An introduction to spherical near-field measurements

Abstract

AN INTRODUCTION TO SPHERICAL NEAR-FIELD SCANNING
Maxwell's Equations and Spherical Modes, Evanescence, Cutoff of Spherical Modal Sum, Spherical Near-Field Transmission Equation, Spherical Near-Field Sampling Criteria, Computation of the Far-Field

IMPLEMENTATION OF SPHERICAL NEAR-FIELD SYSTEMS
Mechanical Positioning Configurations used to Create Spherical Surfaces, Practical Measurement Considerations, Gain Measurement Techniques, Range Uncertainty Evaluation for Spherical Near-Field Measurements

CASE STUDIES
Far-Field Patterns from Spherical Near-Field Measurements, Polarization Parameters, Modal Filtering Examples, Effects of Various Error Sources, Back Projection Diagnostics

Graphical abstract

Recommended prerequisites
The course requires a basic knowledge on Electromagnetics.

Learning objectives

After the course the participant will be able to Spherical near-field (NF) scanning has become a key element in antenna engineering practice. Maturing from its research beginnings in the 1970's to the wide variety of applications found today, it represents a fundamental approach to determination of performance for almost all types of antennas. Nevertheless, a full understanding of the theoretical basis and the principles of measurement practice is held by only some in the antenna engineering community. The reason for this is that commercial software alleviates the need for a knowledge of the underlying theory on the part of technicians operating an antenna range. This course offers participants an opportunity to appreciate the relationship between fundamental knowledge and its application in the practice of antenna measurement.

Course outline

An Introduction To Spherical Near-Field Measurements
EuCAP 2020 Half-Day Short Course, Friday afternoon 20 March 2020

Topic	Scheduled Time
An introduction to spherical near-fieldscanning	Hour session 1
Implementation of spherical near-field systems	Hour session 2
Break	One-half hour
Case studies	Hour session 3

Instructor 1 – Biography

John T. McKenna is a Senior Systems Engineer at NSI-MI. John joined the Company in 2002. He has developed and installed numerous antenna measurement facilities spanning all business areas of the Company: just about all types of antenna measurement systems domestically and around the world, 0.1 – 110GHz. John has been working in the business of electromagnetic wave propagation since 1987. NSI-MI was formed by the merger of NSI and MI Technologies in January of 2016. John has taught a five day short course for spherical near field measurement.

John's career includes years of service with Georgia Tech Research Institute (GTRI), Cypress Semiconductor Corporation, IBM, M/A-COM, Millitech Corporation, and Texas Instruments. At GTRI, he led tasks to exploit and refurbish a Radar Receiver. At Cypress Semiconductor, he designed data communications hardware interfacing parallel RAM data ports to serial fiber-optic cable. At IBM, he developed RF volume characterization capability for 6 GHz on-wafer transceivers. At M/A-COM, he prototyped, developed and produced the first deployed 28 GHz receiver for "wireless cable television," shipping 25,000 profitable receivers under his leadership. At Millitech, he designed and shipped many millimeter-wave radiometer systems, custom filters, mixers, and oscillators. At Texas Instruments, he designed GaAs MMICs for application in phased-array antennas.

John is a member and has served as Secretary in the Atlanta IEEE MTT-S/APS Chapter. He is a member of the Antenna Measurement Techniques Association (AMTA) and is an active volunteer in his home community of Alpharetta, Georgia.

John earned the degrees Master of Science and Bachelor of Science in Electrical and Computer Engineering (MSEE, BSECE) at the University of Massachusetts at Amherst

Instructor 2 – Biography

Patrick Pelland is an Applications Engineer for NSI-MI. In this role, he is responsible for ensuring that EPD engineering efforts are focused and remain on schedule. He interfaces with design engineers and project managers to ensure that delivered solutions match customer requirements and expectations. Prior to this assignment, Patrick was responsible for all contract testing activities performed in the Los Angeles office. This includes interaction with customers, scheduling, project management, testing and processing of data. In addition to his main responsibility, he also supported field installation efforts, customer training, range assessment activities and a number of in-house research and development tasks. NSI-MI Technologies was formed by the merger of NSI and MI Technologies in January of 2016.

Patrick has spent his professional career working in the antenna measurement field with an emphasis on spherical near-field theory and uncertainty analysis. Prior to working at NSI-MI, Patrick worked with the Canadian Space Agency's Radio Frequency Qualification Group as a contract employee during his time as a graduate student at the University of Ottawa.

Patrick has been an active member of the Antenna Measurements Techniques Association (AMTA) since he was a graduate student in 2010. Most recently, he organized AMTA's student day at the 2015 conference. Patrick has authored and co-authored a number of papers for a variety of international technical conferences, including AMTA, APS, EuCAP and ANTEM.

Patrick holds a Master of Applied Science in Electrical and Computer Engineering and a Bachelor of Applied Science in Electrical Engineering, both from the University of Ottawa in Ontario, Canada. In conjunction with the Canadian Space Agency, Patrick developed an automated error evaluation procedure for spherical near-field antenna measurements. This research was presented in his master's thesis, titled "Automated Error Assessment in Spherical Near-Field Antenna Measurements". Several technical papers were written as a follow-up to this research in the years since Patrick's graduation.

Key bibliography

- J.E. Hansen (ed.). "Spherical Near-Field Antenna Measurements". Peter Peregrinus, Ltd., on behalf of IEE, London, 1988.
- Scientific Atlanta, "Series 2020 Antenna Analyzer Spherical Near-Field Range Configuration". 1982.
- Clive Parini et. al., "Theory and Practice of Modern Antenna Range Measurements". 2015."