SC14 - Fundamentals of RCS Measurements

Abstract:

Radar Cross Section (RCS) measurements are an integral part of many defense-related companies. Focusing on the most relevant topics in such a unique technical discipline can be difficult for the beginner, especially when hands-on proficiency takes significant time under the leadership of a senior practitioner. In this compact tutorial, the student is exposed to the most relevant issues related to making quality RCS measurements.

Recommended pre-requisites:

The course requires a basic knowledge of high school math and physics. Quality RCS measurements are the product of patience, attention to detail, and adhering to some basic rules of how radar waves interact with materials and structures.

Learning Objectives:

After the course, the participant will have a foundational awareness of the issues that matter most in making quality RCS measurements. Participants will understand the basics of wave travel, how RCS impacts survivability, how facility design, test planning, target preparation and mounting, signal processing, and best practices lead to quality RCS data products. Participants will also have an understanding of how RF forensics play a critical role in mitigating measurement errors, and how a range certification process can aid practitioners and end-users in the best use of RCS measurement data.

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Course Outline:

The three-hour tutorial is a PowerPoint lecture-based experience including practical examples with opportunities to address participant questions. Topics covered in the tutorial include:

- What is RCS and why does it matter?
  - Radar fundamentals
  - Radar Range Equation
- Basic scattering principles
  - Wave propagation
  - Incident field requirements
  - Wave interaction with materials and structures
- Measurement facilities
  - Indoor vs Outdoor
  - Direct illumination vs collimation
  - Collimating reflector configurations
  - R&D vs QC facility
  - Personnel access to target environment
  - Facility validation
  - Facility certification
- Measurement techniques
  - Target preparation
  - Target handling
  - Target mounting
  - Target motion
  - Test body usage
  - Monostatic vs bistatic illumination
- Test matrix development
  - Frequency
  - Polarization
  - Azimuth and Elevation
  - Target configurations
- RF measurement hardware
  - Vector Network Analyzers
  - Instrumentation radars
  - Antenna selection
  - Reflector selection
  - RF Cabling

- Calibration methods
  - Commonly used calibration targets
  - Calibration best practices
  - The role of computational electromagnetics

- Target mounting and positioning schemes
  - Foam columns
  - Ogival pylons
  - String systems
  - Azimuth, elevation, roll, and translation

- Data presentations
- Single parameter products
  - Multi-parameter products
  - Data processing software

- Measurement errors and mitigation
  - Target/facility interactions
  - Target/mounting structure interactions
  - Target/RF instrumentation interactions
  - RF interference
  - Environmental errors

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Instructor:

Dr. Hirsch Chizever received his BSEE from the University of Evansville in 1985, MSEE from the University of Dayton in 1995, and his PhD in Electrical Engineering from the Air Force Institute of Technology in 2022. Since 1985, Dr. Chizever has specialized in the trade craft associated with RCS, antenna, and material measurement techniques, signal processing tool development, and measurement range design and operations. Additional expertise includes:

- Range error diagnostics and mitigation
- NIST certification
- Calibration schemes
- Test body design and implementation
- Large system RF forensics
- Mobile RF measurement systems
- SAR imagery algorithms
- Multi-static illumination scenarios
- Super-resolution techniques
- Clutter rejection methods
- Radar target recognition

Dr. Chizever's understanding of electromagnetics and decades of hands-on range experience allows him to deliver practical information to those wishing to rapidly advance their knowledge of measurement science.