Friday, March 13, 2015

10:30 — 11:00   **MacGyver on the Hudson — Introduction**
Inexpensive and widely available build-it-yourself technologies — like the Arduino ecosystem of embedded computers, sensors, and actuators; the the Parallax kits for building robots; and many kits for building aerial drones — give us, as mathematics educators, the opportunity to teach mathematics in exciting settings and to prepare our students to make better personal and public policy decisions about the developing symbiosis between humans and robots. This is the introductory talk in a series of independent but related talks on leveraging this power. All the the talks will include classroom-ready materials addressing topics in current courses. The minicourse **MacGyver on the Hudson** on Saturday 11:00 — 12:45 will give participants hands-on experience with these technologies. This talk presents the big picture and how we choose what to buy. Speaker: Frank Wattenberg, U.S. Military Academy.

11:15 — 11:45   **Programming Arduinos, Robots, and Quadcopters**
The Arduino ecosystem, robots, and quadcopters get their power from mathematics and programs that implement that mathematics. This talk is is an introduction to Arduino programming. It will cover the basics of building and programming devices that use a combination of sensors and actuators to, for example, collect data, build remotely operated or autonomous robots, explore Mars or the Moon, or do aerial surveillance. The emphasis will be on classroom-ready learning materials that require only the parts contained in the Arduino starter kit, priced about $90.00. Speakers: Frank Wattenberg and Matthew Mogensen, U.S. Military Academy.

12:00 — 12:30   **Sensors and Actuators**
The Arduino ecosystem includes a very wide variety of inexpensive sensors and actuators including imaging, physical, chemical, and biological sensors and light, sound, and mechanical actuators. As one example, a pair of transceivers that enable two Arduino devices to communicate with each other is under $7.00. The emphasis in this talk is on classroom-ready materials leveraging inexpensive sensors and actuators beyond the basic Arduino starter kit. It will include practical considerations — for example, which sensors are well-documented. Speakers: Drew Wilkerson, Army Research Laboratories and Frank Wattenberg, U.S. Military Academy.

12:45 — 1:15   **Robots**
Robots offer a fun, interactive, and accessible way to demonstrate mathematical concepts in a classroom environment. For a total price of under $150.00, a combination of the Parallax BOE wheeled robot kit and an Arduino Uno give us and our students the power to build and experiment with robots. For the same price, commercial, Arduino-powered, ready-built kits such as the Sparki are also available. As one example, we can experiment with autonomous vehicles, see how

mathematics can help design them, and address the different aspects of real-time decision-making that are involved. Much of the mathematics we explore is one or two dimensional. In addition to geometry, classroom-ready materials include the ideas and numerics of differentiation and integration.
Speakers: Matthew Mogensen and Ben Minden (cadet), U.S. Military Academy.

1:30 — 2:00   **Quadcopters**
Quadcopters and other aerial drones are being used for many different purposes — from the battlefield, to emergency rescue scenarios, to taking wedding pictures. They can be built from readily available kits and they rely on the same programming as the Arduino ecosystem. In fact, many use Arduino chips. They are more expensive than robots and pose more difficulties, but they are within range of high schools and colleges. The mathematics, for example, is inherently three-dimensional and the use of aerial vehicles is often restricted. This talk will focus on our experience building a quadcopter and programming it. Speakers: Ben Minden (cadet), U.S. Military Academy, and Drew Wilkerson, Army Research Laboratories.