



# Synergetics: The Master Equation

## Simulations of complex systems described by the Master Equation.

Synergetics deals with complex systems composed of many individual parts that interact and are able to form spatial, temporal or functional structures by means of self-organization.

The field of Synergetic was first introduced in 1969 by Hermann Haken and earlier in a related design framework by Buckminster Fuller. It receives renewed attention in describing emerging phenomena in social and life sciences.

In this project, we will develop a generalized framework for the evolution of such complex systems using the master equation. The classical stochastic solution of the Master equation (as introduced by Gillespie) will be enhanced in order to account for spatially varying populations of interacting individuals. Hybrid computations involving deterministic and stochastic descriptions will be investigated.

In particular, phenomena that can be formulated as reaction-diffusion-coagulation systems will be considered, with examples from life sciences and social sciences such as bacterial colonies and competing societies. The optimization of the interaction

rules of certain individuals in order to achieve specific macroscale behavior will be investigated.

### PREREQUISITES

- Programming experience
- Multiscaling, Stochastics or Probability classes
- Independent worker

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