

**National Science Foundation  
Directorate for Computer and Information Science and Engineering Advisory  
Committee (CISE AC)**

**October 17, 2008**

**National Science Foundation  
Arlington, VA**

**MEETING SUMMARY**

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The fall meeting of the National Science Foundation's Directorate for Computer and Information Science and Engineering's Advisory Committee (CISE AC) was held at the National Science Foundation in Arlington, Virginia on October 17, 2008.

**Welcome and Introductions**

Dr. Richard Karp, Chair, CISE Advisory Committee (AC) called the meeting to order at 8.30 a.m., welcoming participants physically present as well as those participating by teleconference. AC members introduced themselves. A list of attendees can be found in Appendix I.

The minutes from the Spring 2008 meeting were approved.

Dr. Jeannette Wing, Assistant Director of NSF for Computer and Information Science and Engineering, noted that due to budget constraints, it was possible that the next AC meeting, scheduled to occur on May 1, 2009, meeting, would be conducted via teleconference. She indicated she would let AC members know if this were the case within the next few months.

**NSF and CISE Update**

Dr. Jeannette Wing provided the CISE Update covering NSF topics and CISE information on budget, staffing, scientific programs such as CDI and Expeditions, and education. Dr. Wing also discussed CISE efforts to enlist community engagement and provided suggestions to the AC on ways they can help. Slides from Dr. Wing's presentation are included in Appendix II and her presentation is posted on the CISE AC Sharepoint site for the October 17<sup>th</sup> meeting, for those with access.

During and following her presentation, the AC discussed the following issues:

- Small Grants for Exploratory Research (SGER): an AC member expressed concern that NSF Program Directors did not exercise their full budgetary discretion in recommending SGER awards. Dr. Wing noted that CISE was an NSF leader in using the SGER award mechanism.
- Expeditions in Computing program: an AC member asked if CISE believed that the four awards made in 2008 represented high risk research. Dr. Wing responded that CISE capitalized upon the merit review process to identify

transformative, high risk projects (e.g. cracking the  $p=NP$  problem or building a DNA computer).

- **Send NSF Talent:** Dr. Wing noted that CISE is searching for a new IIS DD to succeed Dr. Haym Hirsh who is scheduled to leave NSF at the end of the summer of 2009. She encouraged the AC to nominate strong candidates. Dr. Wing noted that CISE is constantly looking for strong Program Director and Division Director candidates, and that individuals join the directorate at all stages during the calendar year, with stronger concentrations in the summer (June-September) and winter (January) months consistent with the academic year calendar. One AC member asked about CISE's policy on telecommuting. In response, it was noted that NSF has a core and situational telework policy that CISE actively supports, with all CISE staff encouraged to enter into situational telework arrangements.
- **AC Impact:** An AC member thanked Dr. Wing for acknowledging the past contributions of the CISE AC but voiced concern that the AC is generating input that may be fragmented and incomplete.
- **Reviewer Letter:** An AC member noted that the letter sent to reviewers thanking them for their NSF service in merit review was a good thing to do.
- **Grant Highlights:** Dr. Wing encouraged the CISE PI community to submit "highlights" when requested by CISE Program Directors; highlights describe important outcomes of NSF-supported research or education grants. Dr. Wing pointed out that the publication of a PI's highlight in the President's Budget Request for NSF is a notable achievement.

### **Broadening Participation in Computing**

Dr. Melissa O'Neill, CISE AC member, provided an overview of the recommendations of the AC subcommittee on broadening participation as reflected in the subcommittee's draft Plan for Broadening Participation, a document that was shared with the AC prior to the meeting. The draft plan names targeted stakeholders and guiding principles as well as three goals with associated strategies. The plan also includes long term indicators to measure the impact of efforts to broaden participation in computing. Dr. O'Neill's presentation is available at the CISE AC SharePoint site for the October 17<sup>th</sup> meeting, for those with access. During and following her presentation, the AC discussed the following issues:

- **Institutional Transformation:** The AC discussed the draft plan's potential for effecting transformation in academic institutions. It was noted that institutional transformation is a promising idea where the long-term goal relies on leadership within the institutions. It was noted that CISE must provide incentives and convince academic departments that this is important to them for funding, for enrollment, etc., and that top-down university endorsement is essential, with deans and administrators supporting the efforts. One member noted that at his institution, institutional transformation focused on broadening participation has been a goal for 10 years. He noted that recently, his President defined specific goals against which Deans will be evaluated; all colleges and departments have specific goals and broadening participation plans. Several members discussed personal experiences with institutional transformation successes demonstrated in ADVANCE, an NSF program designed to increase the participation and success

of women in science and engineering career fields in academic institutions. AC members encouraged CISE to build on what ADVANCE teams have learned to broaden participation in computing. It was noted that institutional transformation may not be within the reach of a plan to broaden participation in computing, but that departmental transformation may be. An AC member encouraged CISE to focus on changing behavior at the level CISE can impact – PIs, Department Heads (not necessarily academic Provosts and Presidents), to deal with challenges and opportunities specific to computing.

- Lessons Learned and Best Practices: One AC member voiced strong support for the draft plan and encouraged CISE to add specific components that extract lessons learned from other successful NSF programs. This advice was echoed by a number of AC members, with one member proposing development of a clearinghouse of best practices.
- An AC member noted that of the 50+ recommended actions described in the draft, (s)he had concerns that increased participation of underrepresented group members in committees may overburden such individuals, hindering rather than helping them, and that directing more funding to send underrepresented students to workshops and conferences may divert their attention from more important learning/research activities. There was general agreement that the AC was too large and diverse to reach consensus on each one of the 50+ actions described in the draft plan.
- Requirement for BPC Plans in CISE proposals: One AC member expressed concern that the recommendation that every CISE proposal must contain a broadening participation in computing (bpc) plan may create more busy/paperwork and not necessarily value-added. Another AC member offered a different perspective, expressing that (s)he felt that a bpc plan/attachment might provoke proposers to think about bpc approaches more creatively, encouraging institutions to think about these issues. (S)he noted that the catch 22 is that a requirement to submit bpc plans must not be too onerous but must be sufficient to actually make a difference. Dr. Jan Cuny, the CISE Program Director who convened the AC subcommittee, noted that the subcommittee was briefed by representatives from other NSF directorates who have undertaken similar activities – that the Division of Chemistry created such a requirement for one of its programs, and that the subcommittee was impressed with the results. She noted that the existence of departmental bpc plans provides a framework for PIs who want to effect broader participation but who don't exactly know what to do. One member noted that in general we spend too much time reinventing the wheel and that such a requirement may help departments think about bpc challenges more holistically, allowing each individual within the department to figure out how they feed into the holistic picture. Some AC members liked the idea, while others remained concerned. Another member encouraged CISE to pilot the effort in one program to assess its potential impact. One AC member encouraged CISE to focus more on bringing folks together, and less on requirements. Similarly, another member proposed that CISE not “require” the submission of bpc plans in proposals, but instead adopt an approach that says “we know a lot about what works and what doesn't to broaden participation in computing, and we would like

- to work with you to effect significant increases in the participation of underrepresented groups in our field ....” .
- **Intervention Points:** Several AC members indicated support for interventions at critical points: people entering the pipeline; K-4; no later than 3<sup>rd</sup> grade.
  - **Persons with Disabilities:** The challenges and opportunities to broaden the participation of persons with disabilities were also discussed. Several AC members described personal and rewarding experiences working with students with disabilities. One AC member asked if we are accidentally losing young people with disabilities as early as in the K-12 pipeline.
  - **Publishing Data:** One AC member asked about the potential value of publishing data on, for example, faculty diversity at academic institutions to shame institutions into doing better. In general, there was agreement that this may not be the best approach.
  - **Measuring Success:** One AC member noted that we must be able to measure the success of the program.

### **Computing Challenges and Opportunities within the Geosciences**

Dr. Tim Killeen, Assistant Director of NSF for the Geosciences, made a presentation to the CISE AC by videoconference.

Dr. Killeen discussed the long-term work of the United Nations’ Intergovernmental Panel on Climate Change (IPCC). Since 1990, the IPCC has been sounding the alarm on climate change, receiving the Nobel Peace Prize in 2007 for its work (sharing the honor with former Vice President Al Gore). Despite all the information now available, big uncertainties remain particularly regarding water. There are uncertainties in the projected patterns of precipitation in key regions and on what happens after the precipitation falls. Dr. Killeen discussed the Ocean Observatories initiative which is launching a new era of scientific discovery within the ocean basins using interactive remote human telepresence.

Dr. Killeen outlined some of the challenges for computer science vis-à-vis the geosciences. An emerging vision for geosciences is the establishment of a petascale collaboratory to provide computational resources to address and minimize the time-to-solution of the most challenging problems facing the geosciences. Dr. Killeen discussed the Earth System Modeling Framework (ESMF), a high-performance framework for earth science modeling and data assimilation. Objectives of the ESMF include providing a predictive capability for the earth system on time scales that range from days to decades; going beyond the physical climate system to include predictive capability for marine and terrestrial ecosystems; incorporating social sciences and agent-based modeling systems; and identifying new observations and algorithms needed to advance predictive skill.

In summary, Dr. Killeen stated that the GEO community has traditionally gone its own way but today’s scientific and technical challenges urgently require cutting-edge computer science contributions. A new family of simulation systems is needed for stewardship of our planet and end-to-end systems and interdisciplinary work must be integrated, with NSF leading this effort.

Dr. Killeen's presentation is available at the CISE AC SharePoint site for the October 17<sup>th</sup> meeting, for those with access. Following his presentation, the following comments were made:

- Research in the areas Dr. Killeen described is ripe with research opportunities not only for geoscientists, but for experts in computer science, complex systems, and applied mathematics.
- NSF must play a fundamental role in supporting research in uncertainty. There are probabilistic tools that are CISE-relevant and key to understanding extreme (high impact, low probability) events. One member expressed concern that the role of computation in Dr. Killeen's presentation seemed limited to computation for larger and larger simulations. But modeling is critical too with a need to focus on understandable models of Earth processes, predictive models, model abstraction, knowing the limitations of models and when a process can't be modeled and similarly knowing the limits of predication accuracy. Related to all this, is the importance of triaging and preparing data for model construction. Dr. Killeen agreed with these points.
- In the event that computing advances lead to implementation of thousands of general purpose cores within the next decade, one AC member asked Dr. Killeen if there was a performance level at which climate modeling no longer would need computing advances. Dr. Killeen responded that in his perspective, the killer application is earth systems modeling – or global systems modeling - that includes all aspects of natural and social phenomena and interactions. He noted that he sees no end to need for computing performance augmentation. Dr. Killeen noted that he would like to see 1 km resolution in his lifetime; he feels that the path to and impact of 1-2 km resolution would result in significant new scientific understanding.
- The need for an end-to-end systems strategy was noted, including capabilities for data assimilation and deployment, integration of components from different institutional models, algorithm development and deployment, visualization, middleware for decision tools used in the desktop, etc.
- The importance of solving big data challenges was noted. Domain decomposition, as a new way to represent data, led to the development of a much more efficient algorithm which reduced the time necessary to compute solutions. Are there lessons learned from other sciences that CISE and GEO can look to for solutions (e.g. bioinformatics). It was noted that data provenance and data interoperability are also significant challenges. Dr. Killeen indicated that there is an analog to bioinformatics but there are critical differences. For example, genomics does not demand that scientists work with a very wide range in timescales; earth systems modeling does.
- DOE uses an integrative approach, where architecture-software libraries-models interdependent. This is an effective model and NSF should learn from it.
- One member asked how NSF sees social sciences data affecting changes in global systems simulation. Dr. Killeen responded that there is some primitive work going on in industry (e.g. the insurance industry), but that this is the frontier.

- An AC member noted that there is a clear need to evaluate the implications of proposed solutions to global warming; models need to be developed to assess the promise of proposed solutions.
- Several slides demonstrated model inconsistencies; one AC member asked if this was due to data, model assumptions, and/or computational problems? Dr. Killeen responded that some models are known to be missing factors, may include bugs, etc. He also noted that uncertainty may in fact grow as we add more detail; it may not shrink.

## **Computational Methods for a Sustainable Environment, Economy, and Society**

Dr. Carla Gomes, Cornell University, briefed the AC on the newly funded CISE Expedition award *Computational Sustainability: Computational Methods for a Sustainable Environment, Economy, and Society*. Dr. Gomes and her colleagues at Cornell University, Bowdoin College, the Conservation Fund, Howard University, Oregon State University and the Pacific Northwest National Laboratory will explore the development and application of computational methods to enable a sustainable environment, economy and society. Gomes and her team hope to create a new field of computational sustainability--much like computational biology has arisen in past decades--that will stimulate new research synergies across the areas of constraint optimization, dynamical systems, and machine learning. A comprehensive slide presentation on this work can be found in Appendix II. Dr. Gomes' presentation is available on the CISE AC SharePoint site for the October 17<sup>th</sup> meeting, for those with access.

The following points were made in the subsequent AC discussion:

- How do you get back intuition of how model behaves in black box implementation? How do you provide better understanding of behavior of model e.g. sensitivity analysis? Researchers working on stochastic programming developed heuristic technique for playing out large numbers of possibilities – do techniques of this kind apply to computational sustainability. Dr. Gomes responded that indeed yes, empirical models coupled with formal models are used to try to learn from interaction between models.
- Our field needs new highly visible noble endeavors to get people excited. Computational sustainability might be a noble endeavor. Students don't view computer science and engineering as a noble endeavor, yet computing impacts healthcare, medicine, environment, etc.
- How do you facilitate interdisciplinary research? Dr. Gomes responded that the building blocks are interdisciplinary teams focused on specific problems. Working together, teams can re-pose the problems to find important solutions – the benefit of multiple perspectives shines through.

## **Preparing to Meet with Dr. Bement**

The AC prepared to meet with the NSF Director, Dr. Arden Bement, and members proposed to discuss the following issues with him, time permitting:

- Real-world problems don't typically divide up into the computing sub-fields

- Computing is not just a science of the artificial; it's the artificial science of the natural.
- Computing researchers must expand their vistas beyond inward-looking; general undergrad opinion is that computing is programming.
- Many scientific challenges genuinely extend the limit of computing capability.
- Computing allows scientists to ask new questions.
- There is broad support for proposed broadening participation plan, and for a number of specific recommendations.
- The AC would like to continue the tradition of providing slightly off-topic presentations that freshen the mind/perspective.

### **Meeting with NSF Director, Dr. Arden Bement and Deputy Director, Dr. Kathie Olsen**

In his opening remarks, Dr. Bement noted that he always enjoys meeting with the CISE AC, and that he admired the AC's focused agenda on computing and the environment. He noted that there was a continuing resolution in place that would allow the agency to operate at the FY 2008 level through March of 2009. Dr. Bement and the AC then shared perspectives on the following issues:

- **Broadening Participation:** Dr. Bement noted that broadening participation is a very high priority at NSF, as reflected in the agency's strategic plan. He indicated that he liked the draft plan prepared by the CISE AC subcommittee, noting its hard hitting and addresses the broadening participation responsibilities that institutions and departments share with NSF; the plan is a value for everyone. AC members noted that several of them had been positively impacted by the ADVANCE program, and urged NSF/CISE to initiate similarly strong interventions for other underrepresented groups. Dr. Bement described the NSF I3 program – Innovation through Institutional Integration – which integrates flagship programs into holistic wholes. An AC member asked how much NSF is committed to broadening participation activities and Dr. Bement responded that NSF is very committed. He noted that the plan that CISE is putting together is synergistic with EHR plans, and supports ideas expressed in the America Competes Act. He noted that a new initiative for Hispanic-Serving Institutions is high on the agenda for the 2010 budget.
- **Computing and the Environment:** An AC member noted that computational sustainability and modeling of global systems are inspirational to computer scientists and help us think about what computing advances can contribute to noble causes. It was noted that the NSF Cyber-enabled Discovery and Innovation (CDI) program allows us to do it. It was noted that looking at environmental challenges expands computer science – enriches scientific fields and computer science, and attract idealistic people who are attracted to noble causes.
- **Interdisciplinary Partnerships:** Dr. Bement noted that NSF awards increasingly involve multiple PIs because scientific problems are more complex and need multiple expertise and experiences. As a result, the white space between disciplines is being filled.
- **Working with Industry:** Dr. Bement noted that NSF has worked in partnership with industry over the years and is exploring new ways to expand that effort. He

commended Dr Wing for breaking new ground with the CLUster Exploratory (CLUE) program and other recent initiatives.

- Software: Dr. Bement discussed the importance of cyberinfrastructure in general, noting that legacy software is impeding the full utilization of advanced hardware instruments like petaflop machines.

## **Green IT**

Dr. Douglas Fisher, CISE Program Director, provided an overview of a promising area of research, Green IT. Dr. Fisher's presentation is available at the CISE AC SharePoint site for the October 17<sup>th</sup> meeting, for those with access. The following points were discussed:

- Network effects – social networking to change behavior – can create on-line communities to advocate approvals and create social incentives.
- In the last two decades, the amount of fuel consumed went down by a factor of 2 with respect to GDP (shift from physical to information economy). Only one third of calories of fuels burned in power plants make it to your home.
- Reduce the use of fuel in transportation systems smart control of hybrid vehicles?
- Focus: Playing in the 2% of worldwide CO2 emissions that ICT causes is not a big opportunity. The preference is to focus on outside opportunities because there are big wins elsewhere. But the 2% will get bigger as IT's ecological footprint grows. We have much more to offer than power-efficient processors. Microsoft has a sustainability office working on smart algorithms for rideshare etc.; investing in shared buses with wireless; better telepresence efforts. Microsoft now getting serious about distribution of effort – telepresence for better meetings; making datacenters more efficient; predicting how long CPUs will be idle and at ms level considering powering down etc. Microsoft just started an academic research program on sustainability. There are legislative pressures in other countries that put pressure on big corporations to make CPUs more efficient. We need programming tools to help exploit hardware optimally. How can we get to petascale and pay the energy bill?
- Smart Systems: Thirty percent of use is due to personal behavior (residential). We need smart systems. There is large energy consumption in TV's, ovens, etc, that must be powered on all the time. Giving people feedback can change behavior. Members also discussed where CISE research dollars would be optimally invested. A suggestion was made that emphasis be placed on research into areas that would increase computing's "indirect" benefit in other sectors, rather than funding research that would have reduce IT's "direct" footprint (as this was only 2 percent of the human energy footprint). This was countered, to some extent, by a claim/observation that many of the indirect and systemic effects (e.g., high-resolution climate modeling) could not be achieved without power-aware computing technology.

Drs. Wing and Karp thanked the AC for the productive conversations. With no further discussion, the meeting was adjourned at 4:30 p.m.

## ATTENDEES

### Members Present:

**Professor Richard M. Karp, Chair**, Electrical Engineering & Computer Science, Univ. of California at Berkeley, CA

**Professor Anant Agarwal**, MIT Computer Science and Artificial Intelligence Lab, Cambridge, MA

**Professor Annie Anton**, North Carolina State University College of Engineering, Raleigh, NC

**Professor Randal Bryant**, Computer Science, Carnegie Mellon University, Pittsburgh, PA

**Professor Jorge Diaz-Herrera**, Computing & Information Sciences, Rochester Institute of Technology, Rochester, MN

**Professor Michelle Effros**, Department of Electrical Engineering, California Institute of Technology, Pasadena, CA

**Professor Carla Ellis**, Department of Computer Science, Duke University, Durham, NC

**Dr. Stuart Feldman**, Vice President, Engineering, Google, New York, NY (ACCI liaison)

**Dr. Eric Horvitz**, Microsoft Research, Redmond, WA

**Dr. Alan Kay**, President, Viewpoints Research Institute, Glendale, CA

**Professor Jon Kleinberg**, Cornell University, Ithaca, NY

**Dr. Richard Ladner**, Department of Computer Science, University of Washington, Seattle, WA (telecon)

**Professor Andrea Lawrence**, Department of Computer Science, Spelman College, Atlanta, GA

**Professor Jeffrey MacKie-Mason**, University of Michigan, Ann Arbor, MI

**Professor Maja Mataric**, Computer Science Department, University of Southern California, Los Angeles, CA (telecon)

**Professor Greg Morrisett**, School of Engineering & Applied Science, Harvard Univ., Cambridge, MA

**Professor Donald Norman**, Northwestern University (retired), Palo Alto, CA (NEED TO CHANGE AFFILIATION)

**Professor Melissa O'Neill**, Computer Science, Harvey Mudd College, Claremont, CA

**Dr. Vijay V. Raghavan**, Center for Advanced Computer Studies, University of Louisiana at Lafayette, Lafayette, LA

**Professor Martha E. Pollack**, College of Engineering, University of Michigan, Ann Arbor, MI

**Professor Marc Snir**, Department of Computer Science, University of Illinois Urbana-Champaign, Urbana, IL

**Professor Ellen W. Zegura**, College of Computing, Georgia Institute of Technology, Atlanta, GA

### Members Absent:

\***Professor Douglas Arnold**, Director, Institute for Mathematics and Applications, Univ. of Minnesota, Minneapolis, MN (MPS AC liaison)

**\*Professor Cynthia Barnhart**, Associate Dean for Academic Affairs, MIT School of Engineering, Cambridge, MA (ENG AC liaison)

**Dr. Vinton Cerf**, Chief Internet Evangelist, Google, Herndon, VA

**Dr. Andrew A. Chien**, Vice President, Corporate Technology Group, Intel Research, Hillsboro, OR

**Mr. Dwight Gourneau**, President, NAMTech, Inc., Rochester, MN

**Professor Margaret Wright**, Computer Science Department, New York University, New York, NY

\*Liaisons from other NSF Advisory Committees

Appendix II

NSF and CISE Update

[Computational Sustainability](#)