PROPOSITION DE STAGE

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Niveau : M1 or L3

Intitulé du stage : Mining and Harvesting patterns in spatio-temporal Chaos

Mots clés: Physique, Théorie, Modélisation, Physique Nonlinéaire, Physique Statistique Hors Equilibre

Résumé:
Chaotic dynamics is found in many physical systems ranging from electric circuits, to networks, flame fronts, fluid dynamics, or crystal growth. Chaos is loosely defined as a deterministic but unpredictable and never repeating evolution. A general question arising when observing chaotic dynamics is how often a given pattern can emerge from some chaotic dynamics. In this project, we propose to study numerically the fequency of occurence of various patterns.

A specific example of nonlinear dynamics equation is the Kuramoto-Sivashinsky (KS) equation, a universal amplitude equation which appears in various physical systems undergoing a morphological instability. For a field h depending on space and time, the KS equation reads:

$$\partial_t h = -\Delta h - \Delta^2 h + (\nabla h)^2 .$$

The asymptotic properties of the KS equation at large times and large scales have been investigated in details in the literature, and are related to the Kardar-Parisi-Zhang model. However, the local/short-scale properties are less understood. We will start with a numerical approach to identify the occurrence of various patterns using data analysis, or mining techniques. The first aim is to obtain a statistical representation of the occurrence of the patterns.

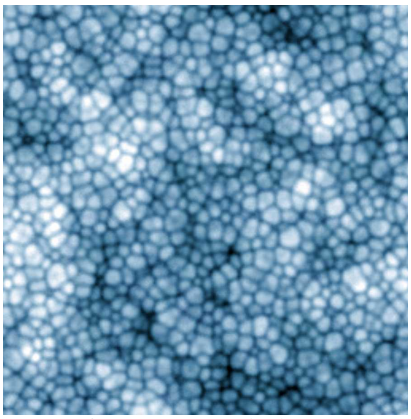

Figure: Chaotic cellular morphology emerging from Kuramoto-Sivashinsky equation in 2 dimensions (Javier Muñoz-García, Madrid)