



Applied Mathematical Sciences Activities

I. AMS Lab Review

II. Multiscale Mathematics Roadmap

**ASCAC Meeting
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New review of AMS Lab activities begun

- In FY1999, Lab AMS programs were mail-reviewed
- In FY2002, a new review process for AMS Lab activities was initiated
 - Lab activities divided by topic
 - o (1) *Linear Algebra, Optimization, Predictability*
 - o (2) *Differential Equations, High Performance Computing*
 - o (3) *CFD, Advanced meshing, "other"*
 - On 1—2 October 2002, part (1) was reviewed



New review of AMS Lab activities, cont'd

- **Reviewed by panel of 6 experts**
 - Margaret Wright, Bob Vanderbei (optimization)
 - John Gilbert, Dan Sorensen (linear algebra)
 - George Karniadakis, George Papanicolaou (predictability)
- **Written proposals and (public) oral presentations**
- **Generally, the panel gave high marks to the Lab research activities**



Multiscale Mathematics Roadmap

- **Why now?**
 - Across the Office of Science, applications involve multiscale physics / biology / chemistry
 - Climate: Regional effects on global climate
 - Biology: Timescales from vibrational frequencies to ligand transport time
 - High-Energy Physics: supernova modeling involves many length/time scales
 - Combustion: fast chemical reaction rates to slow-moving flame fronts
 - Fusion: From the electron gyroradius to the connection length
- **Current models assume separation of length/time scales, which fails in practice**



Multiscale Mathematics Roadmap, cont'd

- Each case involves transfer of information across scales
 - Coupled equations are not known to be well-posed
 - Data are frequently unreliable
 - Current solution techniques are not adequate to handle multiple scales
 - Computational power will be taxed
- However, the good news is that effectiveness of new multilevel methods may benefit from improved information



Multiscale Mathematics Roadmap, cont'd

- Multiscale mathematics may need input from the following areas (preliminary)
 - Variational principles
 - Separation of scales
 - Analogues of filtering techniques
 - The interplay between discrete and continuous mathematics
 - Advanced statistical methods



Multiscale Mathematics Roadmap, cont'd

- **Why is a roadmap needed?**
 - Uncertainty about areas of mathematics needed
 - Strategies for ensuring that the math research is strongly coupled to applications
 - Identify the critical mathematical/applications barriers
 - Prioritize areas of research to tackle critical barriers first



Multiscale Mathematics Roadmap, cont'd

- Roadmapping is just beginning now
 - Plan a series of general and targeted workshops
 - Identify 2-3 application “drivers”
 - Comments / input on plan from committee are welcome
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