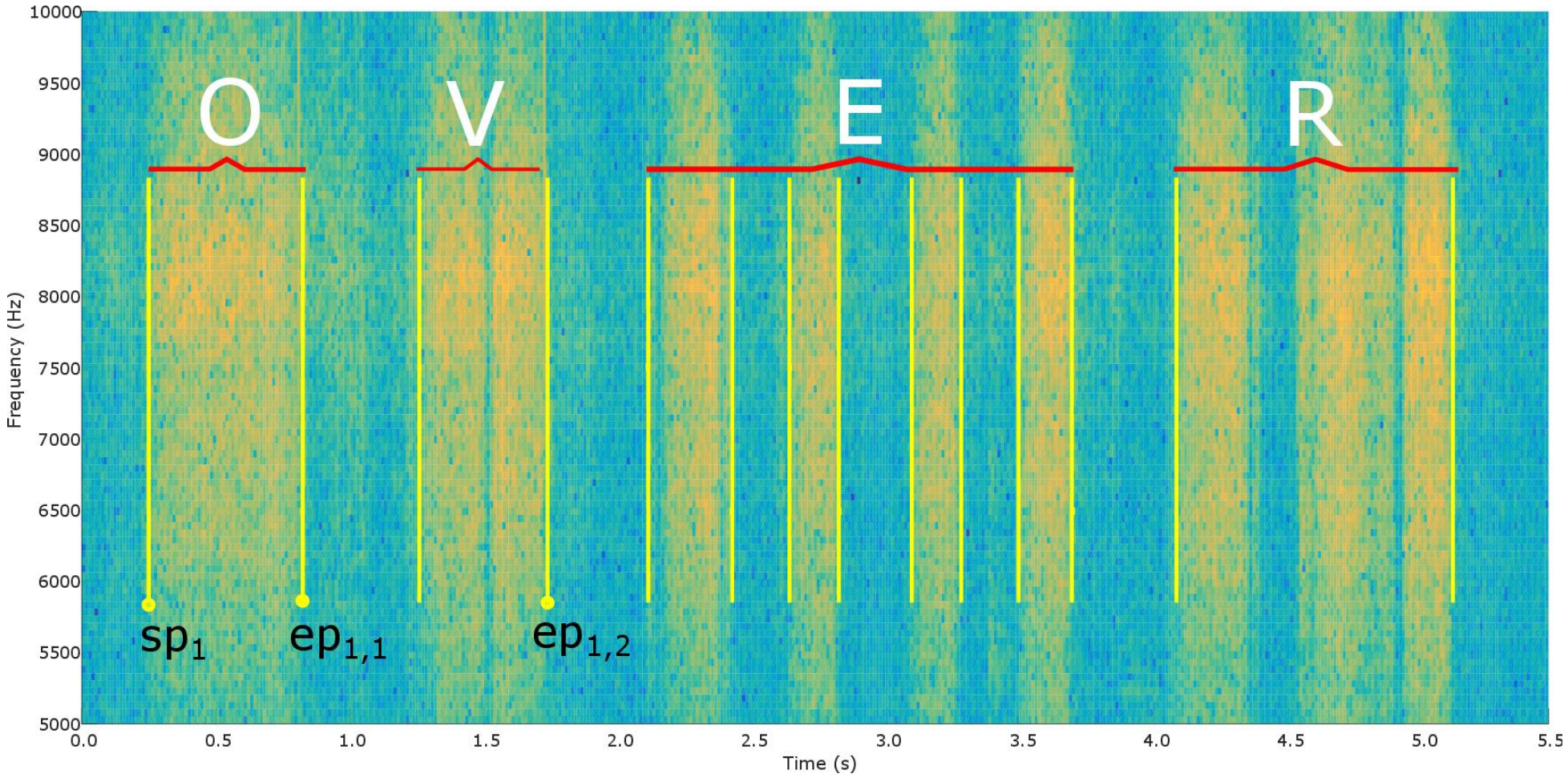


DTW Score

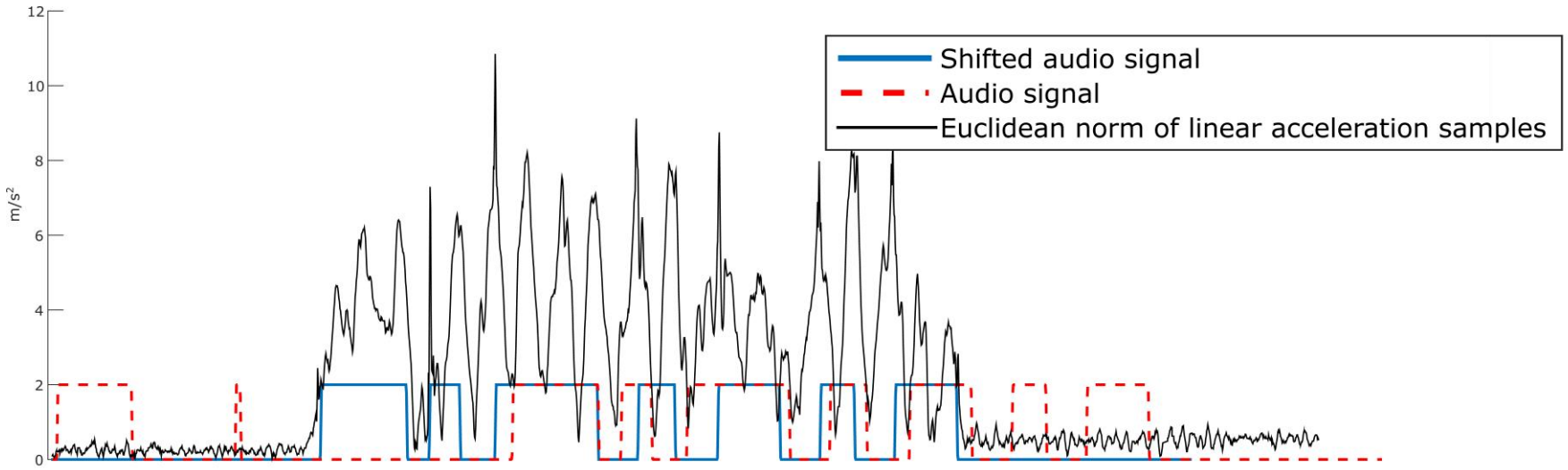


- 428 words
- Recognition rate: 64.5%
- Over 250000 false positives

Using Audio Helps

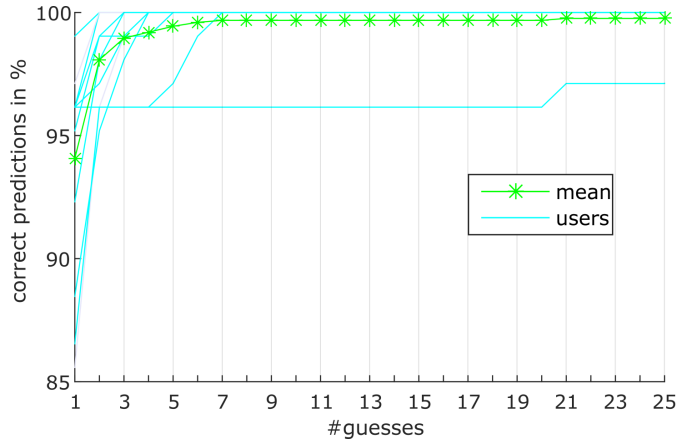


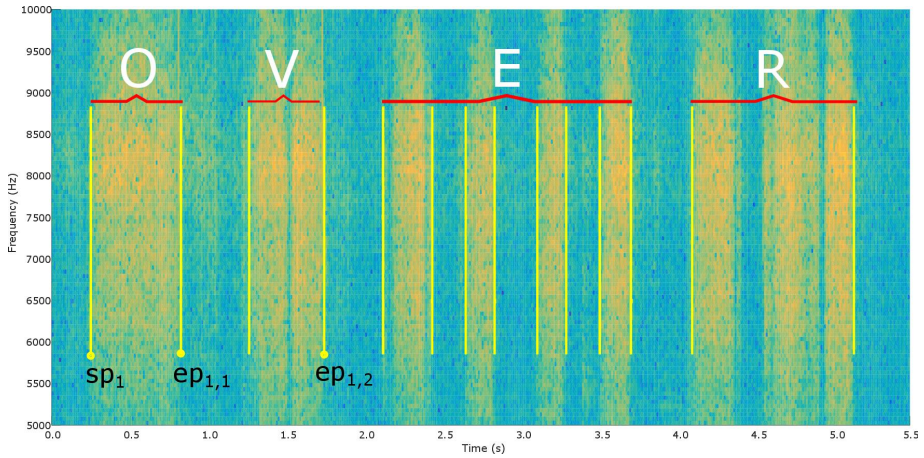
Matching Timestamps



- Recognition rate: 71.2%
- False positives reduced by two orders of magnitude

Summary


100
95
90
85
correct predictions in %
1
3
5
7
9
11
13
15
17
19
21
23
25
#guesses
mean
users


O
V
E
R
sp1
ep1,1
ep1,2
Frequency (Hz)
Time (s)