

# Radar Technologies

This course is intended to provide an overview of Radar Technologies. Course covers the fundamentals of electromagnetism, signal processing, radar equation, propagation, signal detection, antennas, clutter, pulse compression, clutter rejection and tracking.

- **Introduction, 1 hours**
  - Background
  - Radar basics
- **Review of Electromagnetism, 2 hours**
  - Background
  - Maxwell's Equations
  - Electromagnetic Waves
- **Review of Signals, Systems and Digital Signal Processing, 4 hours**
  - Continuous Signals
  - Sampled Data and Discrete Time Systems
  - Discrete Fourier Transform (DFT)
  - Fast Fourier Transform (FFT)
  - Finite Impulse Response (FIR) Filters
- **The Radar Equation, 4 hours**
  - Introduction to Radar Equation
  - Surveillance Form of Radar Equation
  - Radar Equation for Rain Clutter
  - Radar Losses
  - Examples
- **Propagation through the Atmosphere, 3 hours**
  - Reflection from the Earth's surface
  - Atmospheric refraction
  - Over-the-horizon diffraction
  - Atmospheric attenuation
  - Ionospheric propagation
- **Detection of Signals in Noise, 4 hours**
  - Probabilities of detection and false alarm
  - Signal-to-noise ratio
  - Integration of pulses
  - Fluctuating targets

- Constant false alarm rate (CFAR) thresholding
- **Radar Cross Section, 3 hours**
  - Radar cross section (RCS) of typical targets
  - Physical scattering mechanisms and contributors to the RCS of a target
  - Prediction of a target's radar cross section
- **Antennas, 2 hours**
  - Antenna Fundamentals
  - Reflector Antennas – Mechanical Scanning
  - Phased Array Antennas
  - Frequency Scanning of Antennas
  - Hybrid Methods of Scanning
- **Radar Clutter, 3 hours**
  - Ground
  - Sea
  - Rain
  - Birds and Insects
- **Waveforms and Pulse Compression, 3 hours**
  - Radar waveforms and their properties
  - Matched filters
  - Pulse Compression
  - Linear frequency modulation (LFM) waveforms
  - Phase coded (PC) waveforms
  - Other coded waveforms
- **Clutter Rejection, Part 1 - Basics and Moving Target Indication, 2 hours**
  - General description
  - MTI cancellers
  - Effect of signal limiting on performance
  - Multiple and staggered PRFs
- **Clutter Rejection, Part 2 - Doppler Filtering, 3 hours**
  - Description of pulse Doppler processing
  - Moving Target Detector (MTD)
  - Range and Doppler Ambiguities
  - Ambiguity Resolution
  - The “Ambiguity Function”

- **Airborne Pulse Doppler Radar, 2 hours**
  - Pulse Doppler radar in small fighter / interceptor aircraft
  - Airborne, surveillance, early warning radars
  - Airborne synthetic aperture radar
- **Parameter Estimation and Tracking, 3 hours**
  - Observable Estimation
  - Single Target Tracking
  - Multiple Target Tracking
  - Track-before-detect techniques
  - Integrated Multiple Radar Tracking
- **Transmitters & Receivers, 3 hours**
  - Transmitters
  - Receivers and Waveform Generators
  - Other Transmitter / Receiver Subsystems
  - Radar Receiver-Transmitter Architectures