

MIMO

ANTENNA SYSTEMS

A 2-day
hands-on
short course

Albuquerque, NM,
March 16 & 17, 2017

MIMO capable wireless systems use Multi Element Antennas (MEAs). While single antenna/port systems are well understood, MEAs pose certain challenges. This is primarily because MEAs are designed to be excited under the control of smart algorithms. These algorithms can and, during normal operation, do synthesize a large variety of patterns from an MEA by changing its excitation vector according to the propagation environment and other conditions. As such, traditional performance metrics are not adequate in describing MEA performance, especially their performance in MIMO. In this class, we will explain from first principles how to characterize MEAs and how to analyze

and optimize their performance in a MIMO capable wireless communication system for the ultimate spec, Capacity and Throughput. This approach allows for the **antenna designer** to design smaller and less costly 4G and 5G products without sacrificing capacity performance. Additionally, **communications engineers** can better assess the dynamic range of their smart algorithms and Spectrum managers can combine MEAs with MIMO techniques to mitigate Harmful Interference and optimize Spectrum Utilization Efficiency.

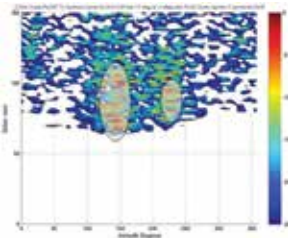
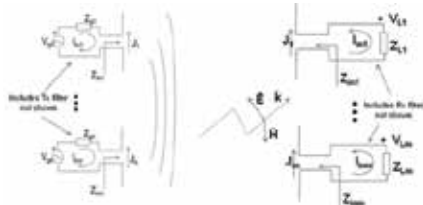
You will learn how single and, especially, multi element antennas affect the capacity of a communication system. You will learn how to design antennas systems that outperform others based on capacity and throughput. You will learn a Cross-Layer design approach of MIMO systems. You will be exposed to tools that accomplish capacity based design of antenna systems.

Topics Covered:

Single antenna fundamentals, Multi Element Antenna fundamentals, Information theory for antenna engineers, communication systems with single antenna elements, MIMO enabled communication systems with MEAs, design and characterization of MEAs, CTIA 2x2 MIMO test plan, software tools for MEA design, examples.

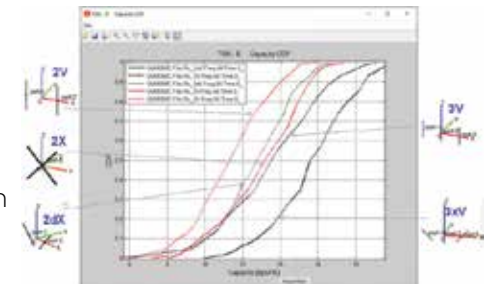
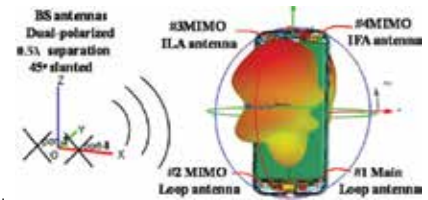
Day 1—Theory

- Stratton-Chu solution of Maxwell equations
- General solution of any antenna problem, the active E-field gain function
- Antennas as Transmitters and Receivers
- Tx-Rx pattern reciprocity and other fundamental antenna properties
- Information theory and Shannon's Capacity formula
- Friis Formula and Single Input Single Output system capacity
- SISO antenna design to maximize capacity
- MIMO antenna systems; what, why, how
- Traditional performance indicators (ECC, MEG, etc.)
- Antenna termination effects and transformations
- Multipath propagation environments
- Propagation environment models (3GPP and IEEE standards for 4 and 5G systems)



Day 2—Hands-On

- Electromagnetics exact MIMO system transfer function and channel matrix
- Capacity Cumulative Distribution Function (CDF) and Probability Density Function (PDF)
- MIMO capacity formulas (channel side info; ergodic, beamforming & waterfilling capacity)
- 2, 3, 4-port antenna design examples
- polarization and spatial diversity
- multi-branch ant system matching & isolation
- MIMObit; a MIMO ant system simulation tool
- Hands-on MIMObit usage



Participants are encouraged to bring their own laptop. Those interested, will get a trial version of MIMObit in class and be able to run it directly on their own for some of the course examples, or their own specific wireless problems, as appropriate.

Course #: 63130 **8:00am-5:00pm**

March 16 & 17, 2017

Albuquerque, NM

Continuing Education South Bldg, Rm 219

\$1,950 per person

20% discount if registered by March 3

Student Fee: \$500 per student

Breakfast and lunch will be provided.



Instructor: Nick Buris. Nick, an IEEE fellow, has 30 years experience in the antennas, microwave and systems fields having worked in academia, large corporate research laboratories, NASA and having started his own small business developing software simulation tools for wireless systems. In 2016 NEBENS released MIMObit, a tool addressing MIMO antenna system design as well as coverage, coexistence and dynamic spectrum access elements of wireless communication systems.

Offered in partnership



For more information contact Marth Beckett | 505-277-6033 | itpro@unm.edu

505-277-0077
ce.unm.edu/MIMO