Lecture plan

Lecture 1. Error control problem in the numerical analysis. A priori and a posteriori approaches to the error analysis of PDE's. First a posteriori estimates originated from the works of Runge, Prager-Synge, Mikhlin, and Ostrovski.

Lecture 2. A posteriori error indicators for FEM. Explicit and implicit residual methods. Dual-weighted residual method. Error estimation in terms of goal-oriented functionals.

Lecture 3. Functional approach to the derivation of a posteriori estimates for linear elliptic problems. First examples.

Lecture 4. Functional approach to the derivation of a posteriori estimates for linear elliptic problems. Practical implementation. Relations with other a posteriori methods.

Lecture 5. A posteriori error estimation in terms of non-energy quantities. Estimates for non-conforming approximations.

Lecture 6. Mixed and hybrid finite element methods. Stability and rate convergence estimates.

Lecture 7. Mixed approximations on distorted meshes. A priori rate convergence estimates.

Lecture 8. A posteriori error estimates for mixed finite element approximations.

Lecture 9. Mathematical problems in the theory of viscous incompressible fluids. Stokes, Oseen, Navier-Stokes models. Models of Non-Newtonian and electrorheological fluids. Models with rotation. Existence and a priori estimates.

Lecture 10. Functional a posteriori estimates for problems related to viscous incompressible fluids.

Lecture 11. Functional approach to a posteriori error control for variational inequalities.

Lecture 12. A posteriori estimates for modeling errors and errors arising due to uncertain data.