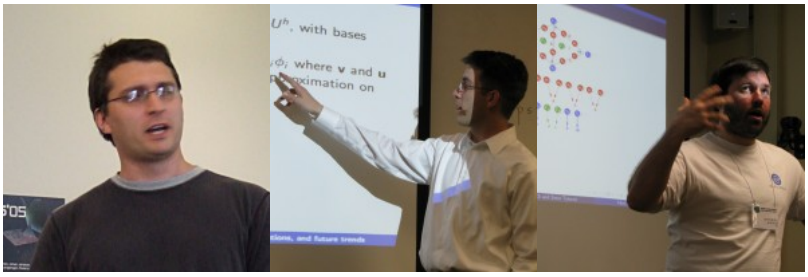
Scientific Computing

CBC Lecture series: Foundations of Finite Element Computing - August 4-8, 2008

Dmitry Karpeev (Argonne National Laboratory, USA), Robert Kirby (Texas Tech, USA) and Matthew Knepley (Argonne National Laboratory, USA) will visit the CBC to give a lecture series on the Foundations of Finite Element Computing. The lecture series consists of five two-hour lectures and will take place in Bakrommet (or possibly Storstua) at Simula Research Laboratory.

Total number of participants: 23
Total number of gueste outside of CBC: 5
Number of different nationalities represented: 6
Total number of speakers: 3
Total number of talks: 6



Program

- Monday (August 4, 13-15)

Overview (Matt)

Sieve Concepts (Dmitry)

Discussion

- Tuesday (August 5, 13-15)

FEM Transformations (Rob)

Discussion

- Wednesday (August 6, 13-15)

Sieve Design (Dmitry)

Discussion

- Thursday (August 7, 13-15)

Sieve Implementation (Matt)

FMM in Sieve (Matt)

Discussion

- Friday (August 8, 13-15)

Open

Abstracts

Dmitry Karpeev / Matthew G. Knepley

Programmability remains the main challenge in high performance scientific software today. The lack of common conceptual pieces among various methods and application domains clearly contributes

to this problem. We will present an abstract formulation of the finite element paradigm: restrict--compute--complete, and discuss implementations of this principle, some undergoing active research, that conform to a common compact interface. The implementations will be specialized to the different application domains. Not only does this approach significantly reduce the complexity of common FEM usage, but also the developed components can be reused in many other domains, such as optimal direct solvers of the Fast Multipole Method type.

We discuss a conceptualization of finite element computing in the usual terms, breaking it into locally homogeneous computational kernels, and also the methodology for systematic assembly of local computation into a global whole. We will discuss contemporary techniques that take advantage of the ubiquity of the local kernels and optimize their use. We also show that the same paradigm of global assembly of local pieces can be used to conceptualize FEM computation, parallel data management and hierarchical solvers.

Robert C. Kirby

Traditionally, special-purpose finite elements are created for different PDE types, and special purpose programming implements particular basis functions for them. However, there are mathematical foundations that unify our understanding of a very wide class of finite elements and guide the implementation of general-purpose code for computing all of the basis functions of any order on a reference element. Second, finite element codes typically map these reference basis functions to each element in a mesh to evaluate stiffness matrices and load vectors. While the classic Lagrange element may be transformed very easily, many other elements require more complex transformations. A new theory of transforming equivalent, interpolation equivalent, and not interpolation equivalent elements will be presented, with applications to scalar elements and H(div) elements as well.

Participant list

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What	
When	Aug 04, 2008 01:00 PM to Aug 08, 2008 04:00 PM
Where	Bakrommet
Contact Name	Anders Logg
Add event to calendar	vCal iCal