Storing cycles and robust heteroclinic cycles
M2 project

Hopfield neural networks are simple models of information storage and retrieval, used both in the context of artificial intelligence and the brain [1]. Cycling orbits, that is periodic or recurrent solutions that visit multiple nodes of the network, are likely candidates for fragments of encoded information (working memory, cognitive tasks) [2, 3]. We conjecture that such cycles can be found near so-called robust heteroclinic cycles that exist for idealizations of a transformed version of the Hopfield network with voltage variables replaced by firing rate variables [4], [5]. We propose to conduct a numerical and theoretical study of robust heteroclinic cycles in the firing rate Hopfield networks and investigate their relation to the cycling orbits. A good starting point can be some work by Chuan Zhang available in the form of a preprint [6], [7]. The study requires basic knowledge of dynamical systems and their applications in computational biology. Some experience with MATLAB or a similar program is also an asset.

References

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