

ISTeC (Information Science and Technology Center) Research Advisory Committee  
 Retreat on the Scientific and Engineering Foundations of Information Science and  
 Technology  
 Saturday, May 8, 8:15am to 3:00pm, Lory Student Center

## STANDARDIZED REPORT FORM

Name of Breakout Session:	<b>Computing and Information Processing in Support of Basic Science and Engineering</b>
Chair and Participants:	Marty Gelfand (Physics), Chuck Anderson (CS), Randy Bartels (ECE), Wim Bohm (CS), Pat Burns (VPRIT), Alexander Hulpke (Math), Naz Karim (ChemE), Ross McConnell (CS), HJ Siegel (ECE&CS), Mark Simmons (Biology), Grzegorz Szamel (Chem), Simon Tavener (Math), Brian Willson (ME)
Introduction:	<p>The ubiquity of computing in science and engineering, and the tremendous diversity of computationally intensive research at CSU, made any notion of “central planning” obviously futile, and it was not even broached. Instead, participants took advantage of the opportunity to learn about each others work, and to brainstorm. We came up with six topics for which participants in this session agreed that further, focused discussions would be productive. This list cannot be considered complete in any sense: if other faculty had been present, undoubtedly other topics could have been raised. Nonetheless, these seemed to be reasonably starting points, and there was real enthusiasm for discussions across disciplines. (Note that not everyone listed under interest in further discussions were present at this breakout, some added themselves after afternoon re-assembly, others were suggested by those present. In any case, the follow-up sessions should be advertised broadly.)</p>
CSU Grid and other computational infrastructure:	<p>Different participants had different ways of dealing with the need for large computational resources in their research: some had large, dedicated clusters, some relied on collaborators at national laboratories, others simply made do with limited resources. There was general unawareness of the CSU Grid, based on equipment which is expected to arrive in the near future (funded by Colorado Institute of Technology). (See <a href="http://cogrid.colostate.edu">http://cogrid.colostate.edu</a> for information.) Siegel expressed a concern that the CSU Grid might end up underutilized, based on his experience at Purdue. It seemed important to link up local grid administrators/developers with potential users early on. The following expressed interest in further discussions: Anderson, Bohm, Burns, Chong, Gelfand, Rajopadhye, Siegel, Szamel.</p> <p>Karim noted the potential usefulness of expensive proprietary software for research in his field. Software donations are worth exploring through CIT, particularly if the software developers have Colorado connections, and other avenues (since there are various motivations for such donations, both by software developers and by industrial users of the software).</p>

### Computational Fluid Dynamics and Partial Differential Equations

Computational fluid dynamics, and partial differential equations generally, have an enormous range of application in scientific and engineering disciplines, and they still offer questions of fundamental mathematical interest. One example of an application of local interest with large societal impact is simulation of combustion, with the payoff in more efficient engine design; climate modeling is another, and there are certainly more that this group of participants were not aware of. Such computations can require enormous computational resources (the more the better). At CSU there is expertise in Mathematics and Computer Science relevant to CFD/PDEs, as well as in the application areas; bringing together faculty from all of these areas was strongly supported. Follow-up discussions could include: Anderson, Bartels, Rajopadhye, Tavener, Willson, and faculty from Civil Engineering and Atmospheric Science.

### High Performance Embedded Computing

Interest in this area is motivated by expertise in the CS department in the development of powerful computing based on FPGAs, which can be used, for example, in conjunction with sensors to process data locally before sending it to a central site for additional analysis. This can be an enabler for various applications (biomedical robots were mentioned, but, more generally, any situation in which real-time processing of multiple images is necessary is a candidate for this technology). Interest in further discussions was expressed by Anderson, Bohm, Karim, Rajopadhye, Siegel, Willson.

### Bioinformatics

There was relatively little discussion of this subject, because it was recognized that there was insufficient representation of potentially interested faculty among the participants. Bioinformatics is a large field, and the critical question “what does/should bioinformatics mean at CSU?” needs to be addressed. Bartels, Karim, McConnell, and Rajopadhye expressed interest in participating in further discussions, and Tony Rappe, Terry Gray, and Amy Pruden were among those whose names were raised as being potentially interested, but many others probably would be, as well.

### Animal Identification Program

Pat Burns informed the rest of us about the National Animal Identification System, recently announced by the US Department of Agriculture. ([http://www.usaip.info/.](http://www.usaip.info/)) The motivation for this program is to control the spread of livestock disease by tracking the history of diseased animals, and finding what animals they had been in contact with. Aside from the matter of data collection (which, initially, will be passive, and will not involve monitoring any animal characteristic other than its location at the farm level) there are issues of data storage, analysis, and modeling, where there should be opportunities for applied research. Anderson, Burns, Hulpke, Karim, McConnell, and Tavener were interested in further discussions.

### Cross Disciplinary Education

It was recognized that courses in which students of, for example, CS and ECE could interact with students from other disciplines that are heavy users of information technology could be beneficial to both groups, but also that there would be difficulties in running courses which were sufficiently interesting to the former and accessible to the latter. CS475 was mentioned as being of potential interest to students in application areas. The courses GS510 and 511 could serve this purpose, also. Interested parties include Bohm, Burns, Gelfand, Grit, Hulpke, Rajopadhye, Siegel, Tavener, and further discussions clearly should be coordinated with the ISTE Education Advisory Committee.

## **Outcome: Focus groups for future exploration**

- CSU Grid (and related computing infrastructure)
- Computational Fluid Dynamics
- High Performance Embedded Computing
- Bioinformatics
- Animal Identification Program
- Cross Disciplinary Education (applications/algorithms/implementations)

## **CSU Grid**

- Charge: how to make Grid hardware (from Sun, Hitachi, Oracle) easy to use for at least some classes of problems
- Getting licences for high-end software through IStEC/COGrid/CIT
- Pat Burns, Chuck Anderson, Ed Chong, Wim Bohm (sensor grid aspects), Grezgorz Szamel, Marty Gelfand, HJ Siegel, S Rajopadhye

## **Computational Fluid Dynamics/PDEs**

- CFD relevant to broad range of applications, esp. when combined with chemical kinetics (e.g., combustion)
- Fundamental interest in multiscale dynamics
- “Large” computations: Simulations run for a week, computational power always a bottleneck.
- Applications have significant societal impact (e.g., energy efficiency).
- Chuck Anderson, Brian Willson, Simon Tavener, Randy Bartels, S Rajopadhye

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## **High Performance Embedded Computing**

- Real time processing of high volume data: Image processing, dealing with other kinds of sensor data, biomedical robots, proteomic data analysis
- Bohm’s work (SA-C) can serve as enabler for applications
- Brian Willson, Chuck Anderson, Naz Karim, Wim Bohm, HJ Siegel, S Rajopadhye

## **Bioinformatics**

- What does bioinformatics mean at CSU?
- Model guided experiments
- Use of high-end software for designing and understanding complex biomolecules
- Simulations.
- Naz Karim, Tony Rappe, Terry Gray, Randy Bartels, Ross McConnell, Amy Pruden, S Rajopadhye

## **Animal Identification Program**

- Tracking tagged cattle, poultry etc. huge amount of data. Radio Frequency ID (RFID). Optical sensors used for finding ids. USDA/ US Dept. of Agriculture. Bovine Disease analysis, tracking and database.
- Huge data bases, need fast analysis to deal with disease outbreaks.
- Big open problems regarding optimal response strategies, modeling...
- Ross McConnell, Chuck Anderson, Naz Karim, Simon Tavener, Alexander Hulpke

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## **Cross Disciplinary Education**

- How can we serve students in CS/ECE/Math and “application” disciplines? Interactions between students in different areas may be beneficial.
- Courses in microprocessors and embedded systems that are accessible to non-ece/cs students? Adjusting the pre-reqs of courses like CS475 to suit

non-ece/cs students?

- ISTECE Education Advisory Committee
- Alex Hupke, Simon Tavener, Wim Bohm, Pat Burns, HJ Siegel, Marty Gelfand, S Rajopadhye, D Grit