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| **What is being discussed?** | **Reference** |
| Introduction | |
| *Broad context*  Neurobiological models are used to study synchronous activity which resembles activity of the cortex found in vivo.  There are numerous model types, each with advantages and disadvantages. For examining the activity of large networks, simple neuron models are preferred. Moreover, for the examination of cortical activity a recurrent network is used.  One model is the balanced random network, which is frequently used to study dynamics of large-scale sparsely-connected networks. |  |
| *Social relevance*  Perhaps something about maintaining balance to prevent epilepsy. But not too much about social relevance. Quite a fundamental study. |  |
| *Former research*  The balanced network is examined extensively and four states are classified based on synchrony and regularity. The state of a network is mostly based on the amount of external input and the ratio of the conductance of inhibitory and excitatory neurons.  A balanced state is also reached with a network with neurons containing properties more realistic. These neurons contain an differential equation for their conductance as well. | (Brunel & Brunel 2000)  (Yger & Harris 2013) |
| *Scientific relevance*  However, it is not examined whether this type of networks can reach the four states as mentioned in (Brunel & Brunel 2000). Moreover, it is unknown whether the transitions between several states are similar or if the behavior is different. |  |
| *Research question*  It is examined whether the more realistic neuron model can reach different balanced network states and which parameters influence the state transitions and in what manner. |  |
| *Hypothesis*  Blanced state with different states can be reached, but transition will be different because of the difference in the neuron models. |  |
| *Research approach*  As a huge parameter space is faced, simulations of all parameter would not be doable in the given amount of time. So the paper of (Yger & Harris 2013) is used as begin point and it is tried to reach a balanced state. From there on simulations are performed to explore what the influence is of changing parameter values. After exploration, the state transition values are examined by systematically determine the measures of the regularity (CV) and the synchrony (frequency)of networks with different parameter sets. This regularity and synchrony will be quantified so different states can be differentiated. |  |
| *Expectations*  Expected is that exploration simulation will reveal interesting ranges to resume simulations for more detailed analyses. It is expected that these simulation will show differences in regularity and synchrony but it is unexpected if there will be a clear transition between fases or whether these transition will be more continuously. |  |
| Methods | |
| *Simple neuron model*  Simple neuron model, with one differential equation. Specify chosen parameters and give equation. | (Brunel & Brunel 2000) |
| *More complex model*  More complex model with differential equations for conductances. Specify chosen parameters, give equations and explain why a simpler form of the model is used (no complex depolarization mechanism, but a simple reset). | (Yger & Harris 2013) |
| *Simple neuron balanced states*  Give network parameters used for the 4 reached states with the simple neuron model. Also give the calculations for scaling. Perhaps some quantification? Now only judgment of states by naked eye. | (Brunel & Brunel 2000)  (Golomb & Hansel 2000) |
| *More complex neuron balanced states*  Network parameters to reach balanced state. Translation of parameters of Yger to Brunel. Methods of large simulations to explore parameter space. | (Brunel & Brunel 2000; Yger & Harris 2013) |
| *Quantification of different states*  Regularity can be measured by the ISI and the CV can be calculated.  Synchrony can be measured by the total frequency(?)  By performing large simulations within the parameter space, for each parameter set these measures can be calculated. Combining these measures different states can be determined.  Maybe even a 3D plot with color coding can be produced, so there appears a kind of phase diagram. | http://www.yger.net/the-balanced-network/ |
| *--- If time left, further analyses on bursting behavior ---* |  |
| Results | |
| *Balanced network of simple neurons*  Show plots of global activity similar to (Brunel & Brunel 2000). (when code for quantification of other network can be used for this one as well, insert a plot with range of parameters for different states) |  |
| *Balanced network of more complex neurons*  Show plots of global activity of different states (same type of plots as in (Brunel & Brunel 2000)).  Plot of classification of different states by naked eye (explorative search). A sort of phase diagram. |  |
| *Quantification of different states*  Color diagram of the CV of combinations of 2 parameters: gext & ginh, to visualize regularity. Perhaps separation of 2 states with least squares?  Color diagram of the frequency(?) of combinations of 2 parameters: gext & ginh, to visualize synchrony. Perhaps separation of 2 states with least squares?  3D color diagram (4 dimensions) with both parameters, CV and frequency. It shows the 4 different states with continuous data.  Phase diagram with the classification by LS method to show a 2D separation as in (Brunel & Brunel 2000).  Perhaps, if classification is succeeded, show some global activity plots to visualize the transitions between quantified states. |  |
| Discussion | |
| *Summary of results & conclusion*  Primarily focus on the results of the more complex neurons en conclude whether or not the states described in Brunel can be reached by this model. |  |
| *Evaluation and explanation results*  Try the explain the results theoretically: so depending on whether the states can be reached, why is that. What differences in the model could cause this difference or why does a different model have the same properties.  But also, there are made some assumptions translating the Yger model. What the influence be of these translations? Could this have made me draw the wrong conclusion?  Also discuss the results on a methodological way. There is made use of scaling, other software for example. Clould this influenced the results? |  |
| *Feedback to former results*  Involve (Brunel & Brunel 2000; Yger & Harris 2013) and compare results. |  |
| *Feedback to broad context & social relevance*  Try to generalize findings and stress what is not well-founded to generalize. Involve the shortcomings and benefits of computational models in order to make use of the drawn conclusion. |  |
| *Suggestions for future studies*  Depends on the results. Possibilities; other parameters, even more detailed neuron models, STDP/ unsupervised learning. |  |
| *Final conclusion*  Repeat conclusion, use it for best future study and sress relevance of follow-up research. |  |