Retinal waves are spontaneous bursting activity propagating in the developing retina until vision is functional. In this work we propose a biophysical modelling of the mechanisms that generate the spontaneous intrinsic cell-autonomous rhythmic bursting in Starburst Amacrine Cells (SACs), observed experimentally in [1] which is directly linked with the emergence of stage II retinal waves. We analyze this system from the dynamical system and bifurcation theory perspective.

**Context & Motivation**

Necessary components for the emergence of retinal waves [1]

- Spontaneous rhythmic activity of isolated SACs
- Refractory mechanisms modulating the silent period of the bursting activity (slow After Hyperpolarization current, sAHP)
- Coupling via cholinergic synapses to ensure the necessary level of synchrony

**Modelling Cell-Autonomous Bursts**

- Modeling the ionic mechanisms of intrinsic rhythmic bursting according to [1] based on an extended M-L model
- Fast oscillations of the voltage while applying an external current pulse of 150 pA followed by a subsequent AHP.
- Blocking all calcium related currents leads to the vanishing of both fast oscillations and AHP.

**Modelling network interactions**

- Spontaneous rhythmic bursts of isolated SACs in rabbits [1]
- Recording of spontaneous cell-autonomous spikes in isolated SACs

**Conclusions & Future perspectives**

- We propose a biophysical modelling of the spontaneous intrinsic cell-autonomous rhythmic bursting in Starburst Amacrine Cells during stage II retinal waves, directly extracted from experimental and biophysical data.
- Our model is able to generate spontaneously the observed rhythmic bursting, without the need of any external excitation to trigger the system, as opposed to [3] and [4].
- With our model we are able to explain biophysically and dynamically how the slow oscillations are generated and entrained in developing SACs.
- We have shown by our modelling the network effect: there is a necessary level of synchrony to be achieved between neighboring SACs to generate propagating waves.

**Acknowledgements**

This work was supported by the French ministry of Research and University of Nice (EDSTIC) and INRIA. We warmly acknowledge Matthias Hennig and Evelyne Sernagor for their invaluable help.

**References**

4. Th. Karvouniari, Bruno Cessac, Theodora Karvouniari, Lionel Gil, Olivier Marre, Serge Picaud, Bruno Cessac, retinal network simulations for the Voltage of 625 neurons on a square lattice Black and white colours correspond to low and high activity respectively.

**Simulation of Isolated SACs**

- SACs are in a regime where they can oscillate spontaneously.
- As they oscillate, the calcium concentration unloads, the voltage is quite lower.
- Where oscillations stop, reaching a steady state where the sAHP increases up to a point where oscillations recommence.
- Weak coupling leads to localized fleming of activity. Strong coupling leads to complete synchrony. Moderate coupling leads to propagating patterns.

**Network Simulations**

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