The project will involve a collaboration between MathNeuro researchers (Pascal Chossat, Mathieu Desroches, and variable overlaps and learnt patterns, in order to allow for switches to learnt patterns with a dependence on the external input, or on biological parameters (settings) and to some extent be random. Different overlaps. The choice of the overlap and the subsequently activated learnt pattern should depend on the external input.

First, by considering a network of QIF neurons and subsequently extend this to Hodgkin-Huxley type networks. In this spirit, a lot of work has been done over the last two decades in order to model the activity of cortical neural masses (1,2,3,4). The starting point was the Wilson-Cowan (or Amari) model which describes in a simplified way the evolution of the average electrical activity of a neural mass. Each unit (neural mass) receives signals coming from other units. The differential equations of the network's units are then complemented by additional equations representing the evolution of the "weights" of connections between unit (i.e. interaction strength).

In their recent articles (3,4), the above approach has allowed us to model sequential association of ideas or concepts, each concept being represented by a stable stationary state of the Wilson-Cowan model with a proportion of units being active, the other ones remaining inactive. It has been shown experimentally that related concepts are coded in the brain by overlapping neuronal populations (5). Based on these findings the models of (3,4) represent related concepts as having a common active unit (overlap). Such overlaps provide a mechanism of spontaneous transitions between related concepts. These transitions rely also on the weakening of the synaptic weights and the noise inherent to biological signals. The order in which these fast transitions occur depend upon the system's parameters.

References


Mission confiée

The current proposal for a postdoctoral project aims at generalizing our previous approach published in [3,4] and make it render more biological features in two ways. First, by considering a network of spiking networks instead of a Hopfield network. Indeed, firing rate models can be derived from spiking network models using an infinite size limit, see for example [6]. We therefore aim to find sequential dynamics in such networks by extending the work done in [3,4], notably by considering spiking networks with multiple stable attractors with only a few modes active. We propose to do this in the context of quadratic integrate and fire (QIF) neurons and subsequently extend this to Hodgkin-Huxley type networks. Second, in a more realistic setting, every time a learnt pattern destabilizes, there should be a possibility for transitions to different patterns, passing through different overlaps. The choice of the overlap and the subsequently activated learnt pattern should depend on the external input, or on biological parameters (settings) and to some extent be random. We will extend the system in (4), as well as the spiking models described above, by including larger and variable overlaps and learnt patterns, in order to allow for switches to learnt patterns with a variable relation to the pattern losing stability.

The project will involve a collaboration between MathNeuro researchers (Pascal Chossat, Mathieu Desroches, and variable overlaps and learnt patterns, in order to allow for switches to learnt patterns with a dependence on the external input, or on biological parameters (settings) and to some extent be random. Different overlaps. The choice of the overlap and the subsequently activated learnt pattern should depend on the external input, or on biological parameters (settings) and to some extent be random. We will extend the system in (4), as well as the spiking models described above, by including larger and variable overlaps and learnt patterns, in order to allow for switches to learnt patterns with a variable relation to the pattern losing stability.
Principales activités
The postdoc will extend the current model, perform simulations of the resulting networks as well as dynamical system's analysis of it. He/she will interact with a team of applied mathematicians and cognitive neuroscientists.

Compétences
We are looking for young researchers with a background in applied mathematics with familiarities with biophysical modeling and basic programming.

Avantages
- Subsidized meals
- Partial reimbursement of public transport costs
- Leave: 7 weeks of annual leave + 10 extra days off due to RTT (statutory reduction in working hours) + possibility of exceptional leave (sick children, moving home, etc.)
- Possibility of teleworking (after 6 months of employment) and flexible organization of working hours
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Social, cultural and sports events and activities
- Access to vocational training
- Social security coverage

Rémunération
Gross Salary: 2653 € per month