ENGINEERING TOOLS FOR SCIENTIFIC DISCOVERY

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New technologies and tools often provide the critical foundations upon which new discoveries in science are made. Revolutions in instrumentation for observing and measuring intrinsic characteristics and behaviors of natural systems are often followed by periods of prolific science. For example, telescopes and microscopes represent one set of tools that have allowed us to look at systems much larger and smaller than our conventional frame of reference, and in the process, have allowed us to develop many fundamental ideas about how matter is organized, how it interacts with itself, and how it empowers the processes of life. Similar to the advent of physical tools for observing the world around us, techniques for modeling and simulating processes by computation and mathematical methods have provided a structure for integrating the knowledge gained from observational science and for predicting future responses or outcomes. This session aims to highlight some of the recent advances in technologies that yielding new windows into how systems comprising discrete members organize and interact. It will cover a range of scales from nano-scale systems to oceanic systems.

At the micro level, the talk by V. Manoharan will highlight how very simple systems of micro- or nano-particles can assemble themselves into ordered structures. Understanding such mechanisms of self-assembly is key to building new kinds of optical materials and photonic devices. At an organismal level, by situating listening devices at various locations around the world, the talk by S. Wiggins will cover how we can track the behavior of marine mammals and how their sound-dependent lives are affected by their increasingly noisier environments. At a much different scale, R. Duren will introduce us to the Kepler space telescope that helps answer fundamental questions of solar system formation and the frequencies of earth-like planets. Finally, at an environmental level, sustainability is a key concern, from helping stabilize tuna populations, to transitioning to ethanol fuel without messing up food production, and in general how to better allocate our diminishing natural resources. The capstone talk by C. Gomes will show how recent advances in computational sustainability can contribute to the environment, economy, and society. The key connecting thread among all these talks, as stated earlier, is understanding how systems comprising discrete members organize and interact and engineering tools to support such understanding.