***Systems with Stochastic Pattern Formation***

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R 3.28 Thu Z2 17:00-17:30

Mathematical models based on systems of reaction-diffusion equations provide fundamental tools for the description and investigation of various processes in biology, biochemistry, and chemistry; in specific situations, an appealing characteristic of the arising nonlinear partial differential equations is the formation of patterns, reminiscent of those found in nature. The deterministic Gray-Scott equations, or e.g. or Gierer Meinhardt model constitute an elementary two-component system that describes autocatalytic reaction processes; depending on the choice of the specific parameters, complex patterns of spirals, waves, stripes, or spots appear.
In the derivation of a macroscopic model from basic physical principles, certain aspects of microscopic dynamics, e.g. fluctuations of molecules, are disregarded; an expedient mathematical approach that accounts for significant microscopic effects relies on the incorporation of stochastic processes and the consideration of stochastic partial differential equations.
The randomness leads to a variate of new phenomena and may have a highly non-trivial impact on the behaviour of the solution. E.g. it has been shown by numerical modelling that the stochastic extension leads to a broader range of parameters with Turing patterns by a genetically engineered synthetic bacterial population in which the signalling molecules form a stochastic activator-inhibitor system. The stochastic extension may lead to multistability and noise-induced transitions between different states.
In the talk, we will introduce the Gray Scott system and Klausmeier system, which is a special case of an activator-inhibitor system. Then, we give shortly the proof of existence and uniqueness, and introduce its numerical modelling.

## References

1. `https://www.sciencedirect.com/science/article/abs/pii/S0377042719303322` Theoretical study and numerical simulation of pattern formation in the deterministic and stochastic Gray-Scott equations. J. Comput. Appl. Math. 364,

2. Joint work with Akash Panda: the stochastic Giere-Meinhardt system (arXiv)

3. Joint work with Jonas Toelle: A Schauder Tychonoff type Theorem and the stochastic Klausmeier system (arXiv)

4. Work in Preparation with Mechtild Thalhammer, Debopriya Mukherjee - Proof of convergence for the stochastic Gray-Scott system