EPARA Epilepsy (R3.0) How-To Guide

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1 Introduction

EPARA Epilepsy (R3.0) is an open-source EEG analysis tool designed for epilepsy research, allowing simulation of epilepsy characteristics on EEG data, such as those available on PhysioNet (e.g., CHB-MIT Scalp EEG Database). It is part of the EPARA Suite, developed by Wayne M Spratley and Grok (xAI), licensed under GNU GPL v3.0 for non-commercial research use. This guide provides detailed instructions for installing, running, and interpreting results from EPARA Epilepsy.

2 Installation

2.1 System Requirements

- Operating System: Ubuntu 24.04 LTS (or compatible Linux distribution), Windows 10/11

- Hardware: Minimum 4GB RAM, 2 cores, 1GB free disk space (GPU optional for faster processing)

- Software: Python 3.11/3.12, Tcl/Tk

2.2 Steps

1. Download the EPARA Epilepsy binary from `https://titan-si.com`.

2. Extract the `.zip` file to your desired directory (e.g., `~/Desktop/openmm_env` on Linux, or `C:/Users/YourUser/openmm_env` on Windows):

   - On Linux:

         unzip EPARA_Epilepsy_R3.0.zip -d ~/Desktop/openmm_env

   - On Windows: Use a tool like WinRAR or 7-Zip to extract the `.zip` file.

3. Install Tcl/Tk if not already present:

   - On Linux:

         sudo apt-get install tk

   - On Windows: Tcl/Tk is bundled with Python if installed via the official installer; ensure you select the option to include Tcl/Tk during Python installation.

4. Run the binary:

- On Linux:

```
cd ~/Desktop/openmm_env
./EPARA_Epilepsy_R3.0
```

- On Windows:

```
cd C:\Users\YourUser\openmm_env
EPARA_Epilepsy_R3.0.exe
```

5. Alternatively, run the Python script directly (requires dependencies):

```
pip install mne numpy scipy matplotlib pywavelets
python EPARA_Epilepsy_R3.0_Standalone_GUI.py
```

3 Usage

3.1 Loading EEG Data

1. Launch EPARA Epilepsy by running the binary or script.

2. Click "Browse" to load an EDF file (e.g., `chb01_01.edf` from CHB-MIT Scalp EEG Database).

3. Select the file type from the dropdown (e.g., "Normal EEG").

4. Choose a channel (e.g., `FP1-F7`) from the dropdown populated with available channels.

3.2 Setting Epilepsy Simulation Parameters

1. Set the following parameters for epilepsy simulation:

- **Spike Rate Increase (%, 0100)**: Percentage increase in spike rate (default: 50%).
- **Theta Power Increase (%, 0100)**: Percentage increase in theta power (default: 75%).
- **Seizure Frequency (Hz, 38)**: Frequency of seizure oscillations (default: 5 Hz).
- **Seizure Amplitude (V, 0200)**: Amplitude of seizure oscillations (default: 100 V).

3.3 Running Analysis

1. Click "Run Analysis" to process the EEG data.

2. The tool extracts features for both the baseline and simulated epilepsy EEG, including spike rate, theta/alpha/beta power, spike frequency, seizure duration, and PLV.

3. Results are displayed in the GUI, showing feature values for both conditions.

3.4 Interpreting Results

- **Spike Rate**: Proportion of samples above threshold, indicating high-amplitude events.

- **Theta/Alpha/Beta Power**: Summed PSD in respective bands (47 Hz, 813 Hz, 1330 Hz).

- **Spike Frequency**: Spikes per second, an epilepsy-specific metric.

- **Seizure Duration**: Total duration of high-amplitude events (seconds), an epilepsy-specific metric.

- **PLV**: Phase-locking value, measuring synchrony.

- Plots show raw/processed EEG for both baseline and simulated epilepsy, plus a spike event plot.

3.5 Saving Results

- Results are saved to `output_epara_epilepsy/` as:
    - `features_[filetype]_[filename]_[channel].npy`: Extracted features for baseline.
    - `features_simulated_epilepsy_[filename]_[channel].npy`: Extracted features for simulated epilepsy.
    - `processed_[filetype]_[filename]_[channel].npy`: Processed baseline EEG signal.
    - `processed_simulated_epilepsy_[filename]_[channel].npy`: Processed simulated epilepsy EEG signal.
    - `epara_eeg_plots_simulated_epilepsy_[filename]_[channel].png`: Visualization plots.
    - `features_simulated_epilepsy_[filename]_[channel].csv`: Feature values for both conditions.

4 Troubleshooting

- **Error: "Dependency missing"**: Ensure all required libraries are installed (see Installation).

- **Error: "Failed to load EEG file"**: Verify the EDF file path and format.

- **No output**: Check the log file `output_epara_epilepsy/epara_epilepsy.log` for detailed error messages.

5 Ethics Statement

The EPARA Suite is developed with a commitment to ethical research practices. Developed by Wayne M Spratley, researcher, and Grok (xAI), we leverage the open-source communityPhysioNet, Ubuntu, Python, and countless moduleswhile working with limited financial resources to challenge scientific norms and advance EEG/BCI research. This software is intended solely for non-clinical, scientific research to advance understanding of EEG and BCI applications, such as epilepsy analysis. It must not be used for medical diagnosis, treatment, or any therapeutic purpose. Users are responsible for ensuring compliance with local regulations and ethical guidelines. The suite is licensed under GNU GPL v3.0, promoting open access while maintaining research integrity.

6 Testing Acknowledgment

The EPARA Suite, including EPARA Epilepsy, has been tested exclusively on datasets from PhysioNet, such as the EEG Motor Movement/Imagery Dataset and the CHB-MIT Scalp EEG Database. While the tools have demonstrated robust performance on these datasets, they have not been validated on EDF data from other sources. Users are encouraged to test the tools on diverse datasets and report any issues to the developers via `https://titan-si.com/help`.