Politecnico di Torino

In collaboration with:

SUPSI

GAIT User Guide

Version 1.2023

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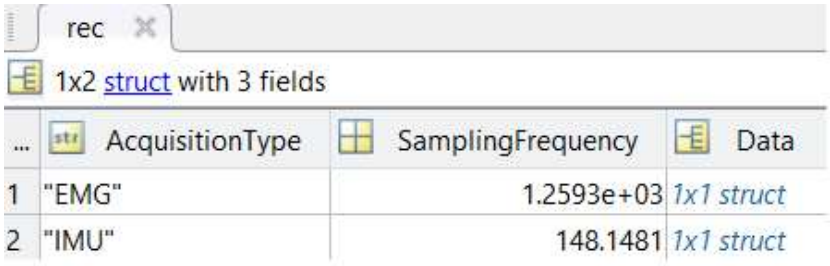
Contents

1. Loading Data

The file designated for the gait analysis must be a structure array named as "rec" (see Fig. 1), and it must have the following fields:

1. "AcquisitionType" - Indicating whether the signals were obtained from IMU or EMG.
2. "SamplingFrequency" - The sample frequency utilized by the acquisition system must be specified.
3. "Data" - Numerical arrays representing the signals must be entered in this field. The naming of individual signals is at the discretion of the user.



rec

1x2 struct with 3 fields

...	AcquisitionType	SamplingFrequency	Data
1	"EMG"	1.2593e+03	1x1 struct
2	"IMU"	148.1481	1x1 struct

Figure 1: "rec" struct file

Upon executing the code, the user is prompted to load the struct file referred to as "rec", and to specify whether EMG signals should be included. Subsequently, all IMU signals contained within the struct file will be displayed (see Fig. 2). The user, after identifying the gyroscope signal that corresponds to the mid-lateral axis of the body, should press the enter key to display a list-box for signal selection (see Fig. 3).

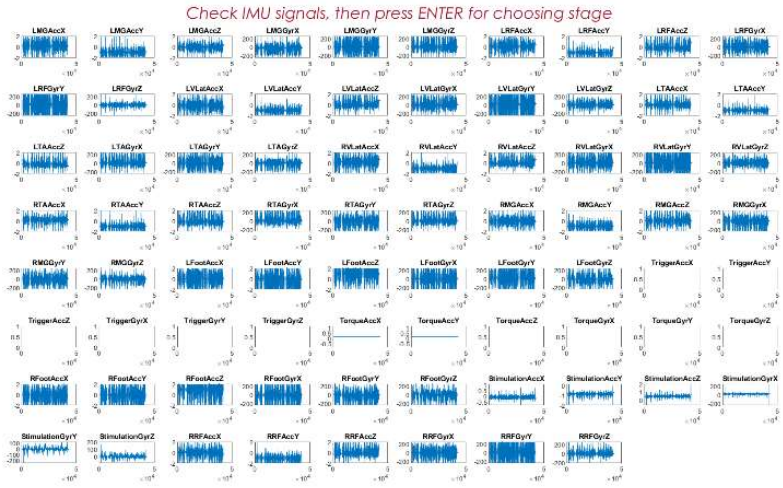


Figure 2: displaying IMU signals contained in "rec" struct file in the "Data" field

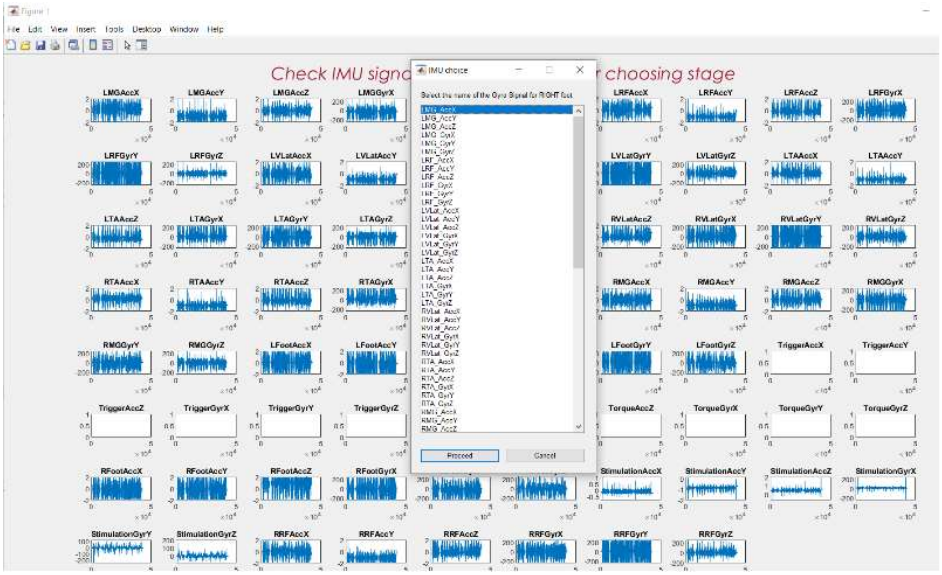


Figure 3: list box containing all file included in "rec" struct file in the "Data" field

2. Smoothing Signal

Four plots representing various lengths of the moving average filter window will be presented (refer to Figure 4). As previously described, by pressing enter, the user will have the option to select one of the four signals by clicking the appropriate ID number, as shown in Figure 5.

Figure 4: Display of filtered signals with different window lengths

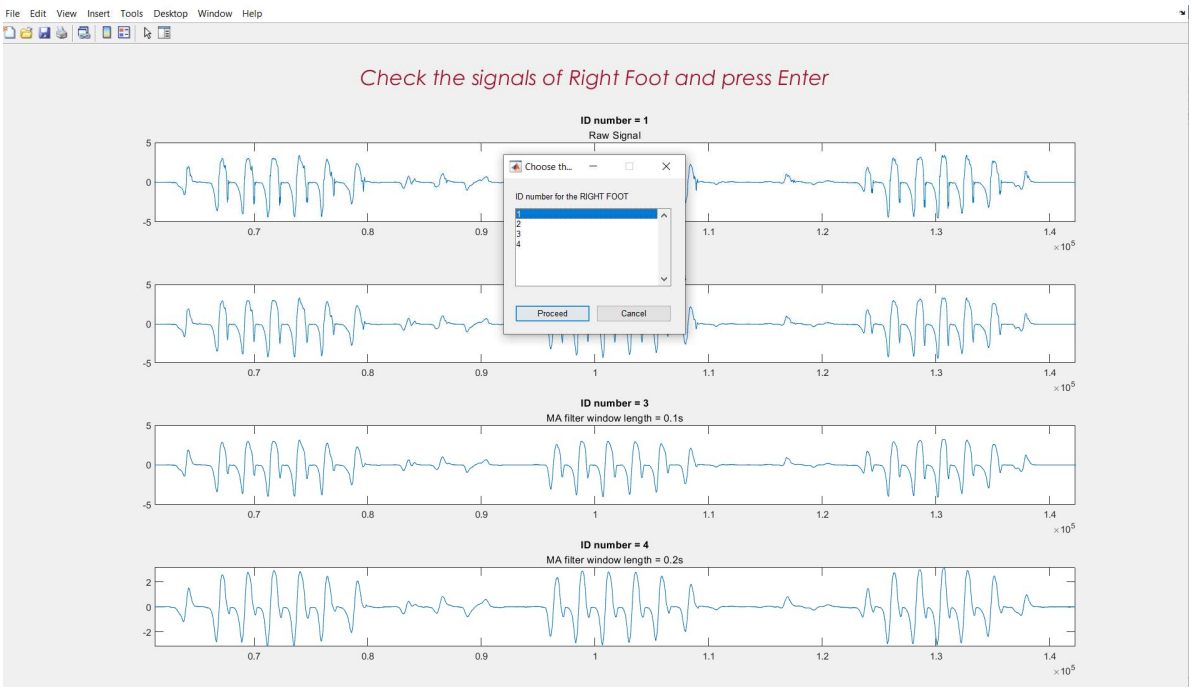


Figure 5: List-box by which the user can choose the filtered signal. Corresponding ID number is given in the title of each Matlab plot.

3. Gait Segmentation

The user will have the option to zoom in on the display for the purpose of verifying if the segmentation of the walking repetitions has been correctly identified by the algorithm (Fig 6- 7). Upon completing the examination, the user may select their desired option from a query dialog box (Fig. 8) regarding the segmentation:

1. "Accept": to accept the segmentation as identified by the algorithm.
2. "Choose which ones to change": to make modifications to specific repetitions segmented by the algorithm.
3. "Change all": to undertake a new walk segmentation process.

Figure 6: Signal display with walk segmentation detected by the algorithm. The user can zoom in to check whether the time instants chosen as the beginning and end of each "rep" have been properly placed. Example of signal display with zoomed segmentation on "reps" 1-2-3 in Fig. 7

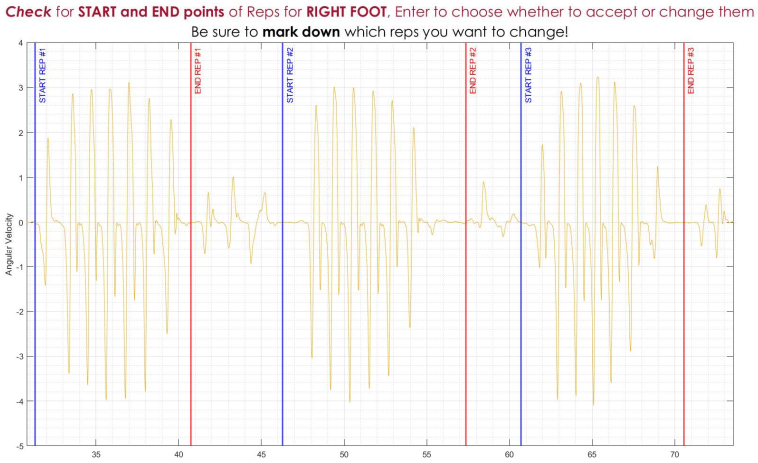


Figure 7

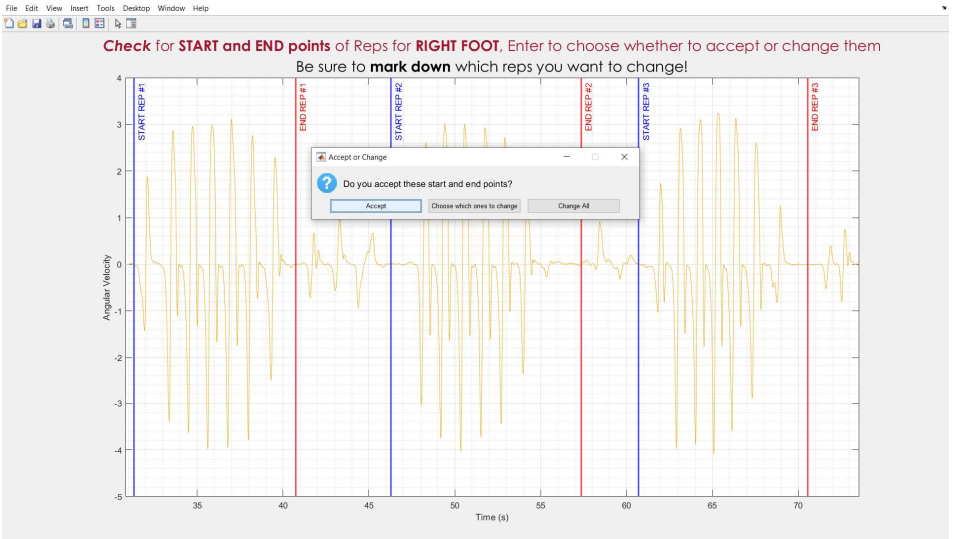


Figure 8: Question dialog box with which the user can implement the 3 choices: "Accept," "Choose which ones to change," and "Change All."

3.1 "Choose which ones to change"

The user will have the option to select which "rep" of the walk they wish to modify from a list (see Fig. 9). To make multiple selections, the control key must be held down. Subsequently, the zoomed view of the selected "rep" will be displayed, and the point to be edited will be indicated with a red vertical line. The modification of the point can be performed by positioning the cursor's vertical line on the desired point on the plot, executing a c, and subsequently pressing the enter key. (Fig. 10-11).

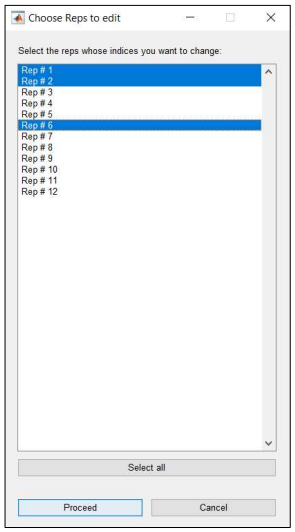


Figure 9: List box by which the user can choose the "rep" to change. For multiple choice hold down the ctrl key

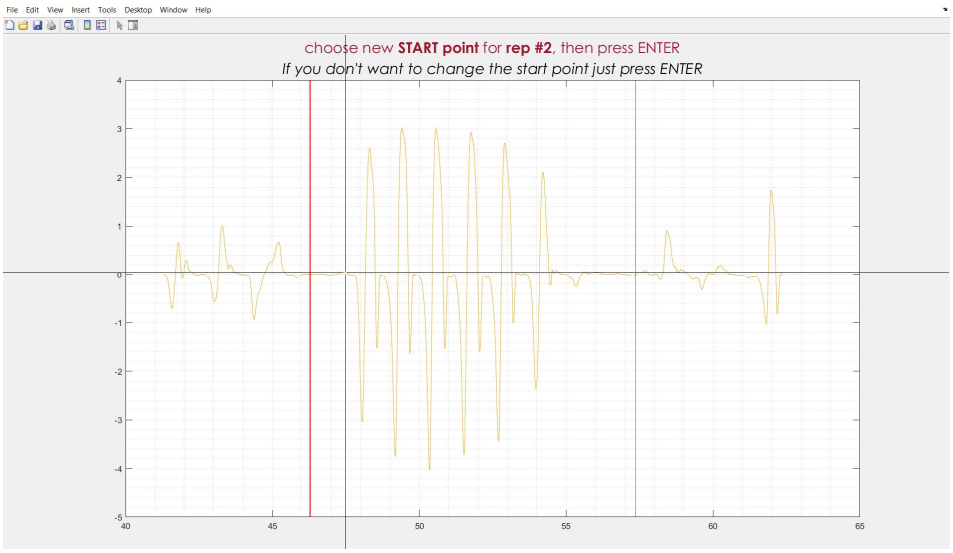


Figure 10: Example of changing the instants corresponding to the beginning of the second "rep". With the red line is represented the instant that is currently being changed

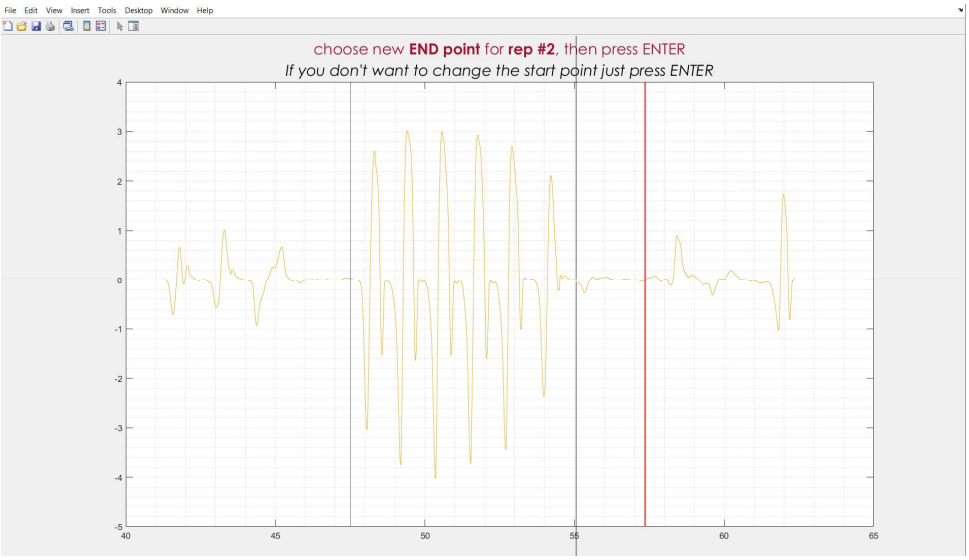


Figure 11: Example of changing the instants corresponding to the end of the second "rep". With the red line is represented the instant that is currently being changed

3.2 "Change all"

Position the vertical line of the cursor at the starting point on the plot of the first repetition, left-click with the mouse and then press the enter key. Repeat the same procedure for the ending instant of the first repetition. Select the "continue" button to proceed to a new repetition or the "end" button to finish the segmentation process. (Fig. 12-13-14)

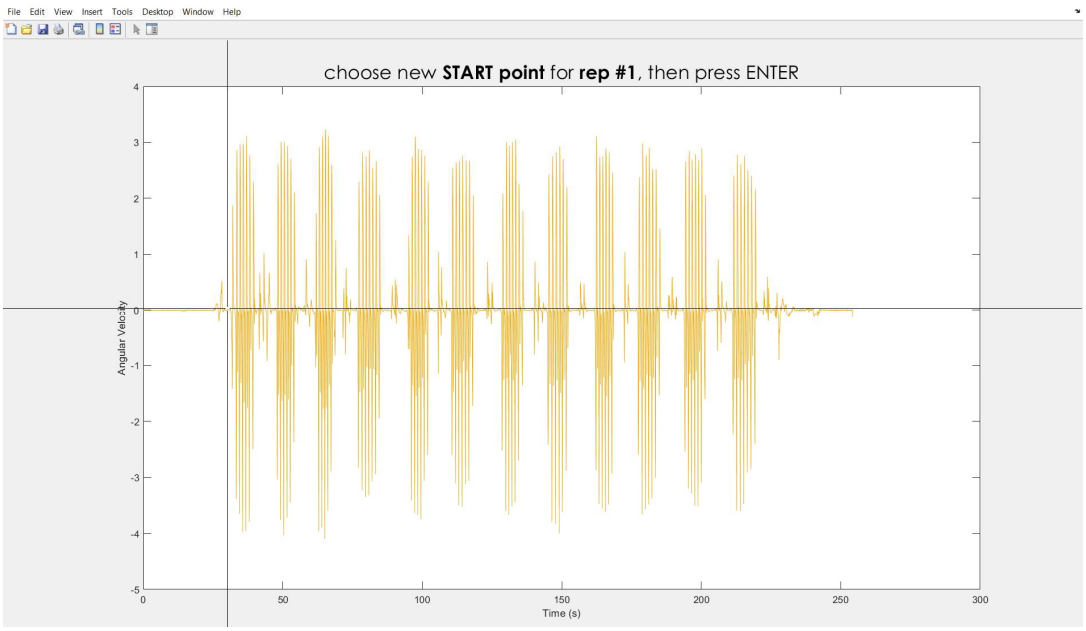


Figure 12: Example of segmentation performed from scratch. In the figure is positioned the instant of the beginning of the first "rep"

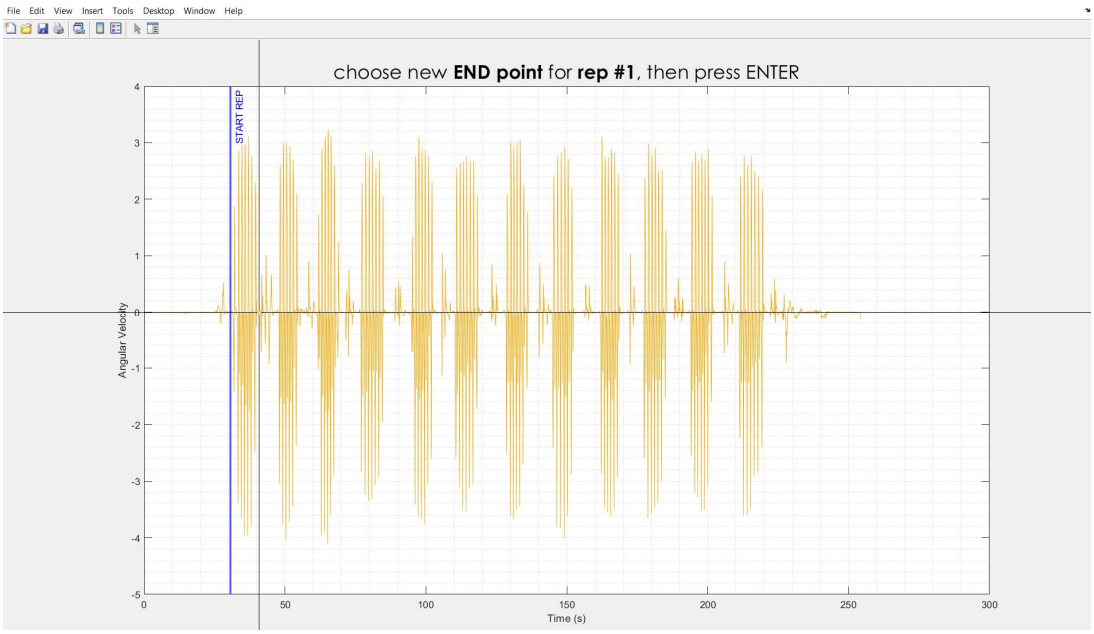


Figure 13: Example of segmentation performed from scratch. In the figure is positioned the instant of the end of the first "rep"

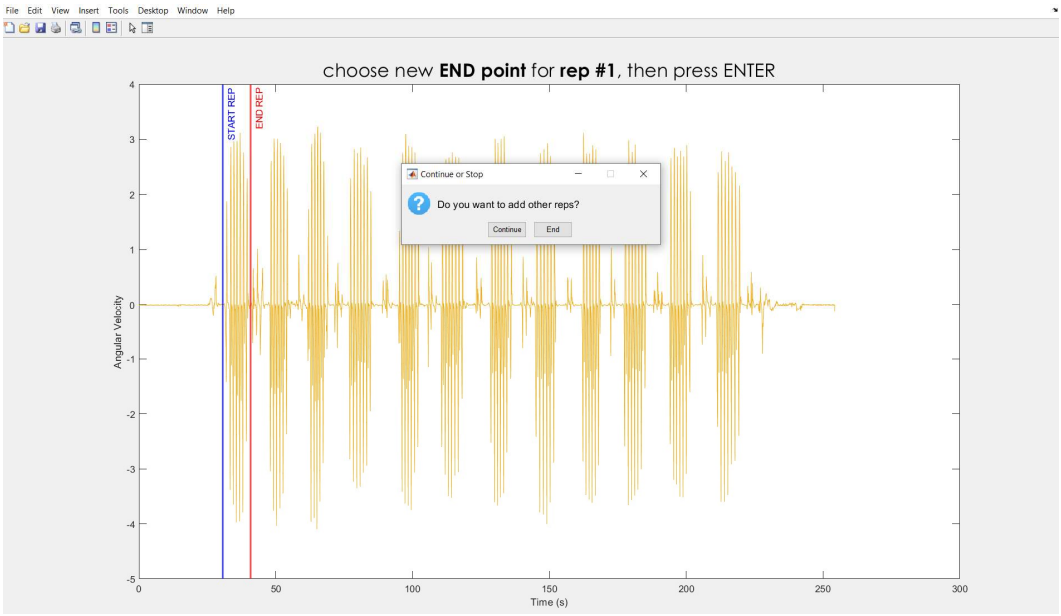


Figure 14: Once the corresponding instants are placed at the beginning and end of a "rep" it will be asked whether the user wants to continue adding more ("Continue" button) or end the segmentation ("End" button)

4. Manual Correction

The user can sequentially view all the "reps" plotted with the events detected by the algorithm (Fig. 15) and undertake for each of them these 4 choices:

- **Change “rep”**: if no changes are desired for the current repetition, just press the Enter key.
- **Deletion of an event**: position the cursor on the intended event to be deleted and left-click with the mouse
- **Addition of a Heel Strike**: position the cursor at the desired location on the plot and press the 'H' key.
- **Addition of a Toe Off**: position the cursor at the desired location on the plot and press the 'T' key.

After completing the editing for a “rep” click the enter button to view the editing and to be able to choose whether to change the “rep” or re-edit the current one (Fig. 16)

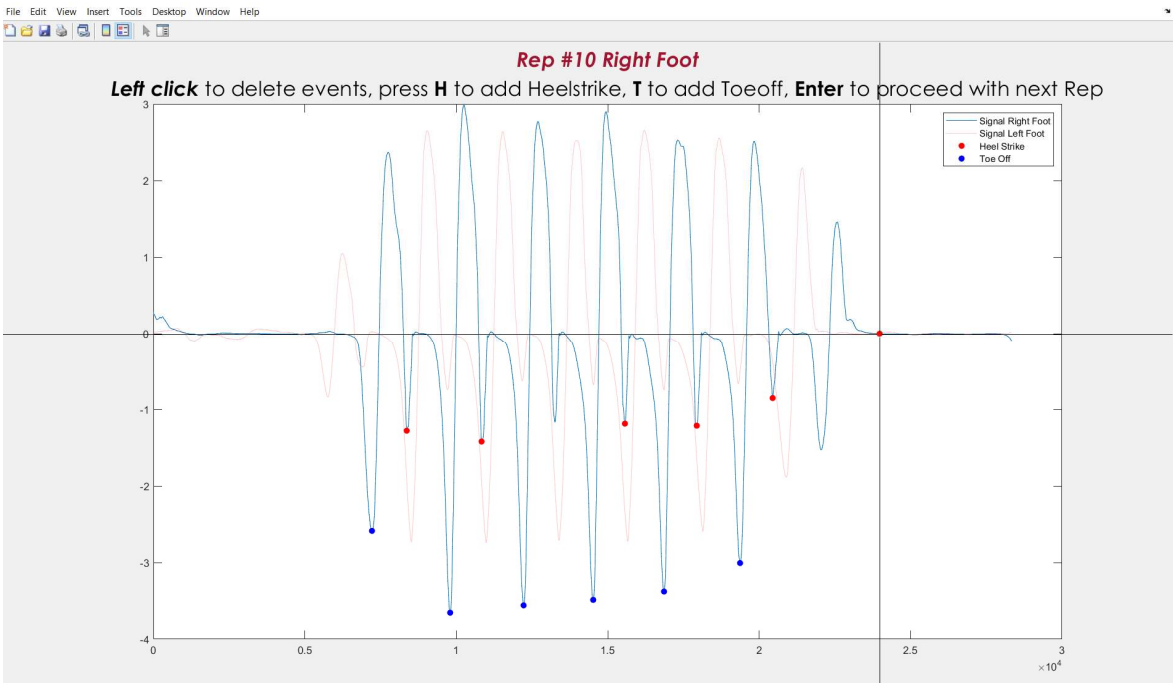


Figure 15: Example of a “rep” that requires modification by the user

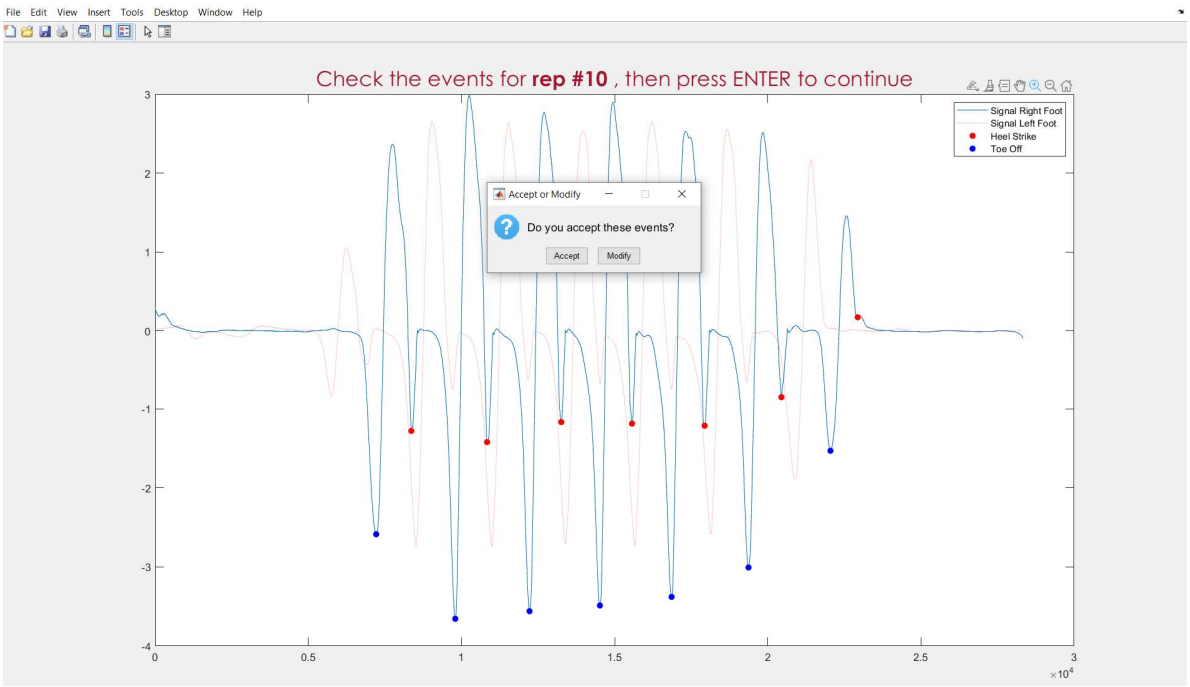


Figure 16: "rep" of Fig.15 after modifications