

Applied Analysis and Modelling

Anna Marciniak-Czochra

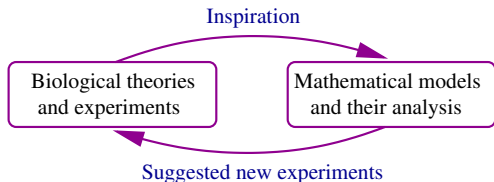
Institute of Applied Mathematics
Interdisciplinary Center for Scientific Computing (IWR)
BIOQUANT
Heidelberg University
<http://www.biostruct.uni-hd.de/>

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Applied Analysis and Applications

- Research Groups
 - Willi Jäger (IWR)
 - Hans Knüpfer (IAM/IWR)
 - Anna Marciniak-Czochra
- Topic: Partial Differential Equations
- Applications: Biology, Medicine, Materials Science, Physics, ...

Interdisciplinary approach



- **Processes-driven modelling:**
 - Mathematical models arising from applications in biology and medicine bringing challenging mathematical problems
- **New mathematical problems:**
 - Analysis needed to build models and to understand their dynamics
 - Analysis supported by numerical simulations
- **Model-inspired experiments:**
 - Models used to make experimentally tested predictions, formulate new biological theories and plan experiments

Examples of applications in biology and medicine

Biological topic: Cell-to-cell communication and regulatory feedbacks in cell growth and differentiation.

- **Stem cell differentiation:** normal and pathological development (Developmental Biology, Hematology, Systems Biology, Neurogenesis)
- **Morphogenesis:** pattern formation during development (Developmental Biology, Cell Biology, Signalling Pathways, Systems Biology)
- **Carcinogenesis:** growth and invasion (Cell Biology)

Mathematics of self-organisation in cell systems

Challenges

- Complexity of biological systems
 - multiple scales (tissues, cells, molecules)
 - transport processes
 - nonlinear regulatory feedbacks
- Enormous amount of biological data on molecular level
- Mathematical models needed to understand the processes

Objectives

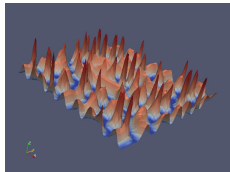
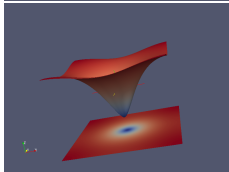
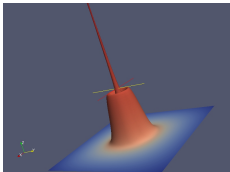
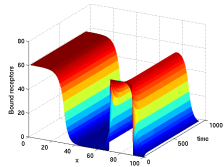
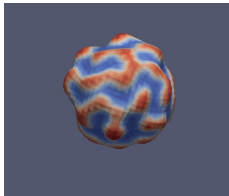
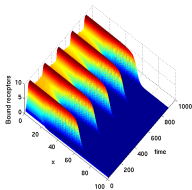
- New models of biological processes (Analysis, Simulation and Optimisation)
- Rigorous mathematical analysis of the models
- New mathematical approaches

Courses WS 2014/15

- Functional Analysis (AMC)
- PDE (K. Gerhardt)
- Seminar: Dynamical Systems (H. Knüpfer)
- Nonlinear Functional Analysis and Applications (W. Jäger)
- Seminar: Semigroup Theory with Applications to Partial Differential Equations (AMC)
- Compact Course: PDEs in Biosciences (AMC)
- Courses on Numerical Methods for PDEs

In the future

- Modelling with PDEs
- Nonlinear PDEs
- Dynamical Systems
- Transport Equations, Reaction-Diffusion Equations, ...
- Homogenisation and Asymptotic Analysis
- Compact Seminars (also interdisciplinary)



Thank you!