

# TVBii - Fast Virtual Brains

Fast C-implementation of the dynamic mean field model as defined in Deco 2014 JNeuro (without feedback inhibition control).

## Usage

```
./tvbii_<os> <parameter_file> <subject_id>
```

Example:

```
./tvbii_linux param_set_1 UE_20120803
```

- first argument is a text file that contains parameters
- second argument is the subject-id for the input files contained in the folder 'input'
- results are written into folder output, file-schema: **BOLD\_<parameter\_file>.txt**
- the relative folder structure, i.e., the location of the folders 'input' and 'output' relative to the program binary needs to remain stable, otherwise the program won't be able to read or write data
- Subject-specific structural connectivity input files reside in the folder **input**. The prefix **<subject\_id>** must be identical for all three structural connectivity input files per subject
- the number of nodes must be divisible by four. If the number of nodes is not divisible by four, "fake" regions must be added that contain zero coupling to other nodes (all zeros in capacities matrix).

## Order of parameters in parameter file

```
#nodes G J_NMDA w_plus J_i sigma time_steps time_steps_FIC BOLD_TR global_trans_v  
random_number_seed
```

Example:

```
84 1.0 0.15 1.4 1.0 0.001 180000 10000 1940 21.2 42
```

- #nodes, time\_steps, time\_steps\_FIC, BOLD\_TR and random\_number\_seed **must** be integers, the others **must** be floating point numbers
- BOLD\_TR and time\_steps are specified in ms, transmission velocities in m/s (respectively ms/mm)
- All other parameters have the same units as in Deco 2014, JNeuro

- `time_steps_FIC` specifies the number of time steps used for FIC tuning simulations. 10000 time steps (i.e. 10 s) is usually sufficient. If simulation results show sudden "jumps" in activity this might indicate that the length of FIC tuning simulation needs to be increased.

## Notes

- To deactivate time delays set `global_trans_v` to a large value like 999999.9 m/s (such that the longest delay is shorter than the model's sampling period of 0.1 ms).
- The BOLD signal is computed with the Balloon-Windkessel model
- The first line in output BOLD files contains the parameters and the average firing rate over all nodes and time steps

```
G J_NMDA w_plus J_i sigma time_steps global_trans_v avg_firing_rate
```

- It's possible to run multiple instances of the program on one computer. Each instance occupies a CPU with 100 % as long as there are no other processes with higher priority.
- For generating input connectomes use the attached Matlab script "Generate\_TVBi\_input.m" using square capacities and distance matrices as input (distances in mm). Briefly, the format of the created input files is:
  - first line: number of nodes
  - then alternating
    - node id and number of connections
    - connection strength / distance / id of connected node, respectively for each of the three file types
    - distance file additionally contains the longest distance
- Use a higher threshold for capacities matrices to make simulations faster (see Matlab script)
- The program binaries ending on `'_SV'` also output model state variables
  - First column: synaptic activity of excitatory population  $S_i^E$
  - Second column: synaptic activity of inhibitory population  $S_i^I$
  - Third column: firing rate of excitatory population  $r_i^E$
  - Fourth column: firing rate of inhibitory population  $r_i^I$