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Top three blog posts
this month:

- MAJ Shakarian Publishes Book
- Classifying Capital Markets with Functional Networks
- Data Gathering in Djibouti

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15 January

for Network Science

Workshop

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Biological Network Research at West Point

Ken Wickiser, PhD

In nature, microorganisms such as bacteria serve as biosensor platforms engaging in chemical warfare as they compete for scarce resources in an ever-changing environment. Some classes of organisms work alone over the course of their lifetime while others band together in times of stress to perform more complex tasks. The Bio-Networks lab at West Point is engaged in several lines of research involving the communication of simple cells and the perturbation of the genetic and metabolomic circuits in these organisms in response to the exposure to a drug or chemical contaminant.

The soil-dwelling social amoeba, *Dictyostelium discoideum* (dicty for short), is a wonderful model organism that shares much of the same molecular architecture as mammals but exists as a single cell feeding on bacteria in nature. However an amazing transformation occurs when the individual cell senses its food source becoming scarce: the cells make a collective decision to collaborate in forming a spore, or

cellular life raft, to ensure the survival of some - but not all - cells in the group. In fact, while some cells enter the spore to weather the starvation conditions, other cells in the group sacrifice themselves by enacting apoptosis (programmed cell death) to form a stalk-like structure that presents the spore up off the ground so the wind or an animal will transport it to a new, food-rich location. The question remains on how the decision is made between the sacrifice and preservation outcomes. Our group is studying the growth of these organisms in the context of localized food shortages and poisonous chemical environments to gain insight into the communication architecture. The group has secured funding from the Office of the Secretary of Defense (OSD) to study these cells in order to build models of simple ad hoc networks. The network of genes in a cell is tightly controlled through the use of feedback and feed-forward controllers, oscillators, and other biological analogs to classic electrical engineering circuitry components. Biotechnology tools have advanced to the point of being able to simultane-

ously assess the expression levels of each of over 30,000 genes present in the cell at any point in time. These massive data sets require computational tools to give insight into the relatedness of the components. The Bio-Networks group seeks to build a large dataset of the perturbations of gene and metabolite networks in simple model organisms due to exposure of chemical compounds of Army interest. At this time the group is analyzing the effect of explosive compounds on microorganisms and, given these data, constructing a graph of biological interactions. Dr. Elizabeth Mentis (Research Associate) and Dr. J. Ken Wickiser (Assistant Professor of Chemistry and Life Science) presented their recent work on the project at the 2011 Defense and Threat Reduction Agency (DTRA) Chemical and Biological Defense Conference in Las Vegas, NV. The researchers discussed the work with leaders in the field of biosensors and defense-related research and established working relationships with several laboratories that will host cadets for summer internships next year.

Minerva Research Initiative at West Point

Kristine Ringler

The Minerva Initiative is a Department of Defense (DoD)-sponsored, university-based social science research initiative launched by the Secretary of Defense in 2008 focusing on areas of strategic importance to U.S. national security policy. The goal of the Minerva Initiative is to improve DoD's basic understanding of the social, cultural, behavioral, and political forces shaping regions of the world and that are of strategic importance to the United States.

Beginning 2010, the Office of the Secretary of Defense partnered with a range of Defense educational institutions to launch Minerva Research Fellow programs at select Joint Professional Military Education schools. In 2011 the program expanded to also include the three Service Academies. Scholars accepted into Minerva Research Fellow faculty positions are expected

to investigate Minerva-relevant research topics and hold a Ph.D. in social sciences or foreign area studies research, as well as possess a significant track record of research, teaching, and academic presentation and publication exploring a given topic area. The program is intended to build DoD in-house expertise in the social sciences by incorporating subject matter expertise into strategic levels of study and engagement across the Services and within the Department. <http://minerva.dtic.mil/index.html>

The United States Military Academy has been awarded two Minerva Chairs from the Office of the Secretary of Defense. The two research projects, entitled "Social, Spatial and Cultural Topologies of African Villages" were awarded to the Department of Geography and Environmental Engineering and "Understanding the Differences in the Islamic Ideology and in Asian Cultures" to the Department of Behavioral Sciences and Leadership.

Both proposals address National Security interests, Minerva topics and will enhance social science research through the use of network science. The Network Science Center is a supporter and collaborator of the USMA Minerva Research Initiative. <http://www.netscience.usma.edu/research/minerva.htm>.

An interdisciplinary approach within the social sciences is the aim of the USMA Minerva Research Initiative. This approach will continue as each Department moves forward with their hiring process of two Minerva Fellow Chairs. In doing so, Minerva at West Point will enhance its research through growing applications and education. The research initiative will inform and generate a better understanding of socio-cultural dynamics within areas of high importance to the U.S. Government's National Security interests. It will also seek to build foundational knowledge that will benefit the U.S. military and academic community.

Network Science Workshop Rescheduled for 22-24 April

Current Publications/Presentations:

Current articles are on NSC website under Publications or linked below:

[Economic Development and Network Science](#)

[Modeling Cooperation in Networks, Organizations, and Systems](#)

[Untangling Arache's Web: Utilizing Social Network Science, AutoMap, and ORA to Analyze Social Change in Tanzania](#)