Secondes journées maths-bio de la fédération OcciMath

Rapport sur les contributions

https://indico.math.cnrs.fr/e/14081

ID de Contribution: **1** Type: **Non spécifié**

Dynamics of cell extrusion in pseudostratified epithelia: modelling to the rescue

vendredi 19 septembre 2025 09:00 (45 minutes)

Orateur: THÉVENEAU, Éric

ID de Contribution: **2** Type: **Non spécifié**

Viscoelastic effects in epithelial tissue dynamics: a particle-based modeling approach

vendredi 19 septembre 2025 09:45 (45 minutes)

Orateur: FERREIRA, Marina

ID de Contribution: **3** Type: **Non spécifié**

Complex neuronal bursting oscillations : the role of slow variables

jeudi 18 septembre 2025 14:15 (45 minutes)

In this talk, I will present recent work on multiple-timescale dynamical systems displaying complex oscillations with both slow and fast components, with application to modeling neuronal activity. After a brief review of bursting oscillations and their multiple-timescale analysis, I will revisit the classical parabolic bursting scenario and show how to understand its spike-adding structure by studying the dynamics of slow variables of such models in their singular limit, and the presence of a so-called folded-saddle singularity. Then, I will look at bursting models with a folded-node singularity, show a biophysical example as well as constructed examples that extend the classical Rinzel-Izhikevich bursting classification scheme. Throughout these two cases (folded saddle and folded node) I will show examples of such bursting dynamics with two slow variables at both single-cell and population levels. In particular, I will show how the burst-excitable structure of networks of theta model may persist across scales up to some mean-field limit.
[This is based on joint papers with D Avitabile (VU Amsterdam), GB Ermentrout (U of Pittsburgh), J Rinzel (NYU & CIMS) and S Rodrigues (BCAM, Bilbao)]

Orateur: DESROCHES, Mathieu

ID de Contribution: **4** Type: **Non spécifié**

A predictive coding perspective on oscillatory travelling waves

jeudi 18 septembre 2025 13:30 (45 minutes)

This talk presents a few studies that aim to interpret oscillatory travelling waves in the predictive coding framework. In the first part, I'll introduce a simple model of the visual cortex based on predictive coding mechanisms, in which physiological communication delays between levels generate alpha-band rhythms. Interestingly, these oscillations propagate as traveling waves across levels, both forward (during visual stimulation) and backward (during rest). Remarkably, experimental EEG data matched the predictions of our model. In the second part of the talk, I'll present two studies that indirectly investigate the link between predictive coding mechanisms and traveling waves experimentally: the first one investigates the effect of a powerful psychedelics drug, N,N, dimethyltryptamine (DMT), on alpha-band oscillations, and the second one interprets the pattern of oscillatory traveling waves in schizophrenic patients in the light of Predictive Coding. In the last part of the talk, I will show some preliminary results on a statistical learning paradigm that directly explores the link between traveling waves and predictive coding processes.

Orateur: ALAMIA, Andrea

ID de Contribution: **6** Type: **Non spécifié**

A computational tissue repair model identifies an early transient decrease in fiber cross-linking that unlocks regeneration in adult mammals

jeudi 18 septembre 2025 15:30 (1h 30m)

In adult mammals, scar formation predominates over tissue regeneration, often leading to dysfunction due to the disrupted relationship between tissue architecture and function. Addressing this challenge is crucial in regenerative medicine. The restricted regenerative capacity in mammals suggests the presence of inhibitory factors established early in life. Our previous studies, using a model of massive subcutaneous adipose tissue (AT) resection, suggest that regeneration in adult mammals may be governed by self-organizing principles similar to those in salamander limb regeneration. We developed an agent-based model (ABM) showing that AT architecture may emerge from simple mechanical interactions between growing adipocytes and the extracellular matrix (ECM). This ABM considers three mechanisms involved in ECM mechanical properties: synthesis, degradation, and fiber cross-linking. We extended this ABM to use it as a predictive model of tissue repair, mimicking both regeneration and scar healing-like architectures. We performed high-throughput multiparametric simulations in which each ECM parameter was independently varied over a wide range of values and used machine learning models to reveal that ECM cross-linking was the most important parameter explaining tissue repair outcomes in silico. Temporal calibration of the ABM with in vivo AT regeneration revealed a six-day window post-injury during which ECM cross-linking modulation significantly impacts repair outcomes. In vivo experiments confirmed these findings: inhibiting cross-link formation within this window promoted regeneration, while inducing cross-linking led to scarring. Taken together, these results showed that the final tissue architecture after an injury emerges from mechanical interactions between cells and ECM, and that modifying ECM cross-linking during the first days after injury guides tissue repair toward regeneration. Our results also show that our ABM represents a significant step toward developing a digital twin of the repair process.

Orateurs: PEURICHARD, Diane; PAUPERT, Jenny

ID de Contribution: **7** Type: **Non spécifié**

Exposés étudiants - Discussions

vendredi 19 septembre 2025 11:00 (1h 30m)

Orateur: TOUS