Modelos Neuronais

Visão Geral

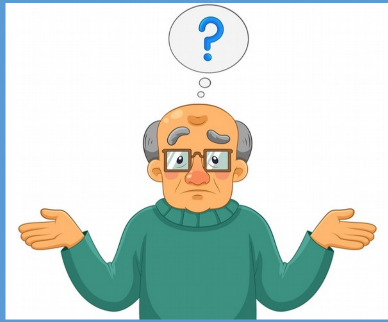
Instituto de Física da Universidade de São Paulo

K.C. Iarosz, F.S. Borges, I.L. Caldas, A.M. Batista, R. R. BorgesE.L. Lameu, M.S. Santos, P.R. Protachevicz, R.C. Bonetti, J.D., R.L. Viana, J. Kurths, M.S. Baptista, Celso Grebogi

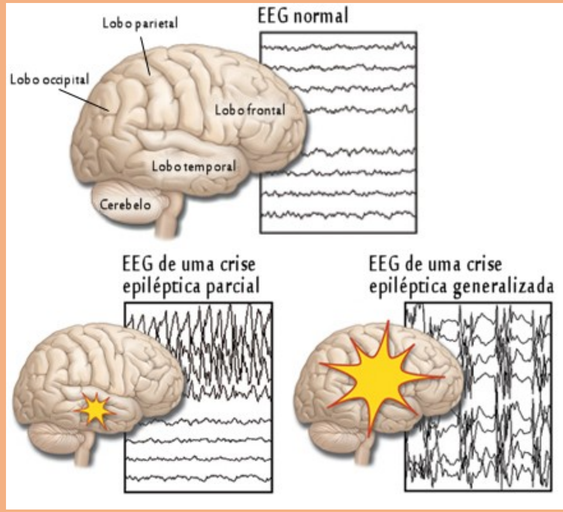
São Paulo – 19/10/2017

Doença de Alzheimer

????



Epilepsia

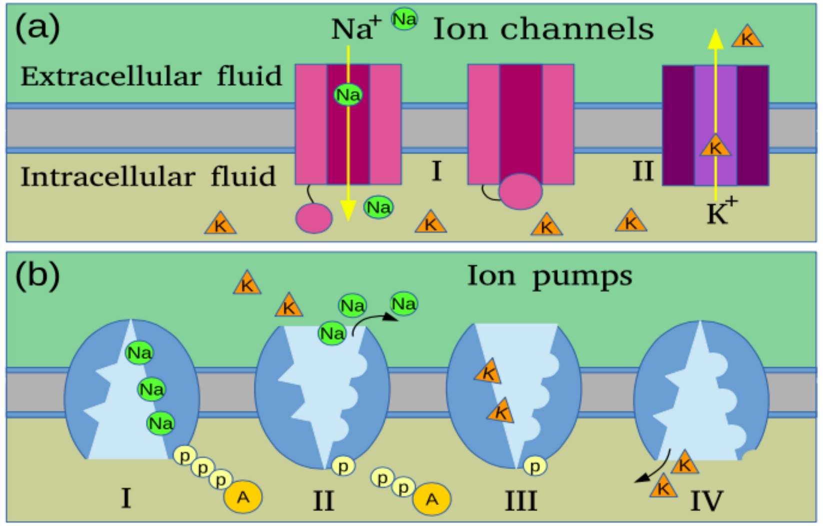


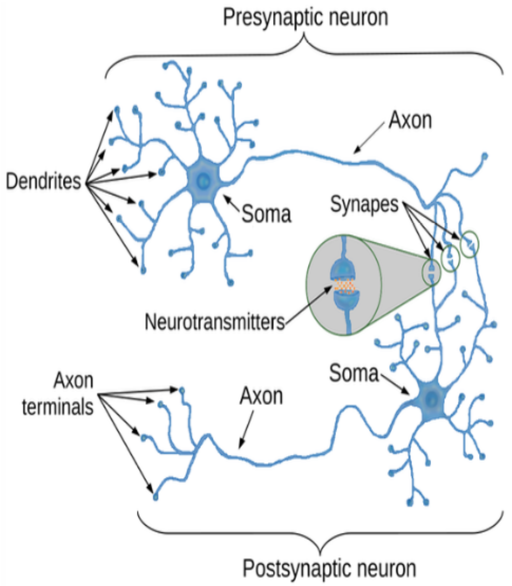
Doença de Parkinson

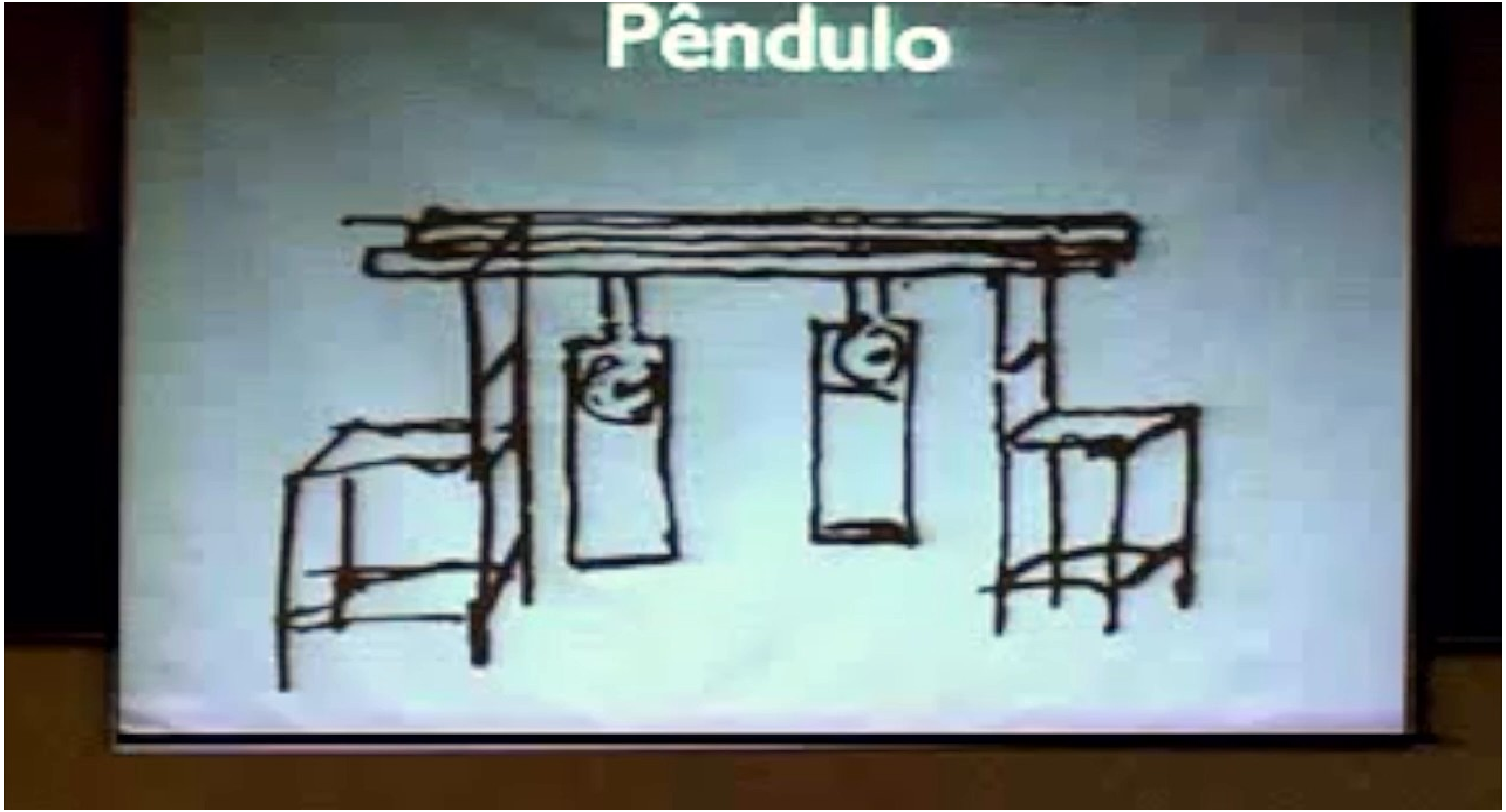
Lesões

General

Problemas → Model → Network → Diagnosis






Pêndulo

Chaos, Solitons and Fractals 101 (2017) 86–91

Contents lists available at ScienceDirect

Chaos, Solitons and Fractals
Nonlinear Science, and Nonequilibrium and Complex Phenomena

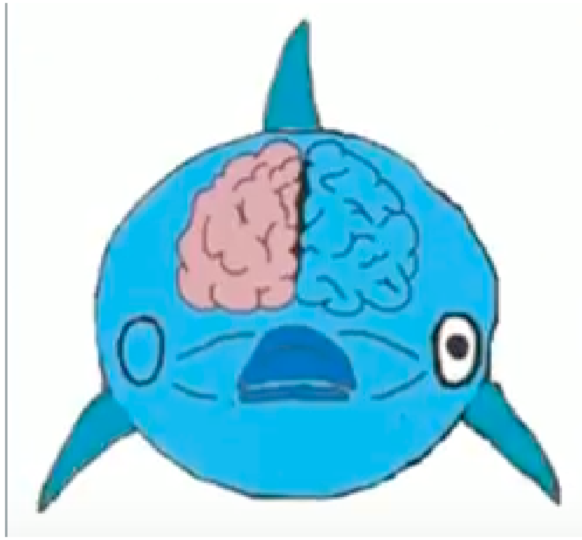
journal homepage: www.elsevier.com/locate/chaos

Chimera-like states in a neuronal network model of the cat brain

M.S. Santos[a], J.D. Szezech[a,b,1], F.S. Borges[c], K.C. Iarosz[c,d], I.L. Caldas[c], A.M. Batista[a,b,c,d,*], R.L. Viana[e], J. Kurths[d,f]

[a] Pós-Graduação em Ciências, Universidade Estadual de Ponta Grossa, Ponta Grossa, PR, Brazil
[b] Departamento de Matemática e Estatística, Universidade Estadual de Ponta Grossa, Ponta Grossa, PR, Brazil
[c] Instituto de Física, Universidade de São Paulo, São Paulo, SP, Brazil
[d] Institute for Complex Systems and Mathematical Biology, Aberdeen, Scotland
[e] Departamento de Física, Universidade Federal do Paraná, Curitiba, PR, Brazil
[f] Department of Physics, Humboldt University, Berlin, Germany; and Potsdam Institute for Climate Impact Research, Potsdam, Germany

350-340 a.C.



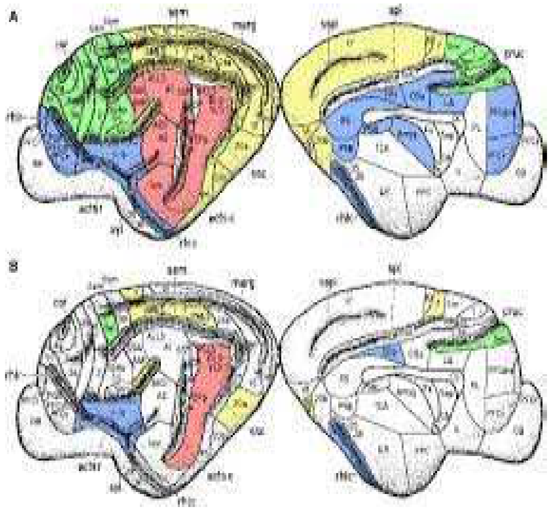
Network

HR model

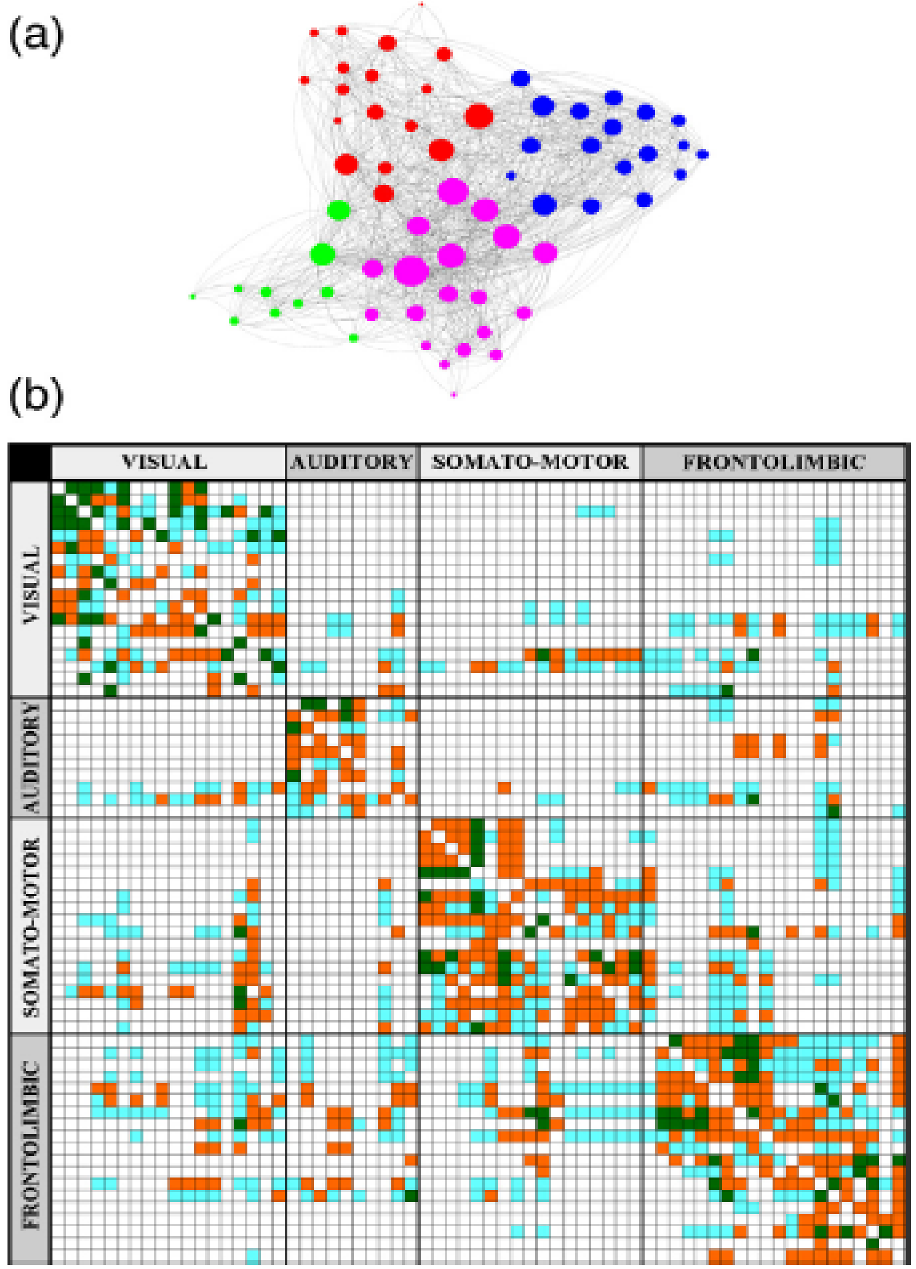
$$\dot{x}_j = y_j - x_j^3 + bx_j^2 + I_j - z_j - \frac{\alpha}{n'_j}\sum_{k=1}^{N} G'_{j,k}\Theta(x_k) - \frac{\beta}{n''_j}\sum_{k=1}^{N} G''_{j,k}\Theta(x_k),$$

$$\dot{y}_j = 1 - 5x_j^2 - y_j,$$

$$\dot{z}_j = \mu\left[s\left(x_j - x_{rest}\right) - z_j\right],$$



AUDITORY SOMATO
VISUAL FRONTOLIMBIC



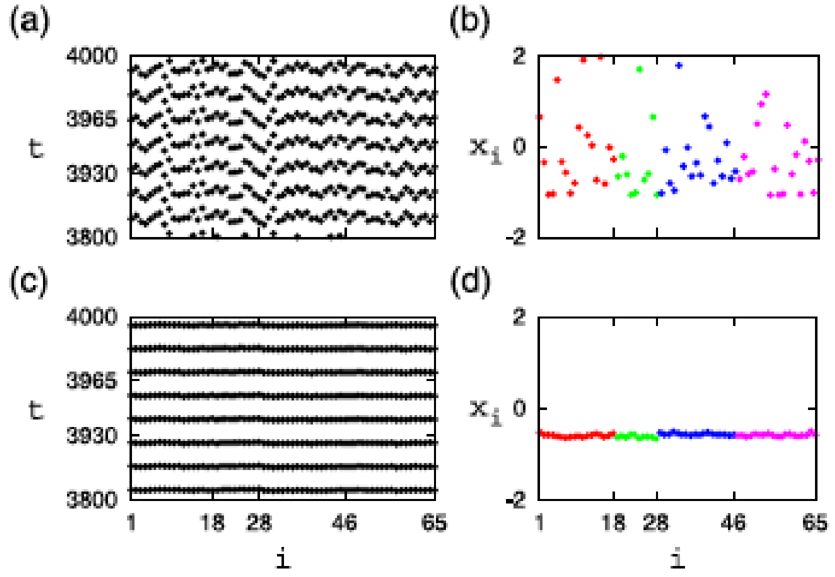


Fig. 2. Space-time plots (left) and snapshot of the variable x (right). (a) and (b) exhibit desynchronous behaviour for $\alpha = 0.001$ and $\beta = 0.001$. (c) and (d) show synchronous behaviour for $\alpha = 0.21$ and $\beta = 0.04$.

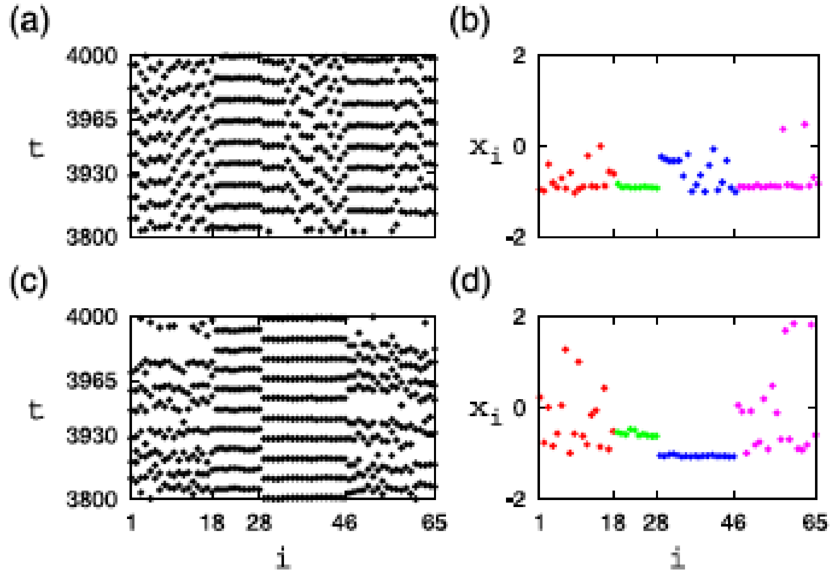


Fig. 3. Space-time plots (left) and snapshot of the variable x (right). (a) and (b) exhibit SC for $\alpha = 0.7$ and $\beta = 0.08$. (c) and (d) show BC for $\alpha = 1.5$ and $\beta = 0.1$.

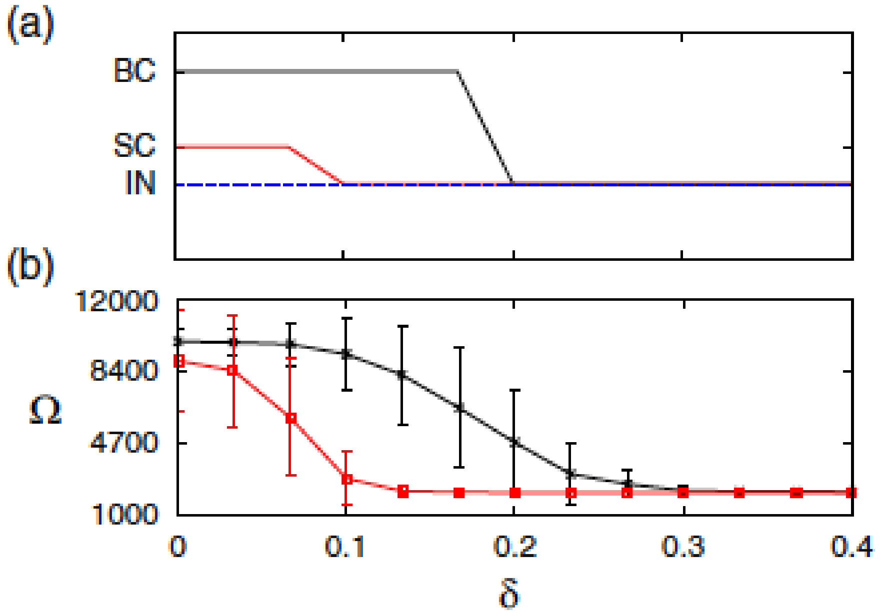


Fig. 7. Noise robustness as a function of δ. (a) for desynchronised bursts represented by the black line ($\alpha = 1.5$ and $\beta = 0.1$) and desynchronised spikes represented by the red line ($\alpha = 0.7$ and $\beta = 0.08$). (b) average chimera-like state lifetime and the standard deviation calculated by means of 400 initial conditions. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

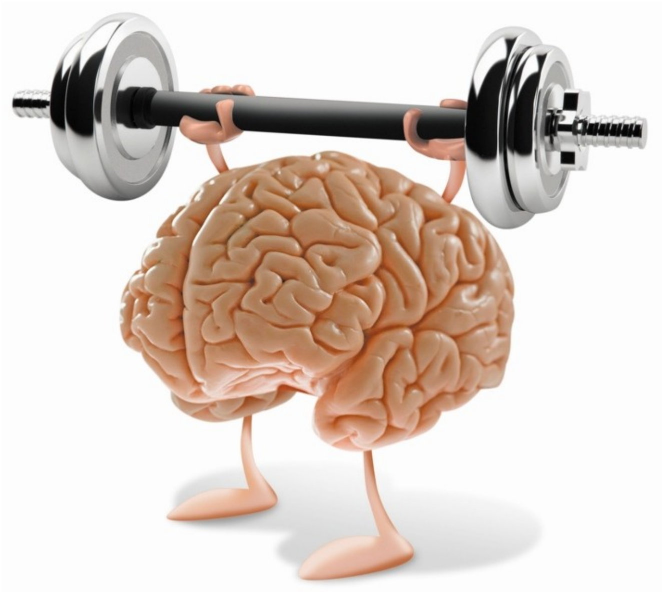
Brazilian Journal of Physics
pp 1–11 | Cite as

Synaptic Plasticity and Spike Synchronisation in Neuronal Networks

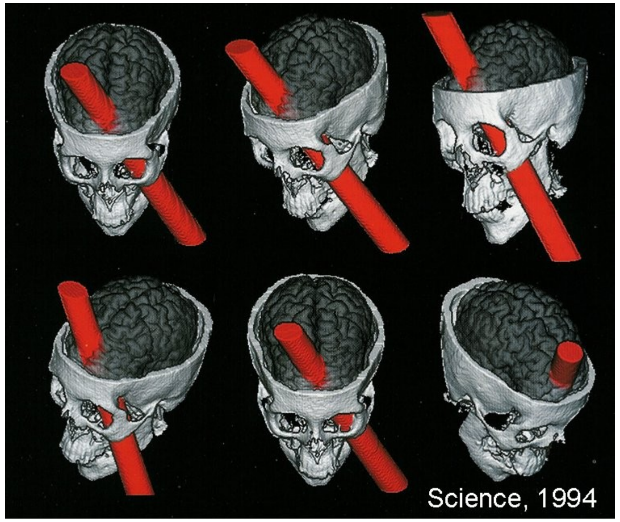
Authors | Authors and affiliations

Rafael R. Borges, Fernando S. Borges, Ewandson L. Lameu, Paulo R. Protachevicz, Kelly C. Iarosz, Iberê L. Caldas, Ricardo L. Viana, Elbert E. N. Macau, Murilo S. Baptista, Celso Grebogi, Antonio M. Batista

General and Applied Physics
First Online: 14 September 2017

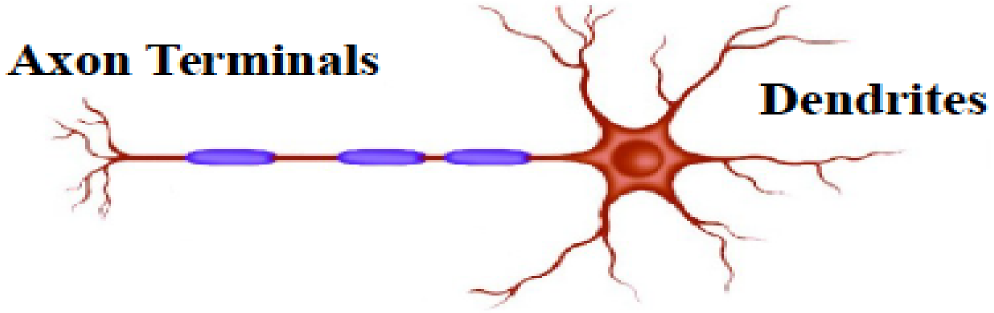


Phineas P. Gage



João Carlos Gandra da Silva Martins

The Hodgkin-Huxley Model



- Based on electrophysiological measurements of giant squid axon;
- Empirical model that predicts experimental data with very high degree of accuracy;
- Provides insight into mechanism of action potential;

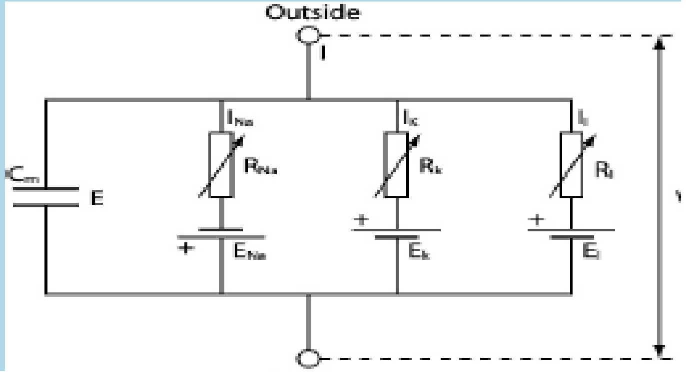
Hodgkin-Huxley model of electrical activity in the squid giant axon

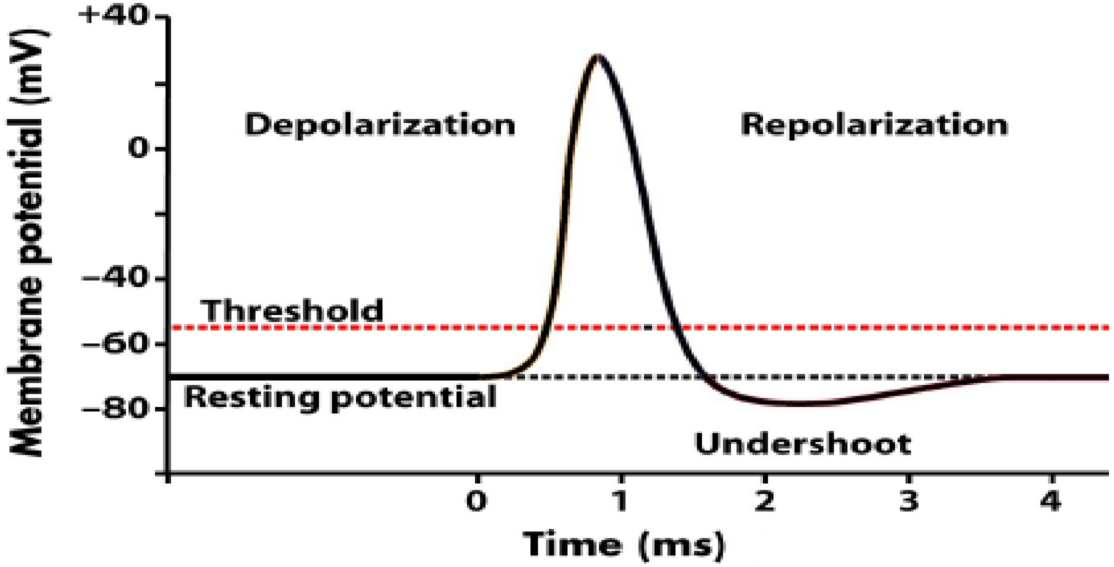
$$C_m \frac{dV}{dt} = -g_{Na} m^3 h (V - V_{Na}) - g_k n^4 (V - V_k) - g_L (V - V_L) + I_a(t)$$

$$\frac{dm}{dt} = \frac{m_\infty(V) - m}{\tau_m(V)}$$

$$\frac{dh}{dt} = \frac{h_\infty(V) - h}{\tau_h(V)}$$

$$\frac{dn}{dt} = \frac{n_\infty(V) - n}{\tau_n(V)}$$





The network is given by

$$C\dot{V}_i = I_i - g_K n^4 (V_i - E_K) - g_{Na} m^3 h (V_i - E_{Na}) - g_L (V_i - E_L) + \frac{(V_r - V_i)}{\omega} \sum_{j=1}^{N} \varepsilon_{ij} s_j + \Gamma_i \quad (1)$$

$$\frac{(V_r^{\mathrm{Exc}} - V_i)}{\omega_{\mathrm{Exc}}} \sum_{j=1}^{N_{\mathrm{Exc}}} \varepsilon_{ij} s_j$$

$$+ \frac{(V_r^{\mathrm{Inhib}} - V_i)}{\omega_{\mathrm{Inhib}}} \sum_{j=1}^{N_{\mathrm{Inhib}}} \sigma_{ij} s_j + \Gamma_i,$$

where V_i is the membrane potential of neuron i (i = 1, …, N), I_i is a constant current density randomly distributed, ω is the average degree connectivity, and ε_{ij} is the coupling strength from the pre-synaptic neuron j to the post-synaptic neuron i. We consider an external pertubation Γ_i, so that each neuron receives an input with a constant intensity γ. The neurons are excitatory coupled with a reversal potential V_r. The post-synaptic potential si is given by

$$\frac{ds_j}{dt} = \frac{5(1 - s_i)}{1 + \exp\left(-V_i + \frac{3}{8}\right)} - s_i \quad (2)$$

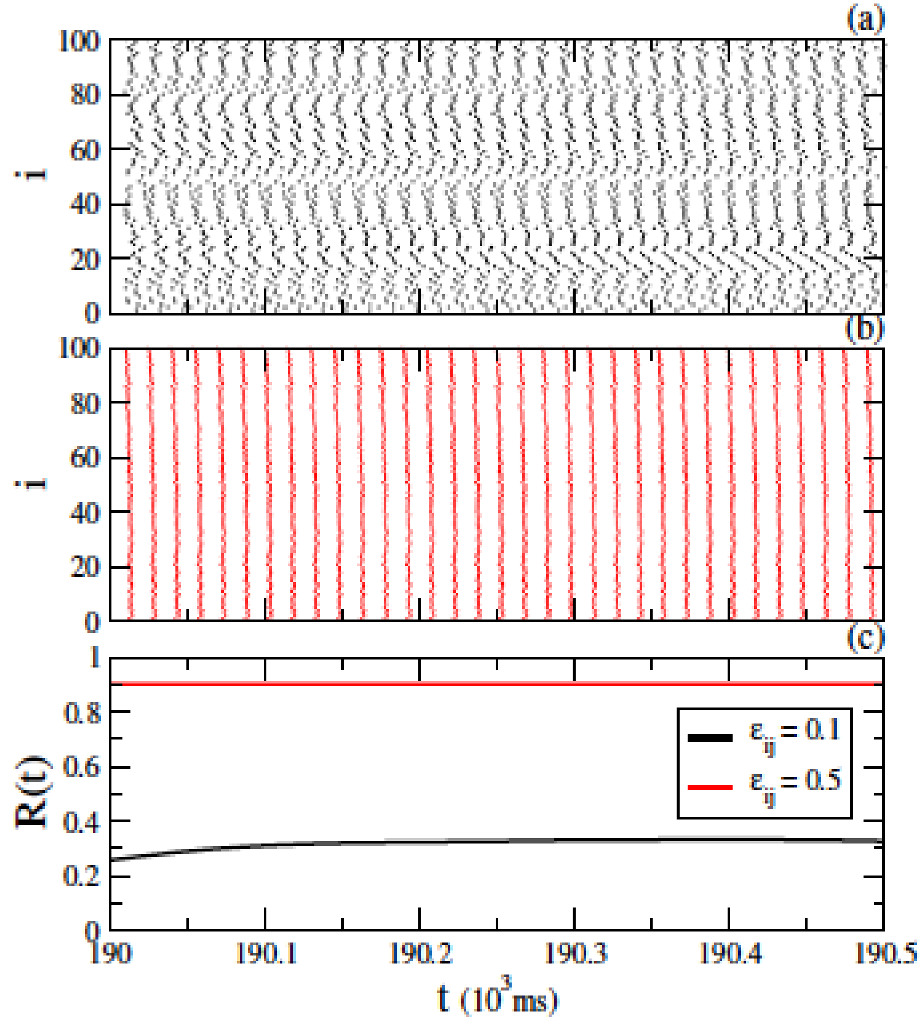
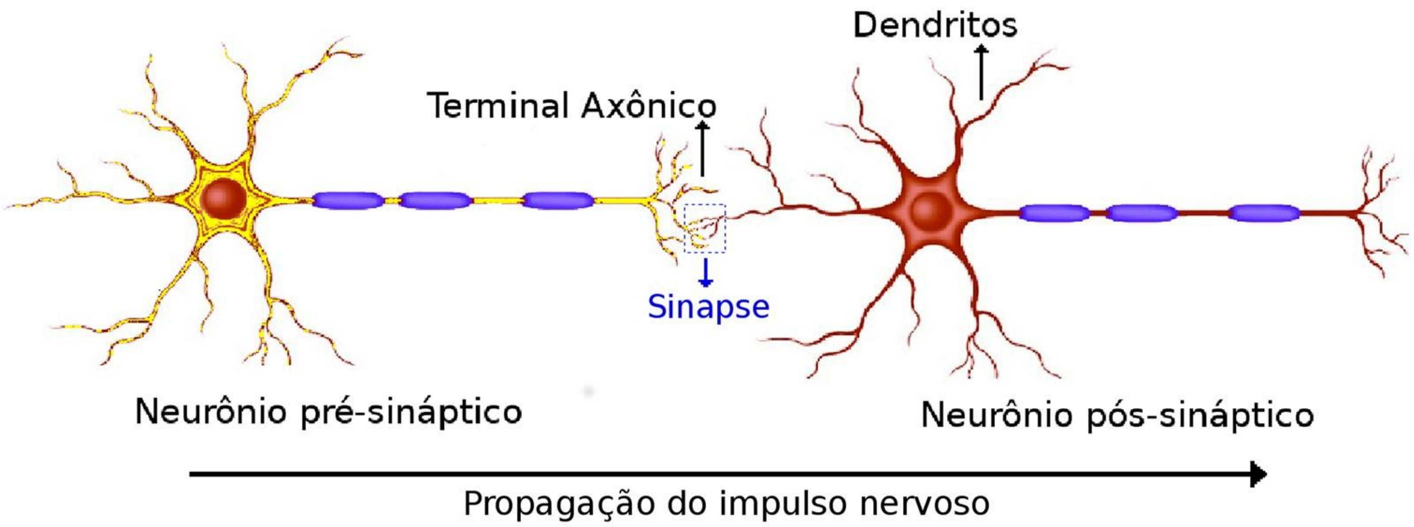
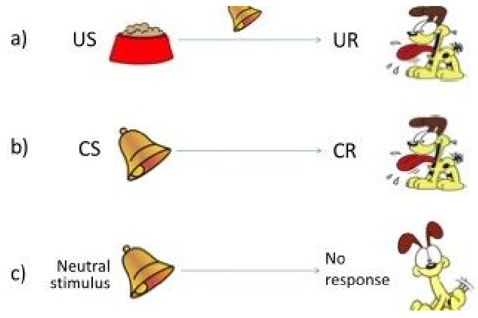


Fig. 5 (Colour online) Raster plots of spike onsets for a random network with 100 Hodgkin-Huxley neurons, $\gamma = 0$, (a) $\varepsilon_{ij} = 0.1$ and (b) $\varepsilon_{ij} = 0.5$. In (c) the time evolution of the Kuramoto order parameter for $\varepsilon_{ij} = 0.1$ (black line) and $\varepsilon_{ij} = 0.5$ (red line).





Conclusions

- Spike synchronisation in the perturbed network can be improved due to a constructive effect on the synaptic weights, depending on the probability of connections.

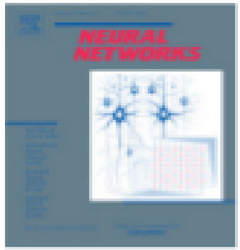
- The abrupt transition from desynchronised to synchronised state is due to directed synapses among spiking neurons with high and low frequency.

Neural Networks 90 (2017) 1–7

Contents lists available at ScienceDirect

Neural Networks

journal homepage: www.elsevier.com/locate/neunet



Synchronised firing patterns in a random network of adaptive exponential integrate-and-fire neuron model

F.S. Borges [a], P.R. Protachevicz [b], E.L. Lameu [b], R.C. Bonetti [b], K.C. Iarosz [a,c,*], I.L. Caldas [a], M.S. Baptista [c], A.M. Batista [a,b,c,d,*]

[a] Instituto de Física, Universidade de São Paulo, São Paulo, SP, Brazil

[b] Pós-Graduação em Ciências/Física, Universidade Estadual de Ponta Grossa, Ponta Grossa, PR, Brazil

[c] Institute for Complex Systems and Mathematical Biology, Aberdeen, SUPA, UK

[d] Departamento de Matemática e Estatística, Universidade Estadual de Ponta Grossa, Ponta Grossa, PR, Brazil