UNDERSTANDING WEATHER RADAR FUNCTIONAL REQUIREMENTS

The Foundations of Effective Radar Systems

Short Course Organizers

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Time	Topic	Description
8:00 AM	OPENING, INTRODUCTIONS, PROGRAM INFO	Get acquainted and provide course overview
8:30 AM	ELEMENTS OF WEATHER RADAR	Review key elements of radar systems using the radar equation for point and distributed targets, Doppler and Polarimetric radar evolution.
9:30 AM	COFFEE BREAK	
10:00 AM	RADAR FUNCTIONAL REQUIREMENTS	Functions a weather radar should perform, including precipitation estimation, warning operations, particle identification, research, etc.
11:00 AM	Part 1: RADAR QUALITY REQUIREMENTS	Introduction to quantitative attributes of radar performance including bias, variance, precision, and representativeness of estimations.
12:00 PM	LUNCH	
1:00 PM	Part 2: RADAR QUALITY REQUIREMENTS	Quantitative examples of radar performance including bias, variance, precision, and representativeness of estimations.
1:45 PM	BREAK	
2:00 PM	RADAR QUALITY ASSURANCE	Data quality analysis and verification, simulations, real data processing, external tests.
3:00 PM	THE FUTURE	Requirements driven by evolving technology
3:45 PM	COURSE END	

ELEMENTS OF WEATHER RADAR

A review of the basic elements of a weather radar system is important to identifying and understanding key requirements. We will use the radar equations for point and distributed targets as a framework for discussing the effects of the various internal and external components of the radar-atmosphere system on system performance. We'll examine the evolution of radar technology from detection through the evolution to Doppler and dual polarization. We'll introduce the concepts of phased array antennas

which are the current phase of radar evolution and discuss the challenges presented by this technology.

RADAR FUNCTIONAL REQUIREMENTS

This section covers the operational and research support functions that a weather radar should perform. We'll use the NOAA Radar Functional Requirements and the Office of the Federal Coordinator for Meteorological Services and Supporting Research handbooks to facilitate the discussion of the wide range of functions modern weather radar systems support.

RADAR QUALITY REQUIREMENTS

We'll select several key functions and products of the radar and present the analysis and reasoning behind the quantitative measures contributing to effective performance and data quality. We'll use the original NEXRAD Technical Requirements and current WSR-88D System Specifications, revisit the NOAA Functional Requirements document, and review several key papers and research reports that led to the classic requirements. We will also look at the effects of clutter and review the development of mitigation methods. We will emphasize the need to ensure that requirements are reasonable and verifiable.

RADAR QUALITY ASSURANCE

Verifying radar performance is always a challenge. There are several ways to assess a radars quality including simulation, testing, data analysis, and field observations. In this section we will look at some examples of past verification efforts supporting programs such as the WSR-88D Open Radar Data Acquisition project, the migration from analog to digital receivers, spectral clutter filter implementation, clutter identification, range-velocity mitigation methods, and dual polarization. Radar calibration will be presented as an example of the challenges of verification.

THE FUTURE

To wrap up the course, we will lead a discussion on the future of weather radar as it evolves the support evolving technology and societal needs. This can include challenges emerging in transportation, industry, urban development, and effects of climate change. Future requirements driven by the acceleration in technology present a particular challenge.