

Radar Toolbox Release Notes



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Radar Toolbox Release Notes

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R2021b

Version: 1.1

New Features

Bug Fixes

Radar Designer App: Plot vertical coverage diagrams

Starting this release, the **Radar Designer** app can plot vertical coverage diagrams. Vertical coverage diagrams, also known as range-height-angle charts or Blake charts, show the relationship between the range to a target, the height of the target, and the initial elevation angle of the transmitted rays for the sensor. This visualization enables users to understand the propagation characteristics of electromagnetic waves through the Earth's atmosphere.

This release also introduces four functions related to Blake charts:

- `range2height` computes the target height based on the initial elevation angle at the radar, the antenna height, and the propagated range.
- `height2range` computes the propagated range based on the target height, the antenna height, and the elevation angle at the radar.
- `height2grndrange` computes the ground range based on the target height, the antenna height, and the elevation angle at the radar.
- `refractionexp` computes the refraction exponent, which is the decay constant of the Cosmic Ray Physics Laboratory (CRPL) exponential reference atmosphere model.

Synthetic Aperture Radar: Convert between ground range resolution and slant range resolution

This release introduces the `grnd2slantrngres` and `slant2grndrngres` functions.

- `grnd2slantrngres` returns the slant range resolutions corresponding to a set of ground range resolutions and a set of grazing angles.
- `slant2grndrngres` returns the ground range resolutions corresponding to a set of slant range resolutions and a set of grazing angles.

Radar Data Generator block: Generate radar data in Simulink

This release introduces the Radar Data Generator block. The block implements a statistical radar sensor model that generates synthetic data and provides the option to generate tracks, detections, and clustered detections. Radar Data Generator maintains the properties of the `radarDataGenerator` System object™.

New custom scan mode for radarDataGenerator

Starting this release, the `radarDataGenerator` System object has a custom scan mode that enables users to point the radar beam in a specific direction.

Merge detections into clustered detections using mergeDetections

Use the `mergeDetections` function to merge detections that share the same cluster labels into clustered detections. By default, the function uses a Gaussian mixture merging algorithm, but you can customize your own detection merging algorithm.

Generate more memory-efficient C/C++ code from tracking filters

These objects now support strict single-precision and static memory allocation code generation:

- `trackingEKF`
- `trackingUKF`

See the Extended Capabilities section on each object reference page for its code generation limitations.

Applications: AI, SAR, Tracking, Radar Coverage, Environment Effects

The release introduces several new application examples:

- “Hand Gesture Classification Using Radar Signals and Deep Learning” (Deep Learning Toolbox) shows how to classify ultra-wideband (UWB) impulse radar signal data using a multiple-input, single-output convolutional neural network (CNN).
- “Introduction to SAR Target Classification Using Deep Learning” lets you create and train a simple convolution neural network to classify SAR targets using deep learning.
- “Automatic Target Recognition (ATR) in SAR Images” shows how to train a Region-based Convolutional Neural Networks (R-CNN) for target recognition in large scene Synthetic Aperture Radar (SAR) images using Deep Learning Toolbox™ and Parallel Computing Toolbox™.
- “Lidar and Radar Fusion in an Urban Air Mobility Scenario” shows how to simulate radar and lidar data and how to use multi-object trackers to track various unmanned aerial vehicles (UAVs) in an urban environment.
- “Extended Target Tracking with Multipath Radar Reflections in Simulink” shows how to model and mitigate multipath radar reflections in a highway driving scenario in Simulink®.
- “Radar Vertical Coverage over Terrain” shows how to visualize 3-D vertical radar coverage over terrain in the presence of heavy clutter.
- “Modeling Target Position Estimation Errors” discusses some of the environmental factors that can result in detection losses and errors in target parameter estimation.
- “Introduction to Scanning and Processing Losses in Pulse Radar” demonstrates how various parameters influence the losses that must be included in the radar detectability factor when evaluating the radar equation. These include losses caused by the pulse eclipsing effect, off-broadside scanning with an electronic beam, and MTI processing, CFAR loss, and filter matching loss.
- “Introduction to Pulse Integration and Fluctuation Loss in Radar” illustrates how to compute gains for several pulse integration techniques. It also demonstrates computation of the losses due to the target's RCS fluctuation.

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Version: 1.0

New Features

New Radar Toolbox

The new Radar Toolbox features a comprehensive set of algorithms and tools for designing, simulating, analyzing, and testing multifunction radar systems.

Radar Designer App: Model radar gains and losses and assess performance in different environments

The **Radar Designer** app is an interactive tool that assists engineers and system analysts with high-level design and assessment of radar systems at the early stage of radar development. Using the app, you can:

- Assess and compare multiple radar designs in a single session
- Add smart radar, environment, and target Radar Designer Configurations to jump-start your analysis
- Incorporate environmental effects due to Earth's curvature, atmosphere, terrain, and precipitation
- Add custom target radar cross-sections, antenna/array models, and both range-independent and range-dependent losses
- Export and save results, sessions, models, and plots to continue your analysis

Evaluate Radar Performance

Radar Toolbox gives you tools to evaluate the performance of radar systems. You can find these tools in Radar Systems Engineering. Significant capabilities allow you to:

- Evaluate the radar received signal-to-noise ratio as a function of transmitted power and target range (radar equation)
- Derive detection and tracking statistics
- Evaluate antenna and receiver gains and losses
- Compute attenuation losses due to atmospheric effects, clutter, and weather
- Compute signal processing gains and losses for synthetic aperture radars

Create Radar Scenarios

Use the Radar Toolbox to create realistic radar scenarios. Functions for creating radar scenarios can be found in Scenario Generation. You can:

- Model platform motion and orientation based on waypoints and trajectories or by simulating inertial navigation systems
- Use `radarScenario` and other functions to create realistic radar scenarios for airborne, ground-based, and shipborne platforms and targets
- Employ plotting functions to visualize the evolution of the radar scenario over time

Simulate Radar Data

The toolbox helps you create simulated radar data using the functions in Data Synthesis. With these functions you can:

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- Simulate radar data at probabilistic or signal levels.
 - Generate signal and track data and object detections
 - Simulate signal data including effects of multipath propagation, clutter, and interference
 - Simulate target echoes from simple geometric shapes or complex structures such as a walking pedestrian or a moving bicyclist

Signal and Data Processing

The toolbox lets you perform signal processing operations on simulated radar data. See Signal and Data Processing for a description of the signal and data processing functions. Among the capabilities are:

- Perform matched filtering and stretch-processing, pulse compression, coherent and noncoherent pulse integration
- Estimate target range, Doppler and angle
- Employ constant false alarm rate (CFAR) techniques to reduce false detections
- Cluster neighboring detections into single extended detections
- Create, delete, and manage tracks for multiple objects

Applications

Radar Applications

- Simulate Radar Ghosts due to Multipath Return
- Highway Vehicle Tracking with Multipath Radar Reflections
- Radar Signal Simulation and Processing for Automated Driving
- Track-to-Track Fusion for Automotive Safety Applications
- Adaptive Tracking of Maneuvering Targets with Managed Radar
- Labeling Radar Signals with Signal Labeler
- Spaceborne Synthetic Aperture Radar Performance Prediction
- Airborne SAR System Design
- Synthetic Aperture Radar System Simulation and Image formation

Radar System Engineering

- Radar Architecture: Part 1 - System components and requirements allocation
- Radar Architecture: Part 2 - Test automation and requirements traceability
- Radar Link Budget Analysis
- Modeling Radar Detectability Factors
- MTI Improvement Factor for a Land-Based Radar System
- Sea Clutter Simulation for a Maritime Radar System
- Introduction to Modeling the Propagation of Radar Signals
- Receiver Operating Characteristic to Tracker Operating Characteristic

Scenario Generation

- Radar Scenario Tutorial
- Radar Performance Analysis Over Terrain

Data Synthesis

- Simulating a Scanning Radar
- Simulating Passive Radar Sensors and Radar Interferences
- Transitioning From Statistical to Physics Based Radar Models