# Readme document for “Designing high-resolution time-frequency and time-scale distributions for the analysis and classification of non-stationary signals: a tutorial review with features performance comparison”[[1]](#footnote-1)

The additional material in this file is provided by B. Boashash and S. Ouelha to assist the reader to better understand the supplementary material of the paper and allow the reader to reproduce the results in the paper. The MATLAB scripts listed below are used to produce the main classification results presented in the paper:

*main.m*

* Description: This script produces the results that are listed in Table 9, of the paper.
* Process: The script is divided into five main stages with different processes:

1. Pre-processing: It starts with loading raw multichannel EEG data, and then filters them using an IIR band pass filter with cut-off frequencies of 0.8 and 12 Hz. After that, filtered data are down sampled from 256 Hz to 32 Hz, and the multichannel scheme is averaged into a single channel. ***N.B.: Due to the size of the EEG data files and the limit imposed by the GitHub website, the EEG data files need to be downloaded from the following link and then placed in the folder “EEGDataSet”:*** [***https://drive.google.com/open?id=0B5Krx2mcHlxqd2thMXVBWUtsTGc***](https://drive.google.com/open?id=0B5Krx2mcHlxqd2thMXVBWUtsTGc)
2. Computing time-frequency distributions (TFDs): Averaged single EEG data are transformed into the time-frequency domain using a specific kernel supplied by the user and selected from the following list of kernels: Wigner-Ville distribution (WVD), Spectrogram (SPEC), Extended modified B-distribution (EMBD), Compact support distribution (CKD), Multi-Directional distribution (MDD), Affine Wigner-Ville distribution (AWVD), Scalogram (SCALO), and Smoothed Pseudo Affine Wigner-Ville distribution (SPAWVD).
3. Feature Extraction: Different features are extracted from the averaged single channel EEG data and its selected TFD transformation. Computed features can be mainly categorized into: signal related features, statistical features, time-frequency features, image features and Wavelet features.
4. Feature Selection: If selected by the user, extracted features can be filtered and sorted with respect to their relevance using a process that combines dimensionality reduction and filtering algorithms. Dimensionality reduction is applied using Maximal Marginal Diversity (MMD), while wrapper feature selection is done using Sequential Floating Forward Search (SFFS).
5. Performance Evaluation: Selected features are used along a random trees classifier to discriminate abnormal EEG from normal patterns. Classification accuracy, sensitivity, specificity, and a confusion matrix are produced for the user inspection.

* Note: TFSAP Toolbox[[2]](#footnote-2) is needed.

1. B. Boashash, Samir Ouelha, Designing high-resolution time-frequency and time-scale distributions for the analysis and classification of non stationary signals: a tutorial review with features performance comparison Digital Signal Processing, 2017. [↑](#footnote-ref-1)
2. TFSAP Toolbox can be found [here](https://github.com/Prof-Boualem-Boashash/TFSAP-7.1-software-package). [↑](#footnote-ref-2)