**Projects:**

1. EEG Pattern modeling and feature extraction.
2. IMU - Accelerometers step modeling.
3. IMU - Gyroscope step modeling.
4. Spatial movement step modeling.
5. Gait parameters extraction.
6. fNIRS denoising and correlation testing

**All of the algorithms must be generic!**

**EEG Pattern modeling and feature extraction.**

1. EEG pattern modeling:

* Calculate Mean Signal pattern between all of the subjects
* Calculate STD Signal pattern between all of the subjects
* You are not allowed to filter the regions of interest eg. N100, P200, N200 P300
* You must filter everything outside of the regions of interest
* When calculating Mean and STD, you must shift each signals so that the regions of interest are best matched in terms of their location and only then calculate the signal statistical patterns (use interpolation where needed).
* Present graph of Mean and STD as done in literature.

2. EEG feature extraction:

Calculate the following features:

* N100 peak time
* P200 peak time
* N200 peak time
* P300 peak time
* Elapsed time of each of the ERPs (N100, P200, N200, P300)
* Mean Value and a Variance of ERPs elapsed times of different subjects

**IMU - Accelerometers step modeling.**

1. Accelerometers step modeling

* Separate each step within the trial from the others using height accelerometer and present the separation to steps for all of the accelerometers based on the height accelerometer.
* From the calculated steps, remove all of the abnormal ones.
* Calculate the Mean signal pattern for each axis.
* Calculate STD signal pattern for each axis.
* Use interpolation for statistics mentioned above.
* Present graph of Mean and STD as done in literature.

2. Accelerometers step modeling

* Separate each step within the trial from the others using accelerometer other then height acceleration measuring one and present the separation to steps for all of the accelerometers based on the chosen one.
* From the calculated steps, remove all of the abnormal ones.
* Calculate Median signal pattern for each axis.
* Calculate Percentiles 10 and 90 patterns for each axis.
* Use interpolation for statistics mentioned above.
* Present graph of Median and Percentiles as done in the literature.

**IMU - Gyroscope step modeling.**

1. Gyroscope step modeling

* Separate each step within the trial from the others using first gyroscope and present the separation to steps for all of the gyroscopes based on the first one.
* From the calculated steps, remove all of the abnormal ones.
* Calculate the Mean signal pattern for each axis.
* Calculate STD signal pattern for each axis.
* Use interpolation for statistics mentioned above.
* Present graph of Mean and STD as done in literature.

2. Gyroscope step modeling

* Separate each step within the trial from the others using third gyroscope and present the separation to steps for all of the gyroscopes based on the third one.
* From the calculated steps, remove all of the abnormal ones.
* Calculate Median signal pattern for each axis.
* Calculate Percentiles 10 and 90 patterns for each axis.
* Use interpolation for statistics mentioned above.
* Present graph of Median and Percentiles as done in the literature.

**Spatial movement step modeling.**

1. Spatial movement step modeling

* Separate each step within the trial from the others using Y axis and present the separation to steps for all of the axes based on Y.
* From the calculated steps, remove all of the abnormal ones.
* Calculate the Mean signal pattern for each axis.
* Calculate STD signal pattern for each axis.
* Use interpolation for statistics mentioned above.
* Present graph of Mean and STD as done in literature.

2. Spatial movement step modeling

* Separate each step within the trial from the others using Z axis and present the separation to steps for all of the axes based on Z.
* From the calculated steps, remove all of the abnormal ones.
* Calculate Median signal pattern for each axis.
* Calculate Percentiles 10 and 90 patterns for each axis.
* Use interpolation for statistics mentioned above.
* Present graph of Median and Percentiles as done in the literature.

**Gait parameters extraction.**

1. Gait parameters extraction

Calculate the following parameters:

* stride length
* stride height
* stride duration
* mean and variance of stride length, duration and height for obstacle avoidance.
* median and percentiles 10 and 90 of stride length, duration and height for basic walking

2. Gait parameters extraction

Calculate the following parameters:

* distance between feet in mid-stance
* distance between feet in double support
* swing duration and length
* double support duration
* mean and variance of distance between feet in mid-stance and double support.
* median and percentiles 10 and 90 of swing and double support duration and swing length

**fNIRS denoising and correlation testing.**

1. fNIRS denoising and correlation testing

* Filter Heart rate and breathing from the signals.
* Detrand the signals using wavelets.
* Use wavelets to further filter the noise.

2. fNIRS denoising and correlation testing

* Filter Heart rate and breathing from the signals.
* Detrand the signals using DCT.
* Use AMAF to further filter the noise.