

Planar near-field measurements of phased array antennas in millimetre-wave bands

Abstract:

This course will present theoretical and practical aspects of the design of active phased array antennas. The basis of design of array antennas will be introduced with focus on practical aspects. The most critical features of the beamformer integrated circuits (BFICs) will be described. The course also introduces the characterization of the radiation pattern of a phased array in near field conditions and its transformation to far field. The planar near-field measurement for a 2D phased array of 8x8 elements will be shown experimentally in-situ for the n257 frequency band.

Graphical abstract:



Recommended prerequisites for attendees:

The course requires a basic knowledge on array antennas, antenna measurement systems and electromagnetism. Transmission-line analysis

Learning objectives:

After the course, the participant will be able to:

- Define requirements for array antenna design: array dimensioning, substrate choice, feeding network, software simulation.
- Evaluate BFICs features: structure, linearity, amplitude and phase error effects, variation with temperature and resolution.
- Setup a planar near-field radiation pattern measurement.
- Apply planar near-field to far-field transformation.

Course outline:

1. Array antenna design (30 min)
 - Theoretical basis
 - Examples with *Matlab*
2. Beamformer integrated circuits (30 min) ○ Structure
 - Linearity
 - Amplitude and phase errors effects
 - Variation with temperature
 - Resolution.
3. 3. Planar near-field radiation pattern measurement (30 min)
 - Theoretical basis
 - System elements
 - Setup requirements
4. Planar near-field to far-field transformation (30 min)
 - Theoretical basis
 - Example with *Matlab / Python*
5. Practical demonstration (1 hour)

It is recommended that the participants bring a laptop with *Matlab* and the *Phased Array System Toolbox*.



Alfonso Tomás Muriel-Barrado was born in Madrid, Spain, in 1990. He received the M.Sc. degree in telecommunication engineering from the Universidad Autónoma de Madrid (UAM), Spain, in 2015. He received the Ph.D. degree from Universidad Politécnica de Madrid (UPM) in 2023 (Cum Laude). In February 2020, he joined UAM as an Adjunct Professor. He is also part of the Grupo de Radiación (GR) Research Group, UPM.

His current research interests include initially focused on the study of new concepts of antenna arrays, both passive and active, to provide them with a certain degree of reconfiguration as well as the design and manufacture of microwave devices. Other research areas include antenna measurement systems, and digital antennas or 5G systems for future applications such as mobile satellite communications.



Ana Vazquez Alejos is an Associate Professor in the Department of Signal Theory and Communications at Universidade de Vigo since 2012, with research lines focused on radio channel modeling, waveform and noise code design, and beamforming antennas for 5G/6G systems. Her Master Thesis obtained in 2002 the Ericsson Award by the Spanish Association of Electrical Engineers, as the best Multimedia Wireless Project. She received the PhD degree from the Universidade de Vigo, Spain, in 2006, with a research on channel radio characterization for the 40

GHz band. In 2009, she was granted a Marie Curie International Outgoing Fellowship and carried out an 18 months research stay in New Mexico State University (USA).

She was involved in teaching of electromagnetism, antenna design and wireless communications at Bachelor and Master level since 2004. She is part of the Sistemas Radio research group and atlantTic research center.

Key bibliography

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