Supplementary Matlab files for

Chapter6 "Spectral and Time Frequency Analyses"

in the book "EEG Signal Processing and Feature Extraction"

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There are in total 12 Matlab files (9 "*.m" scripts and 3 "*.mat" data files) for Chapter6 "Spectral and Time Frequency Analyses". The file list and the descriptions of these files are provided below.

M-Files	MAT-Files
• demo_periodogram.m • demo_welch.m • demo_multitaper.m • demo_yulear.m • demo_stft.m • subfunc_stft.m • demo_mwt.m • subfunc_mwt.m • demo_erserd.m	• data_eeg.mat • data_vep.mat • data_lep.mat

M-Files

- `demo_periodogram.m`: This script is used to demonstrate how to estimate the spectrum of an EEG signal using the periodogram method. Run this script to read the EEG signal from `data_eeg.mat`, to calculate its periodogram, and to show the results in both linear and logarithmic scales.
- `demo_welch.m`: This script is used to demonstrate how to estimate the spectrum of an EEG signal using the Welch's method. Run this script to read the EEG signal from `data_eeg.mat`, to calculate its Welch spectra with different parameters, and to show the results.
- `demo_multitaper.m`: This script is used to demonstrate how to estimate the spectrum of an EEG signal using the multitaper method. Run this script to read the EEG signal from `data_eeg.mat`, to calculate its multitaper spectra with different parameters, and to show the results.

- `demo_yulear.m`: This script is used to demonstrate how to estimate the spectrum of an EEG signal using the autoregressive (AR) method with the Yule-Walker algorithm. Run this script to read the EEG signal from `data_eeg.mat`, to calculate its AR spectra with different model orders, and to show the results.
- `demo_stft.m`: This script is used to demonstrate how to estimate the time-frequency distribution of a visual evoked potential (VEP) signal using the short-time Fourier transform (STFT). Run this script to read the VEP signal from `data_vep.mat`, to calculate its STFT with different window sizes, and to show the results. This script needs to call a sub-function `subfunc_stft.m`, which is in the same folder.
- `subfunc_stft.m`: This sub-function is used to calculate the STFT of a time-series signal with user-defined parameters. All the exact details of the inputs and outputs of this function are given in the M-file.
- `demo_mwt.m`: This script is used to demonstrate how to estimate the time-frequency distribution of a visual evoked potential (VEP) signal using the continuous wavelet transform (CWT) with Morlet wavelet bases. Run this script to read the VEP signal from `data_vep.mat`, to calculate its CWT with different wavelet parameters, and to show the results. This script needs to call a sub-function `subfunc_mwt.m`, which is in the same folder.
- `subfunc_mwt.m`: This sub-function is used to calculate the CWT of a time-series signal using Morlet wavelet bases with user-defined parameters. All the exact details of the inputs and outputs of this function are given in the M-file.
- `demo_erserd.m`: This script is used to demonstrate how to estimate event-related synchronization/desynchronization (ERS/ERD) of multiple trials of laser evoked potential (LEP) signals using STFT. Run this script to read the LEP trials from `data_lep.mat`, to calculate their time-frequency distributions of power and phase, to perform baseline correction (with four possible approaches), and to show the results of LEP, ERS/ERD, and phase locking values (PLV). This script needs to call a sub-function `subfunc_stft.m`, which is in the same folder.

MAT-Files

- `data_eeg.m`: This EEG data file contains two variables.
  - `x`: a short-period EEG trial (with 480 time points) recorded in the eyes-closed condition at Oz;
  - `Fs`: the sampling rate of the EEG signal, which is 160Hz.

- `data_vep.m`: This VEP data file contains three variables.
  - `x`: VEP data (512 time points);
  - `Fs`: the sampling rate of the VEP data, which is 250Hz;
  - `t`: time indices of the VEP data (256 pre-stimulus samples and 256 post-stimulus samples, with a time interval of `1/Fs`).

NOTE

The original VEP data are obtained from https://vis.caltech.edu/~rodri/data/cg_o1t.asc.

See https://vis.caltech.edu/~rodri/data.htm for more details about the data.

- `data_lep.m`: This LEP data file contains three variables.
  - `x`: LEP data with a dimensionality of 512×74 (512: number of time points, 74: number of trials), recorded at contra-lateral EEG electrodes (C3 or C4);
  - `Fs`: the sampling rate of the LEP data, which is 256Hz;
  - `t`: time indices of the LEP data (256 pre-stimulus samples and 256 post-stimulus samples, with a time interval of `1/Fs`).

NOTE

More details about the LEP data can be found in Zhang, Hu, et al. "Gamma-Band Oscillations in the Primary Somatosensory Cortex—A Direct and Obligatory Correlate of Subjective Pain Intensity", Journal of Neuroscience, vol. 32, no. 22, pp. 7429-7438, May 2012.

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