ETH Lecture 401-0674-00L Numerical Methods for Partial Differential Equations

Numerical Methods for Partial Differential Equations

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This Course is an Experiment !

- Flipped classroom
  - Videos
  - Tablet notes
  - Lecture notes

Homework : ≈ 5h

Communication : No Emails !

→ Moodle forum

Overview

1) 2nd-Order Scalar Linear Elliptic BVPs [2w]
   → An important class of mathematical
2) The Finite Element Method (FEM) [3w]
   → Algorithms & Code (LehrFEM++ → Github)
3) FEM: Convergence & Accuracy [1-2w]

[4) Beyond FEM]

[5) Non-linear elliptic BVPs]

6) Linear evolution problems [2w]

[7 Convection-diffusion BVP] [1w]

8) Conservation Laws [2-3w]

[9) Stokes Equation]

Prerequisites

- Bilinear form ?

  $b : V \times W \to \mathbb{R}$ linear in each argument

- Norm ?

  spd blf $\Rightarrow$ norms

- Differential operators: grad, div, curl, Δ

- Gauss theorem: $\Omega \subset \mathbb{R}^d$

$$\int_\Omega \operatorname{div} \underline{f} \, dx = \int_{\partial\Omega} \underline{f} \cdot \underline{n} \, dS$$

- Multi-d integration & differentiation:

$$\operatorname{grad} \{ x \in \mathbb{R}^d \to \|x\| \}(x) = \frac{x}{\|x\|} \qquad x \neq 0$$

$$\|x\| = (x^T x)^{1/2}$$