EPSRC Symposium

Challenges in Scientific Computing

Workshop on

New Directions in Computational Partial Differential Equations

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Introduction

The analysis of PDEs is a fundamental subject area of mathematics which links important strands of pure mathematics to applied and computational mathematics. The practical importance of PDEs cannot be overemphasized. Indeed, PDEs are ubiquitous in almost all applications of mathematics, where they provide a natural mathematical description of phenomena in the physical, natural and social sciences, often arising from fundamental conservation laws. Significant application areas include engineering, materials science, physics, the biological sciences, geophysics and chemistry. In recent years there has been an upsurge of activities on the accurate numerical approximation of coupled multiphysics problems and partial differential equations that exhibit nonlinear degeneracy and a multiplicity of scales. The coupling of stochastic and deterministic mathematical models has also become an active area of research. A related exciting field is the approximation of high-dimensional partial differential equations. An emerging field of research is the approximation of differential equations on surfaces, geometric evolution equations, and complex domains.

The workshop aimed to report on progress through high level scientific presentations and to identify areas of computational partial differential equations (PDEs) which are important in a range of new and developing application areas, and which require the deveopment of new analytical and computational tools for their succesful resolution. The schedule was designed to include discussion time to facilitate research interactions and dissemination.

Scientific Content

The workshop focused around the following major themes:

1. Numerical solution of stochastic PDEs and PDEs posed in domains of high dimension, in particular from problems in quantum mechanics and electronic structure calculations,

2. Numerical analysis and implementation of finite element approximations for elliptic and parabolic PDEs on evolving surfaces and interfaces,

3. Numerical Analysis of PDE constrained optimal control problems for elliptic and parabolic problems,

4. Numerical analysis of complex multiscale models in material science and mathematical biology

Workshop

The workshop took place over 5 days and consisted of 21 lectures (45 minutes) and 3 short contributions. The schedule was fixed to enable plenty of time for lively discussions and research interactions. All presentations were on a high technical level, aimed at a specialist audience and were given by leading researchers in the respective fields. The workshop was highly focused and all contributions were timely: most of the lectures presented new results not yet published in the open literature, in many cases on work in progress, on partial results. Highly stimulating discussions on the open problems mentioned in some talks ensued. This was one of the main objective of the workshop and its format was designed to accommodate such discussions.

Participation

The workshop was attended by 40 scientists, from around the world including UK, Austria, France, Germany, Greece, Italy, Saudi Arabia, Spain, Sweden, Switzerland and the USA.

Dissemination

Abstracts and .pdf files of the lectures slides are published on the website of the conference:
http://www2.warwick.ac.uk/fac/sci/maths/research/events/2008_2009/symposium/wks2/