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Tiny antennas with big potential



Professor Mosallaei, holding metamaterials, is working to make antennas smaller and more efficient. Photo by Lauren McFalls.

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As Northeastern University engineering professor **Hossein Mosallaei** sees it, antenna technology has not been keeping pace with three trends in the development of wireless communications devices: greater energy efficiency, faster speed, and smaller components.

Mosallaei is seeking to address all three areas in a research project that could lead to significant advances for a variety of applications, ranging from medical diagnostic technology to airport security screening devices.

For example, smaller antennas that transmit information quickly and use less power can support the development of tiny medical biosensors that transmit diagnostic data faster and provide doctors with more accurate, focused information about a patient's condition.

"Whether they will help doctors diagnose patients earlier, or help to monitor the world around us more efficiently, the technological capabilities of these tiny antennas will bring about a new era in improved wireless communications," said Mosallaei.

One major challenge for Mosallaei and his team is to create smaller antennas that also transmit information at high speed. Currently, all antennas — whether used for cell phone communication, television reception or medical-device information sharing — function at optimum levels at an operating frequency of 1GHz and about 150 millimeters in length.

Mosallaei hopes to maintain that functionality or better it, working with antennas just one millimeter in length.

The answer, he believes, lies in the use of metamaterials—manufactured materials not found in nature.

Working in the micro- and nanoscales, Mosallaei and his colleagues plan to engineer and assemble antennas integrated with active circuits—all composed of metamaterials—that will be tiny, energy-efficient, and fast.

"Our goal is to develop a new antenna that allows for very quick data transmission over any distance, long or short, while keeping it as small as possible," he says.

Mosallaei and his team were recently awarded a three-year, \$490,000 grant from the Office of Naval Research to support the project.

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