Advances in optimization problems based on error estimators and mesh adaptation

Organized by

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Several procedures of interest in simulation-based engineering can be formulated in terms of a PDE-constrained optimization problem. Possible fields of application include shape and topology optimization, parameter identification in the framework of inverse problems, minimization of suitable energy functionals modeling the most different phenomena.

Within this context, multiple evaluations of an objective functional depending on the solution to a PDE (state problem) are required. Thus, devising a strategy to capture the details of such a solution and the most representative local features that may affect the optimization procedure, becomes a critical issue for the overall success of the numerical methods.

This session focuses on the recent numerical tools developed to improve the quality of the solution to the state problem and the efficiency of the optimization procedure. Topics of interest include, but do not limit to:

1. quantitative a posteriori error estimators to derive certification strategies (e.g., robust optimization, certified descent directions, unsupervised optimization);
2. qualitative and goal-oriented error estimators to drive adaptation procedures (e.g., degree adaptivity, mode enrichment, uncertainty quantification);
3. mesh adaptation to capture under-resolved spatial features (e.g., hierarchical refinement, anisotropic adaptivity).

Applications of interest include topology optimization of elastic structures, optimal aerodynamic design, crack propagation, image segmentation, parameter identification in geophysical problems.