Oberwolfach Seminar:
Shapes and patterns – Analysis and simulation

Date: May 24$^{\text{th}}$-30$^{\text{th}}$, 2015

ID: 1522a

Organisers:
Charlie Elliott, Warwick
Harald Garcke, Regensburg
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Programme:
The seminar provides an introduction to analytical and numerical techniques for dealing with shapes and patterns observed in physical or biological systems. In particular, topics include

- the analysis of relaxation phenomena observed in physical experiments and in shape optimisation,
- the analysis of pattern selection and analysis of energy scaling laws,
- the description of shapes and patterns with phase field and sharp interface approaches, and
- mathematical models for the interplay between shape and patterns in biological systems.

Instead of a comprehensive coverage of this broad area, a variety of quite diverse and representative mathematical techniques are presented. Particular emphasis will be on variational methods and methods related to the areas of convex duality, relaxation, optimisation, phase fields, and finite element discretisations. For all mathematical techniques the physical or biological context will also be briefly explained for motivation.

Reading:
The following optional texts may be helpful as introductory material.

- Robert V. Kohn: Energy-driven pattern formation. Proceedings of the International Congress of Mathematicians, 2006. (A nice and easily readable overview over the basic ideas in energy scaling laws.)
- Stefan Müller: Variational models for microstructure and phase transitions. In Calculus of Variations and Geometric Evolution Problems, Lecture Notes in Mathematics 1713, Springer, 1999. (Available under http://www.mis.mpg.de/de/publications/andere-reihen/ln/lecturenote-0298.html)
- Grégoire Allaire: Shape Optimization by the Homogenization Method. Springer, 2002. (Chapters 1.1, 1.2, 2.1, 2.2 introduce the objective of shape optimisation and the mathematical reason why microgeometries and microscopic patterns are optimal.)
- Harald Garcke: Curvature driven interface evolution. Jahresber. Dtsch. Math.-Ver. 115(2) 63–100, 2013. (Section 5 gives a brief introduction to phase field methods.)

Application deadline: March 20$^{\text{th}}$, 2015