

FAB\$ and LABS

Georgia Tech Sees the Future in RF Printed-Electronics



I have just one word for you, are you listening, “Printed-Electronics” is the future and Georgia Tech is a leader in printed RF electronics among other areas represented in the Agile Technologies for High-performance Electromagnetic Novel Applications (ATHENA) group, led by Dr. Manos Tentzeris. They explore the advancement and development of novel technologies for electromagnetic, wireless, RF, mmWave and sub-THz applications. Their research includes areas such as telecom, defense, space, automotive, health, smart skin, weather/climate and sensing areas and combines inkjet printing, flexible paper/organic substrates, nanotechnology-based structures and green energy scavenging. The activities are typically sponsored by NSF, NASA, DARPA and a variety of U.S. and international corporations.

The group includes the RFID/Sensors subgroup which focuses on the development of paper-based RFIDs and RFID-enabled “rugged” sensors with printed batteries and power-scavenging devices operating in a variety of frequency bands ranging from 13.56 MHz to 60 GHz. In addition, members of the group deal with bio/RF applications (e.g., breast tumor detection), micromachining (e.g., elevated patch antennas) and the development of novel electromagnetic simulator technologies and its applications to the design and optimization of modern RF/microwave systems.

Microwave Journal had a chance to visit their printed-electronics area during IMS in June. The Prototype of Integrated RFID-Enabled Agile Systems (PIREAS) lab is an educational testbed that has been put together at the Georgia Tech Electronic Design Center by a group of graduate and undergraduate students working with Professor Tentzeris in an effort that started in 2006. Currently, the PIREAS lab has expanded beyond UHF RFID applications and introduced microwave and mmWave test and measurement environments. Advanced inkjet printing and other low-cost additive fabrication methods are currently being used within the lab to help advance the state-of-the-art in vertically integrated, flexible electronics. Antennas and RF systems can be measured up to 40 GHz.

The PIREAS lab contains a variety of microwave test equipment. Two Anritsu VNAs provide accurate measurements for antennas and RF systems up to 40 GHz and with a Cascade probe station, small scale signal feeding can be performed. A mmWave far field measurement system provides 360-degree radiation pattern measurements with a high angular resolution. A Keithley Picoamp meter/voltage source provides impedance, voltage and current measurements.

For further dynamic RF characterization, a Tektronix Real-Time Spectrum Analyzer and a Rohde & Schwarz Vector Signal Generator are available up to 8 GHz, as well as oscilloscopes operating up to 3 GHz with passive and active probes for in-circuit measurements. A Keysight FieldFox portable VNA is available for on-field S-parameter measurements up to 4 GHz and a NI PXI system is used for automation of the lab’s VNAs, spectrum analyzer, oscilloscopes and data acquisition systems that are used for DUT-excitation signal generation. The lab has custom RFID/sensor wireless interrogating systems/readers built on software-defined radio platforms for frequencies up to 4.5 GHz, and RF-DC rectifier/harvester characterization equipment including a Rohde & Schwarz and Lady Bug power meter to 40 GHz and an Agilent desktop precision digital multi-meter.

For processing, there are two Fujifilm Dimatix Materials Printers, a PixDro industrial inkjet printer, a Formlabs 3D printer and an Ultimaker 3D printer for flexible electronics. The wet lab has a Branson sonicator, Eppendorf Thermomixer and Vacuum Plus concentrator, used for ink mixing and formulation. A semi-clean room has a Dimatix inkjet printer, UV Crosslinker, Jelight Cleaner, Jeio Tech vacuum oven and KLA Tencor surface profilometer for material curing and characterization.

Georgia Tech is one of the top universities doing research in RF and microwave technologies. They have an active startup community that uses technologies developed in the labs and many students go onto launch companies or continue to research new technologies in our industry, academia or government labs.

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