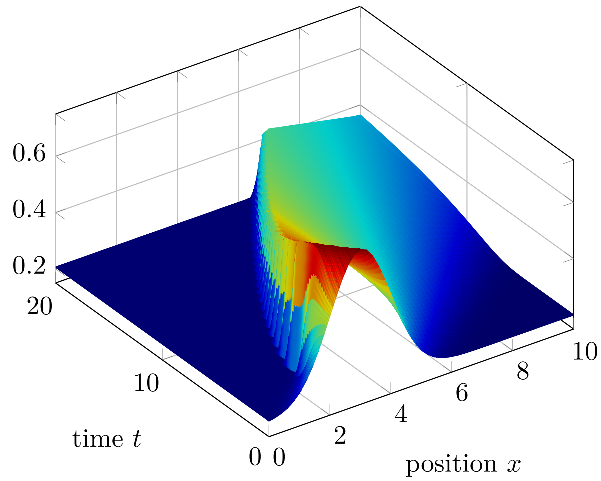
Syllabus: APM 576 - Theory of PDE
Fall 2019



- Instructor: Sebastien Motsch (email: `smotsch@asu.edu`)
- Class: M,W 12:15-1:30
- Office hours: M,W 2:00-3:00pm (WXLA 836)

Textbook: L. Evans, *"Partial Differential Equations"* (2nd edition)

Secondary book: H. Brézis, *"Functional Analysis, Sobolev Spaces and Partial Differential Equations"*

Course Description

This course introduces rigorous methods to study partial differential equations such as existence theory and global behavior of solutions. The goal is to understand *intuitively* PDEs and then to learn analytic tools to *prove* results. This class is intended to focus mainly on **linear PDEs** (e.g. elliptic, parabolic equations) but if time allowed some techniques used for non-linear PDE will be introduced (e.g. fixed-point methods).

Although, there will be no numerical studies of PDEs in this class, numerical solutions will be often used to visualize the behavior of solutions. See for instance: `http://seb-motsch.com/geek/pde_solver_flex.html`

The course will be divided into four parts:

a) **Review** (*chap. 2.1-2.3*): we will review some examples of PDEs with explicit solutions and study *formally* their behaviors.

b) **Functional analysis** (*chap. 5.2-5.7*): from L^p to Sobolev spaces H^1 (where do solutions of PDEs live?), approximation by smooth functions, compactness, Sobolev inequality...

c) **Elliptic PDEs** (*chap. 6*): solving boundary value problem (i.e. $\Delta u = f$).

d) **Evolution equations** (*chap. 7*): solving hyperbolic/parabolic PDEs: $\partial_t u + c \cdot \nabla_x u = \Delta_x u$.

- If time allows, a short introduction to techniques used for non-linear PDE will be presented.

Grading

Biweekly homework (5 homework in total) and a project or presentation.