Biomedical Signal Processing
EEG Project Description

February 2022

1. Administration

This project work is mandatory for passing the course. The work may be done in a group and your project is evaluated through the final report. The Project report should be written in the IEEE template.

2. Project Description

In this project, you have access to 5 EDF files including ECG, EEG, EMG, EOG, Body Position, SaP2, and thoracic and abdominal respiration. In addition, you have access to the annotation of sleep stages, disturbances and sleep apnea events according to the AASM manual. You should design and implement different signal processing and analysis blocks to find the best selection of algorithms to extract features suitable for sleep scoring.

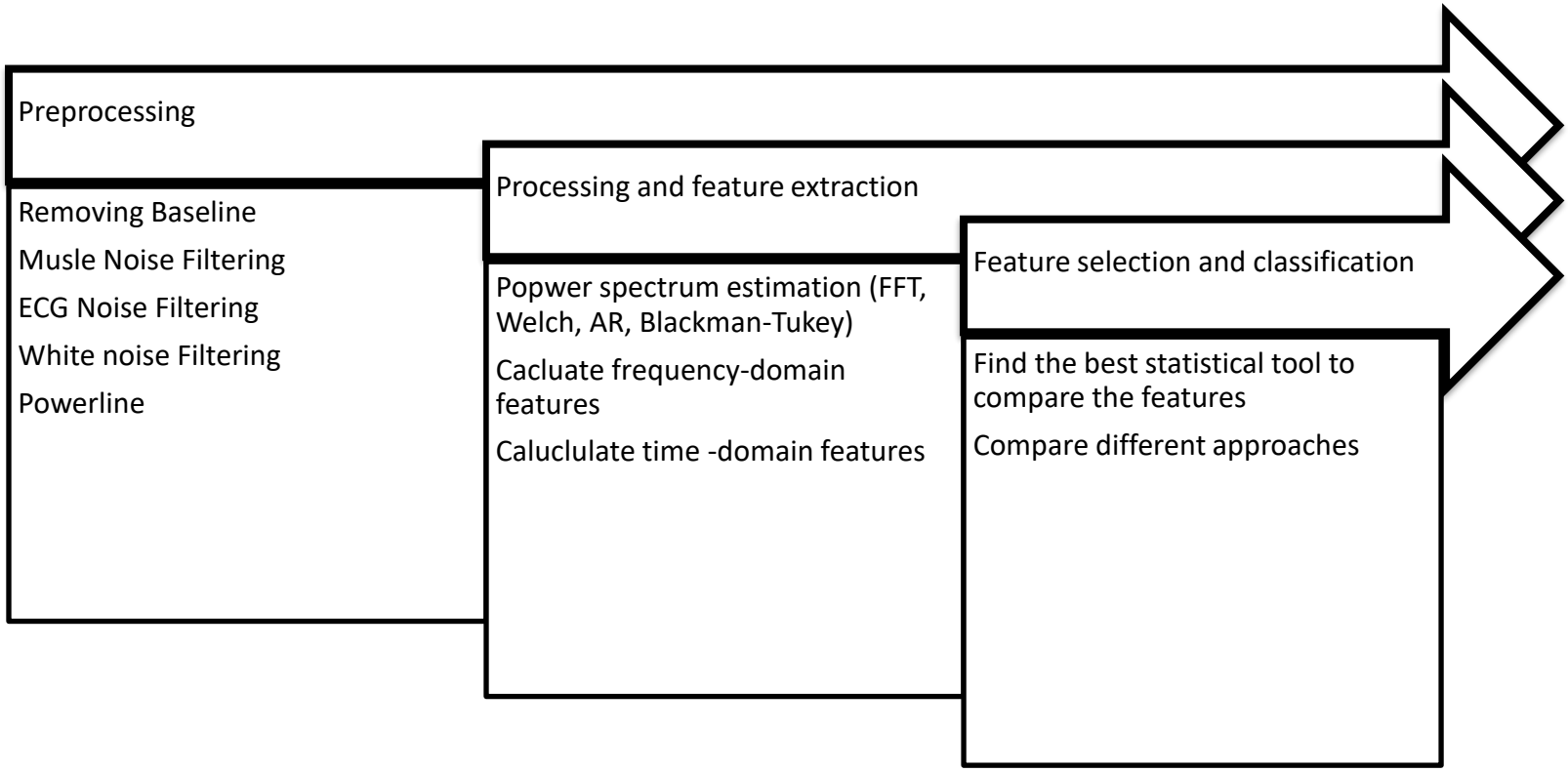
3. Tasks

a. Study the existing artifacts in the signals
b. Implement pre-processing methods with at least two approaches
c. Implement proper methods for extracting spectral features (at least one non-parametric and one parametric method)
d. Extract some time/frequency domain features for each epoch of signal
e. Statistically, check the implemented features between different sleep stages
f. Use a machine learning approach e.g., KNN, SVM or Shallow Neural Network and calculate confusion matrix for training and test sets
g. Repeat the tasks c-h with potential modifications and compare the result of different approaches
h. Suggest the best combination of EEG signal processing steps which can be used for EEG only sleep staging; is there any significant difference from using alternative methods for each block? There is not a “best approach” to these choices, but you have to motivate your choice!

Hints

1. You may find the following feature interesting:
   - Power in different EEG frequency-bands (alpha, beta, gamma, delta, and theta)
   - Spectral edge frequency
   - The power at certain frequencies, for example {1,2,3,4,5} Hz
   - Spectral flux
   - Check for other features from lectures
   - What about looking for features from the Wavelet domain?
2. Recordings are in EDF format, read them with edfread.m but save them as mat file for saving time
3. Annotations are in XML format, use xml_read.m

Note: You may find some ready to use MATLAB source codes for some parts but you need a deep understanding to do the tasks!


Preprocessing
Removing Baseline
Musle Noise Filtering
ECG Noise Filtering
White noise Filtering
Powerline
Processing and feature extraction
Popwer spectrum estimation (FFT, Welch, AR, Blackman-Tukey)
Cacluate frequency-domain features
Caluclulate time -domain features
Feature selection and classification
Find the best statistical tool to compare the features
Compare different approaches