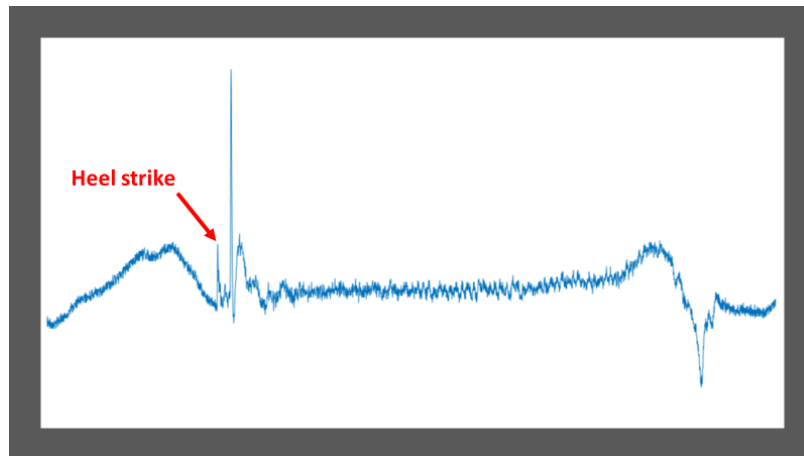# heel_strike_loc

OBJECTIVE

Detect heel strike(s) location from raw accelerometer signals

Figure 1: Example of a typical raw accelerometer signal obtained during a single walking step. The heel strike location is indicated by a red arrow.

IN/OUT

```
function [numSteps, hsLoc] = heel_strike_loc(signal,
samplingFrequency, window1, window2)
```

Inputs:

- ✓ **signal:** raw accelerometer signal (matrix size m x 1)
- ✓ **samplingFrequency:** frequency at which the signal was captured (in Hz)
- ✓ **window1:** number of data points included in the centralized frames (before and after main peaks, default: 500; might need to be smaller for faster signals, e.g. running)
- ✓ **window2:** number of data points included in the window before each main peak (default: 100; might need to be smaller for faster signals, e.g. running)

Outputs:

- ✓ **numSteps:** number of steps recorded by the accelerometer (- 2 as the first and last step are not counted)
- ✓ **hsLoc:** vector including the indexes of each detected heel strike on the raw accelerometer signal

METHODS

The code is structured in 3 different steps:

STEP 1: Low pass filtering and number of steps

1) Apply strong low pass filter to obtain a sinusoidal signal (Figure 2)
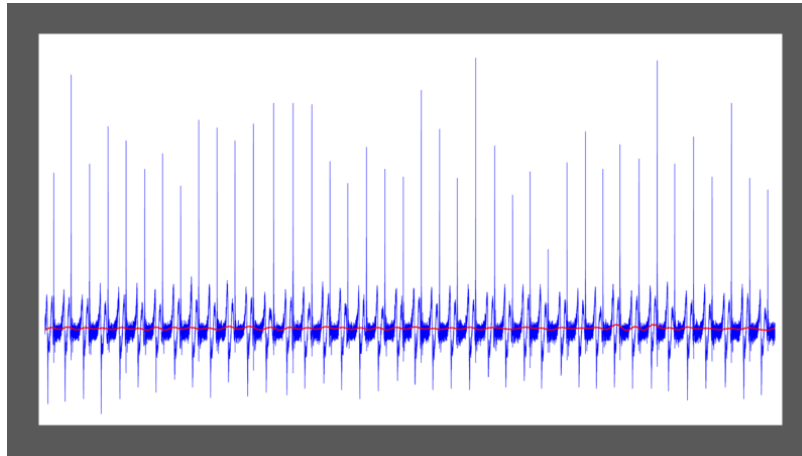
Figure 2: Raw accelerometer data (blue) and corresponding low pass filtered signal (red).

2) Calculate the number of steps using the number of peaks calculated on the filtered signal

STEP 2: Main peaks detection

1) Divides the raw signal into frames (one frame per step)

2) Calculates the location of the main peak on each frame (Figure 3)
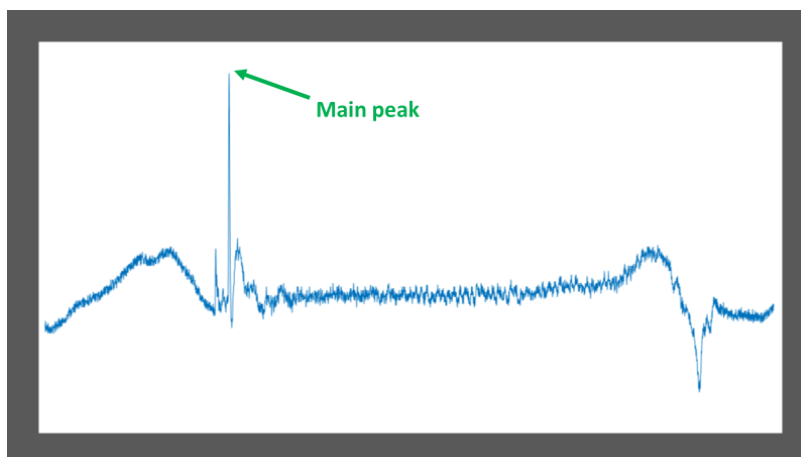
Figure 3: Example of a single frame isolated from the whole raw accelerometer signal. The detected main peak is indicated by a green arrow.

STEP 3: Heel strike detection

1) Creates new frames centralized on every main peak detected (includes X1 data points before and after the main peak, defined by variable *window1*)

2) Calculates the location of every minor peak within a window of X2 data points (defined by variable *window2*) before the main peak

3) Calculates the location of the max of the minor peaks (= heel strike, Figure 4)
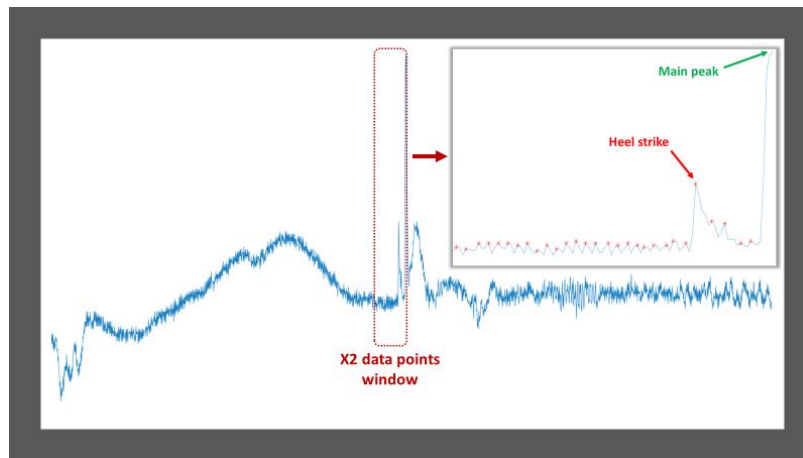
Figure 4: Example of a new frame centralized on the main peak. The window of X2 data points is shown in red, along with the correspond calculated peaks and heel strike location (in red).