



BIOENGINEERING

UNIVERSITY of WASHINGTON

A Department of the College of Engineering & School of Medicine

BIOEN 509 – DEPARTMENTAL SEMINAR SERIES

Thursday, Mar. 11 2010, 12:30-1:20 PM

Foege Bioengineering Building N130A

The Role of Reflection and Emergence in Complex Adaptive Systems

Dr. Kirstie L. Bellman

Aerospace Integration Science Center (AISC), The Aerospace Corporation

Scientists and engineers have always drawn inspiration from biological systems for developing, structuring and engineering new capabilities, whether it is Volta's electric eels or fashionable automatons of the Middle Ages or Minsky's Society of Mind. Hence it is no surprise that many researchers today are looking to biology for new concepts in the development and management of large-scale complex adaptive systems. In this talk, the author discusses two key architectural concepts, controlled sources of variation and reflective architectures, drawn from her work in Neuroscience and Computer Science. After describing some of her research group's existing approaches to computational reflection, the author will discuss the exciting goals and approaches being developed under the German-led Organic Computing (OC) movement. Like other complex adaptive systems, an "Organic Computing System" is a technical system, which adapts dynamically to the current conditions of its environment. However, in OC, the goal is to have the self-organizing, self-configuring, self-explaining, and context-aware system AND the system developers and system engineers codesign and co-develop the resulting system. The OC attitude is "How can we take advantage of the fact that complex systems have emergence and self-organization?" The European applications are being developed with a strong industry pull; including many chip designers and car manufacturers, and such giants as Daimler-Chrysler, Siemens, and Bosch.

Dr. Kirstie L. Bellman is a Principal Scientist in the Computer Systems Division and head of the Aerospace Integration Sciences Center (AISC), which she started upon returning to the Aerospace Corporation after four years at DARPA. The center serves as a research and development capability for a number of DoD and government agencies. AISC's focus is on the development of advanced system and model integration methods, new analytic techniques, and evaluation tools for assessing the impacts of new technologies. Upon completion of her term at DARPA as a Program Manager for the Domain-Specific Software Architectures (DSSA) program, Prototech (rapid prototyping technology and formally-based specification languages), projects in the Formal Foundations program, the large Computer-Aided Education and Training Initiative (CAETI), and several Technology Readiness Projects (TRP), she received an award from the Office of the Secretary of Defense for excellence in her programs. During her years at DARPA, she had the honor of working with Dr. Anita Jones, then DDR&E at OSD, with the Office of Science and Technology Policy in the White House, NATO, and a wide range of government agencies. Dr. Bellman has over thirty-five years of academic, industrial, and consulting experience in both laboratory research and the development of models and information architectures for large military and government programs. Her published research spans a wide range of topics in Cognitive Science, Neuroscience, and Computer Science. In addition to playing a leading role in the development of programs in the error analysis and evaluation of Artificial Intelligence programs, her group did internationally recognized research in conceptual design environments, software integration and architectures, and 'enterprise evaluation'. She started the VEHICLES project, an environment for the conceptual design of space systems that incorporates both conventional and artificial intelligence methods. With Dr. Landauer, she started the Wrappings approach to system integration. While at DARPA, she extended the then new concept of Virtual Worlds to education, business and research environments. With a number of academic partners, she is also developing new mathematical approaches to the analysis of Virtual Worlds containing collaborating humans, artificial agents, and heterogeneous representations, models and processing tools. Lastly she has been working on reflective architectures that use models to manage their own resources and to reason about appropriate behavior. Recently with both national and international partners, she is combining reflective architectures with Organic Computing approaches that emphasize the self-organizational properties of biologically-inspired architectures and operating systems. Among her awards, she recently received the 2008 Award in Technology from the Telluride Technology Festival. Other past awardees include Vint Cerf, Murray Gellman, Charles Townes, and Freeman Dyson.



For more information please visit <http://courses.washington.edu/bioetalk>