Millimeter-Wave and Terahertz Measurements

EEE598 (28176), Mon & Wed, 4:35-5:50pm SCOB302
Prof. George Trichopoulos

Description: The need for ultra-fast communication links and advanced radar imaging methods have pushed the performance of electronics well beyond microwaves (>30 GHz). The advances of semiconductor technology and nanofabrication techniques have enabled RF devices and circuits to operate already beyond 1 THz. The design cycle and characterization of such ultra-fast RF integrated circuits depend on the measurement tools and methods. Additionally, RF measurements are important in characterizing materials based on the electrical properties.

This course introduces the students to the basics of RF measurements with emphasis on on-wafer testing and material characterization. The course discusses the challenges of on-wafer measurements and presents the methods and tools to achieve reliable mmW/THz device and circuit testing.

Content:

- **Overview of MmW/THz devices and circuits** – Passive and active components: transmission lines, filters, sources, amplifiers, sensors, transceivers, applications, semiconductor technologies and fabrication techniques, discrepancy between CAD models and actual device/circuit performance.
- **Electromagnetic material properties in mmW and THz: -** frequency selective surfaces (FSS), THz spectroscopy applications.
- **Basics of RF Measurements and challenges of mmW/THz testing –** Uncertainty and confidence in measurement, calibration, accuracy and precision of measurements, repeatability,
- **Operation Principles of Measurement Equipment** – Network analyzer, Spectrum Analyzer, VNA extender, CW and time domain spectroscopy instruments
- **Probing Methods** – Connectorized, contact probes, non-contact methods, free space material characterization
- **Calibration Methods** – SOLT, TRL, LRRR, Deembedding
- **Modeling Parasitics-** Small signal modeling, parasitics extraction, extracting intrinsic performance of devices
- **MmW/THz Antenna Measurements**

Prerequisites: EEE445 Microwaves (or equivalent). Basic knowledge of Matlab (or equivalent), ADS or HFSS is recommended.

Recommended books: J. P. Dunsmore, Handbook of Microwave Component Measurements, Wiley
D.M. Pozar, Microwave Engineering, Addison-Wesley.

Grading Policy: Homeworks (25%), Midterm Exam (30%), Term Paper and Final Presentation (45%). Four homework assignments will be given.

For further details, please contact Prof. George Trichopoulos (gtrichop@asu.edu).