Short Manual for the EMG-Extractor

https://github.com/FEEDEXP/EMG-Extractor

A method to discriminate EMG regions from noise regions with a Bayesian model
Implemented in MATLAB (The MathWorks Inc., Natick, MA, 2000)
written by
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If you use the EMG-Extractor, please refer to:
Ying R. and Wall C. E. 2016. A method for discrimination of noise and EMG signal regions recorded during rhythmic behaviors. Journal of Biomechanics 49:4113-4118.
http://dx.doi.org/10.1016/j.jbiomech.2016.10.010

The EMG-Extractor is a set of MATLAB scripts that is currently implemented to process **one (1) channel of raw EMG data saved in .csv format**. The EMG-Extractor can be adapted to process multi-channel datasets (e.g., by modifying the **highPass.m** script, see below for a more detailed description).

First, you may need to re-set some or all of the user-defined options prior to running the EMG-Extractor. The EMG-Extractor is very sensitive to sampling rate, and the default settings have been optimized for use on EMGs collected at 10 KHz during chewing. The user-defined options can be changed in the **set_opt.m** script (see below for a more detailed description). After you re-set the options, the EMG-Extractor is run from the **EMG_driver.m** script (see below for a more detailed description).

Scripts:

set_opt.m

This script includes a number of options that you will need to set prior to running the main script (which is EMG_driver.m). There are explanatory comments in the script that should be read prior to making decisions to change default values.

1. Provide the filename that you want to analyze. The file should reside in a folder named '\data' that is in the path.
2. Set the EMG sampling rate. The default is 10 KHz (samples per second).

The EMG-Extractor method is very sensitive to sampling rate because it uses several window sizes to run the Thextonizer, generate the noise model, and perform post processing.

After setting the sampling rate, the variable 'ratio' will automatically adjust the variables 'opt.allowedGap' and 'opt.thextonizerHwSize'. You can further adjust these variables if desired.

3. If desired, you can modify 'opt.winSize', 'opt.posteriorThreshold', 'opt.signalLenThresh', and 'opt.ambiguousLen'. These variables are currently set at values that give excellent results for the EMGs that we have tested at 10 KHz.
4. The variable 'opt.posteriorThreshold' sets the sensitivity of the Bayesian algorithm for determining onset and offset (default=10). The higher the sensitivity (the lower the value of the threshold) will cause the algorithm to find onsets and offsets that differ by very small amounts from noise.

EMG_driver.m

This is the “parent” script that runs the EMG-Extractor. All subsequent scripts are called by the EMG-driver. These scripts are:

importSignal.m This is currently implemented (1) to bring in the first channel of the .csv file, (2) call in the script **highPass.m**, and (3) run a high pass (> 100 Hz) filter. If you would like to bring in more channels in the .csv file, you can modify this script.

noiseModel.m This script and the scripts that it calls up run the Thexton (1996) “thextonizer” method in order to generate a rough noise model.

The scripts that are called by noiseModel.m are:

countThresholdcrossing.m
der3pt.m
extractExtrema.m
integrateEMG.m
roughNoise.m
thextonizer.m

post_processing.m

This script finds the onsets and offsets according to the algorithms developed by Rex Ying. It calls several sub-routines including **findGap.m**.

It outputs the points at which the EMG-Extractor estimates onsets and offsets to occur into a .csv file.

A Note about Additional MATLAB scripts: The GitHub repository (https://github.com/FEEDEXP/EMG-Extractor) includes three additional MATLAB scripts for (1) running the Thexton (1996) method separately (post_thextonizer.m), (2) for integrating raw EMG using a root-mean-square algorithm (EMGcompute.m), and (3) for visualizing output in .tiff format (print_visualizations.m).