University of Colorado at Boulder

AEROSPACE ENGINEERING SCIENCES

Seminar

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A Systems Approach to New Opportunities in Earth Observation for the U.S. and Developing Countries

For decades, satellites and planes have served as useful platforms from which to remotely measure phenomena on the land, in the sea and in the atmosphere. These measurements provide valuable information that informs decision makers in areas such as weather forecasting, mapping, disaster response, water resource management and land use planning. **Currently, several factors are converging to enable new capabilities in satellite and aerial earth observation services, but the effectiveness of these capabilities requires a systems approach to design, execution and evaluation**. The first factor is that smaller, more affordable satellites and unmanned aerial vehicles are increasingly capable platforms for earth observation. Second, sensor technology for some measurements is available in more compact, manufacturable packages. Third, tools for data management, data analysis and information delivery are evolving rapidly. Meanwhile, on the policy and economic front, governments debate the most efficient funding approach to maintain both operational and scientific earth observation capabilities. Governments in many developing countries that previously depended on satellite data provided by other countries now seek to develop domestic capability to build and operate satellite earth observation systems. In the private sector both new and established companies are experimenting with new services based on satellite and aerial earth observation capability. It remains to be seen what will emerge as the dominant business model or government policy to foster satellite and aerial earth observation. (Continues on next page).

Wednesday, June 22, 2016
11:00 am
CLARK Conference Room in
College of Engineering Dean's Offices
NOTE: NEW LOCATION

This presentation discusses a systems approach to earth observation that offers two areas of improvement over traditional approaches. First, traditional earth observation systems were built over multiple years by disparate teams of specialists that designed the sensors, platforms, data analysis and information services, with only loose coordination. The advent of smaller, more accessible satellites, UAVs and sensors allows multidisciplinary teams to work closely together on design and operation of satellite or aerial based earth observation systems. These closely knit teams enable greater feedback between the needs of the end user and the design of the platform, sensors and operations. Second, this approach uses an original Systems Architecture Framework developed by the author that accounts for objectives, constraints, stakeholders, functions and forms of the earth observation system to elucidate decision making during the design process. **Specifically, I will present three areas of work that contribute to a systems approach to enabling improved services based on earth observation: 1) Field research to evaluate the application of satellite and aerial earth observation systems; 2) Modeling and simulation tools to inform the design of earth observation systems; and 3) Design and demonstration of satellite and aerial earth observation systems that can be applied to solutions in water resource management, public health, food security and disaster response.**

In my research, I perform **field research** in the US and developing nations to evaluate the implementation of earth observation systems enabled by satellites and aerial platforms. I study how these earth observation systems are used to support decision makers. The output of this field work informs the design and operation of earth observation systems for environmental applications. One example of this work is my series of publications on newly formed earth observation satellite programs in developing nations. The field work reveals the challenges of implementing earth observation systems and the needs of users. Based on these findings, I further analyze design options for satellite and aerial earth observation systems via **modeling and simulation**. I develop physics-based modeling and simulation tools to capture the performance of the technical systems; I combine this with social science and economics to capture stakeholder value models. The models account for uncertainty by stochastically representing environmental, policy and technology features as random variables. These integrated socio-technical models show how technical designs and operational approaches influence the system performance in meeting the needs of system users. This modeling and simulation work builds on my experience as a systems engineer within the Aerospace Corporation, a Federally Funded Research and Development Center. My research portfolio also includes **development and demonstration** of earth observation systems; this builds on my work at the Johns Hopkins Applied Physics Laboratory as a systems engineer.

Biography:

Dr. Danielle Wood is a researcher, teacher and practitioner in satellite engineering, systems architecture and space policy. In her research, Dr. Wood applies these skills to develop innovative system approaches for earth observation that address environmental challenges such as water resource management and disaster response in the US and developing nations. Currently, Dr. Danielle Wood serves as the Special Assistant to the NASA Deputy Administrator, Dr. Dava Newman. In this role, Dr. Wood serves as the primary advisor to the Deputy Administrator; she contributes to researching, coordinating, and managing activities within the Office of the Deputy Administrator in the areas of exploration, innovation and education. Prior to joining NASA in 2015, Dr. Wood worked as a satellite systems engineer within the Aerospace Corporation, a Federally Funded Research and Development Center that supports US government space activity. In this position, Dr. Wood led multi-disciplinary engineering teams to model satellite constellations; she also performed requirements management and risk analysis for satellite programs. In addition to her work at Aerospace, from 2013 to 2015 Dr. Wood held a research appointment within the Systems Institute of Johns Hopkins University. In this role, Dr. Wood led a research team to analyze the systems engineering approaches of satellite earth observation programs in developing nations. Previously, Dr. Wood completed a research fellowship at the Johns Hopkins Applied Physics Laboratory, where she worked as a systems engineer for satellite instruments and taught courses in systems engineering. During her career, Dr. Wood has worked as a guest researcher and intern with both NASA and the United Nations Office of Outer Space Affairs. In 2012, Dr. Wood completed a PhD in Systems Engineering from the Massachusetts Institute of Technology. Dr. Wood also holds a Bachelor of Science in Aerospace Engineering, a Master of Science in Aerospace Engineering, and a Master of Science in Technology Policy from MIT.