

Python Scripts Read Me

These Python codes can be run locally or in Google Colab and will each generate a single seizure simulation along with a mapped projection. To run in colab, you must upload one of the 3 colab notebooks 'Hysteresis.ipynb', 'Slowwave.ipynb', or 'Piecewise.ipynb' to be run. Then, add the following MATLAB files to your Colab workspace: `bifurcation_crossing.mat`, `curves.mat`, `curves2.mat`, `sphere_mesh.mat`, and `testmesh.mat`. To upload these files, click on the folder icon in the left sidebar of Colab, then click the upload button (a file icon with an upward arrow) and select each required file from your local computer. Once uploaded, these files will be accessible within your Colab session, allowing the script to read the necessary data and produce the expected visualizations. The visualizations will appear at the bottom of the script. The video 'Colab-upload-example.mp4' located in this folder shows a succesful upload and run of these python scripts to colab .

Hysteresis Model

Functions

1. **Random_bifurcation_path.m**
 - **Input:** Desired class/dynamotype.
 - **Output:**
 1. Coordinates of a point on the onset curve.
 2. Coordinates of a point on the offset curve.
 3. `sigma`: Appropriate noise amplitude for the selected path.
2. **pinknoise.m**
 - **Input:**
 1. `dim`: Two-component vector specifying output array size.
 2. `beta`: Set to -1.
 3. `sigma`: Desired pink noise amplitude.
 - **Output:** Pink noise array with dimensions `dim` and amplitude `sigma`.
3. **HysteresisLoop_Model.m**
 - **Input:** Model parameters (`x`, `k`, `R`, `dstar`, `E`, `F`, `N`).
 - **Output:** Fast and slow variable arrays (`x1`, `x2`, `z`) for the simulation.
4. **Resting_State.m**
 - **Input:** Model parameters (`mu2`, `mu1`, `nu`, `N`).
 - **Output:** `x` coordinate of the resting state.

5. **Parametrization_2PointsArc.m**

- **Input:**
 1. Point on the onset curve.
 2. Point on the offset curve.
 3. Radius of the model sphere (0.4).
 - **Output:** Arc path through state-space.
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Slow Wave Model

Functions

1. **Bifurcation_one_path.m**

- **Input:** Desired class/dynamotype.
- **Output:**
 1. Coordinates of a point on the onset curve.
 2. Coordinates of a point on the offset curve.
 3. Fixed point coordinates.
 4. sigma: Appropriate noise amplitude for the selected path.

2. **pinknoise.m**

- **Input:**
 1. dim: Two-component vector specifying output array size.
 2. beta: Set to -1.
 3. sigma: Desired pink noise amplitude.
- **Output:** Pink noise array with dimensions dim and amplitude sigma.

3. **SlowWave_Model.m**

- **Input:** Model parameters (x, k, E, F, C, r, p3).
- **Output:** Fast and slow variable arrays (x1, x2, z) for the simulation.

4. **Parametrization_3PointsCircle.m**

- **Input:**
 1. Point on the onset curve.
 2. Point on the offset curve.
 3. Fixed point.
 - **Output:** Circular path through state-space.
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Piecewise Model

Functions

1. `piecewise_random_path.m`

- **Input:** Desired bifurcation value.
- **Output:** Series of 3D points based on the bifurcation value.

2. `sphereArcPath.m`

- **Input:**
 - `k`: Arc generation parameter.
 - `tstep`: Time step for path discretization.
 - `point1`: Starting 3D coordinates.
 - `point2`: Ending 3D coordinates.
- **Output:**
 - `mu2, mu1, nu`: Coordinates of the arc path.
 - `theta`: Angular distance between `point1` and `point2`.

3. `rotation_matrix.m`

- **Input:**
 - `axis`: 3D vector representing the rotation axis.
 - `angle`: Rotation angle (radians).
- **Output:** 3x3 rotation matrix (`R`).

4. `slow_wave_model_piecewise.m`

- **Input:**
 - `x`: State variables [`x`, `y`, `z`].
 - `k`: Speed of change for the `z` variable.
 - `mu2, mu1, nu`: System parameters.
- **Output:**
 - Derivatives of the system (`xdot, ydot, zdot`).
 - Repeated `mu2, mu1, nu`.

5. `pinknoise.m`

- **Input:**
 - `DIM`: Dimensions of the spatial noise (e.g., (`rows`, `cols`)).
 - `BETA`: Controls the noise spectrum (0: White noise, -1: Pink noise, -2: Brownian noise).
 - `MAG`: Amplitude scaling factor.
 - **Output:** 2D array containing the generated noise.
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Data

1. **Curves.mat**: Points for the onset and offset bifurcation curves (hysteresis model).
 2. **curves2.mat**: Points for the onset and offset bifurcation curves (slow wave model).
 3. **Bifurcationcrossing.mat**: Onset and offset points for the piecewise model and map diagram.
 4. **Testmesh.mat**: Mesh for active rest, seizure, and bistable regions.
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