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Computer Science and Telecommunications Board

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Innovation in Computing and Information Technology for Sustainability A Workshop

DRAFT AGENDA

May 26, 2010—Workshop
Terrell Building - 575 7th Street, NW- Washington, DC 20004

8:30 AM - 8:35 AM **Welcome**
Deborah Estrin, University of California, Los Angeles, Committee Chair

8:35 AM - 10:45 AM **Session 1 – Expanding Science and Engineering with Novel CS/IT Methods**
"The Need to Turn Numbers into Knowledge"
Committee respondent: *Dan Kammen*

What are some example areas of efforts in sustainability and related research where the interface of disciplinary and interdisciplinary research with new methods in computer and information science can generate new innovations and knowledge? One example is the 'Smart Grid,' which provides a physical and IT medium where new levels of efficient and clean energy and information management are possible, and where new levels of data security are needed. Topics range from grid management to the introduction of smart management and charging systems for low-carbon electric vehicles. Another example is Ecological Resilience and Ecosystem Function: monitoring and modeling ecological change, and the interactions of ecological robustness and requires new tools for temporal and spatial resolution, and new methods to explore the dynamics of connectivity in ecological systems, and in teasing out the ranges of anthropogenic impacts.

Vijay Modi, Columbia University
Robert Pfahl, International Electronics Manufacturing Initiative, Inc.
Neo Martinez, Pacific Ecoinformatics and Computational Ecology Lab—Numbers: Where they Come From and What to Do with Them to Live More Sustainably on Earth
Adjo Amekudzi, Georgia Institute of Technology
Thomas Harmon, University of California, Merced—Environmental Cyberinfrastructure and Data Acquisition

10:45 AM - 11:00AM **Break**

11:00 AM - 1:00 PM **Session 2 – Understanding, Tracking, and Managing Uncertainty Throughout the Science-to-Policy Pipeline**
Committee respondent: *Tom Dietterich*

Explicit representation of uncertainty is rare in the science-to-policy pipeline. Data products resulting from fusing information from multiple instruments are often treated as exact when input to models. Outputs from predictive and simulation models are often treated as exact when input to policy making. Policy optimization for management (e.g., reserve design, fishing quotas, habitat conservation plans) often is not robust to uncertainty in the problem formulation or the objectives. Uncertainty about future decision making and imperfect implementation of policies injects additional uncertainty into planning for the future.

- What are the sources of uncertainty that should be explicitly captured?
- What methods are suitable for explicitly representing uncertainty?
- Is the technological state of the art sufficient to model the many different flavors of uncertainty present in large-scale sustainability problems? If not, what characterizes the types of uncertainty that are insufficiently modeled?
- What methods are suitable for assessing uncertainty in each stage of the pipeline? What shortcomings need to be addressed?
- Is the state of the art in human factors, interfaces, and CSCW sufficient to support the large-scale systems, models, and datasets that are necessary to tackle large-scale sustainability problems? If not, what needs are unmet?
- What are the appropriate techniques for working with uncertain data in data fusion, data assimilation, predictive modeling, simulation modeling, and policy optimization?
- Is a pipeline architecture sufficient, or do we need a fully-coupled architecture in which policy questions can reach all the way back to guide data collection and data fusion?
- How can explicit uncertainty representations be integrated into scientific workflow tools?
- Are there alternatives to explicit uncertainty representations that can improve the robustness of management policies to all of these sources of uncertainty?

Peter Bajcsy, University of Illinois at Urbana-Champaign—Instruments and Scientific Workflows
Chris Forest, Pennsylvania State University—Assessing Uncertainty in Climate Models
David Brown, Duke University—Robust Optimization under Uncertainty
John Doyle, California Institute of Technology—Theory and Methodology of Robust-yet-Fragile Systems Analysis

1:00 PM	- 1:30 PM	**Working Lunch**
1:30 PM	- 3:30 PM	**Session 3 – Creating Institutional and Personal Change with Humans in the Loop** Committee respondent: *Alan Borning*

Achieving sustainability objectives demands behavioral changes at the institutional and individual levels. In designing and developing smarter systems an important question is how embed interfaces that work. The human-system interaction literature is replete with counterexamples and numerous failed cognitive models, serving as cautionary tales. Complicating matters, human-system interaction issues arise both with regard to individuals in homes and offices and for administrators of larger systems or facilities. Further, interactions occur at different scales—on the one hand on a day-to-day timeframe for users and on the other in ways that allow incorporation of feedback from the system either to the system itself or to decision makers thinking about larger scale resource management considerations, for example.

- How can data and information be presented at the appropriate granularity and timescale to be most effective? What system, application, and user factors bear on the human-system interaction design choices?
- Describe the potential impacts of the various contexts and tradeoff decisions that might need to be made, including: the impact of context (e.g. stakeholders, and so on); the impact of large vs small groups vs individuals; the impact of income; the impact of use by or for cities vs businesses vs individuals; the role of middleware, the supply chain, and so on.
- How do human factors affecting energy use drive the use and design of technology? How can this be accounted for? When are power, networking, products, and so on really needed? Discuss human choice and its impact on consumption, disposal, re-use, and so on.

Bill Tomlinson, University of California, Irvine—Greening Through IT
Shwetak Patel, University of Washington—Residential Energy Measurement and Disaggregated Data
Daniela Busse, SAP
Eli Blevis, Indiana University—Sustainable Interaction Design

3:30 PM	- 3:45 PM	**Break**
3:45 PM	- 4:30 PM	**Session 4 – Overcoming Obstacles to Scientific Discovery and Translating Science to Practice** Committee respondent: *David Culler*

- What are the motivations for and impediments to applying innovative information technologies to sustainability challenges and how do they differ by domain?
- How can large-scale science addressing real-world problems be made credible, if reproducibility is not possible?
- What lessons can be applied from the transformation of the Internet into a critical infrastructure that must avoid ossification?
- What is the appropriate mix of empiricism, innovation, and application for CS to have an impact in the area of environmental sustainability?

David Douglas—The Role of CS in Open, Sustainability Science

4:30 PM	- 5:00 PM	**Capstone Session & Plenary Discussion** *Randy Bryant, Carnegie Mellon University* *Deborah Estrin, Committee Chair*
5:00 PM		**Adjourn Workshop & Open Session**
5:00 PM	- 6:00 PM	**Reception**