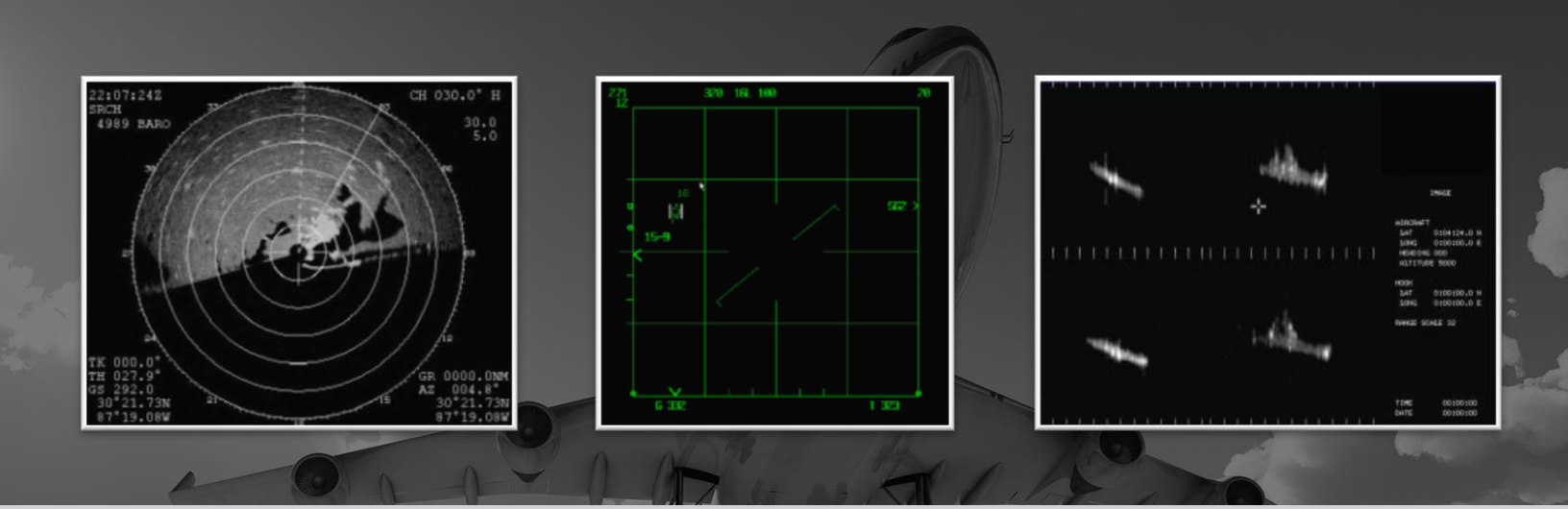


Radar Toolkit® (RTK)

The RTK is a Software Development Kit (SDK) which provides an immensely flexible environment for the development of airborne radar simulations.

Radar Toolkit® (RTK)

The Radar Toolkit® (RTK) is a commercial SDK for the implementation of radar simulation and radar image generation applications.

Our team offers a spectrum of services: customers can purchase the RTK strictly as a Commercial-off-the-Shelf (COTS) SDK to develop their own simulations, or they can purchase a customized solution using the RTK to meet specific simulation needs (including fully implemented radar simulations to their specification).

The RTK can be hosted on a standard PC workstation running the Windows or Linux operating system. Both 32-bit and 64-bit platforms are supported; the simulation models are written in the industry standard C++ programming language. For specialized deployments such as embedded environments, the RTK is also supported under VxWorks.

The RTK provides a real-world, energy level model of the interaction of the emitted radio transmissions and the simulated environment. The software has a design based on the physical radar components which are simulated, allowing a user familiar with radar systems to quickly prototype radar systems and modes which include ground clutter, weather, aircraft, ships, and ground vehicle returns that interact in an appropriate and realistic manner.

Weather Radar Simulation (WXRS)

The WXRS uses the Radar Toolkit® as it's simulation base.

The WXRS has been supplied for many commercial and military platforms, including B747, B777, B787, C-130, KC-135 and KC-46.

- Weather Radars modeled include:
- Honeywell Primus 700A
- Honeywell Primus 701A
- Honeywell Primus 600
- Bendix RDR-1300
- Rockwell Collins TWR-850
- Rockwell Collins WXR-2100
- RDR-1F

… and more

Radar Toolkit® (RTK) Customers

Our customers have successfully used RTK-based radar simulators in similar engineering, development, human factors, and simulation based acquisition applications

Since its introduction in 1994, the Radar Toolkit® product has been fielded on hundreds of systems. Listed below is a sample list of some of our customers and end users:

- U.S. Navy
- U.S. Air Force
- U.S. Army
- U.S. Marine Corps
- British MoD
- Singapore Air Force
- Japan MoD
- Saab Aerospace
- BAE
- Selex Galileo
- Flight Safety
- Taiwan Air Force & Navy
- Royal Australian Air Force
- Canadian Forces
- Mexican Air Force
- Argentine Air Force
- Italian Air Force & Navy
- Royal Thailand Air Force
- Swedish Air Force
- Hungarian Air Force
- Indian Navy
- Indian Army Air Defence College
- National Test Pilot School
- FedEx
- Gulfstream
- CSC
- JSF Program
- Eurofighter Program
- Lockheed Martin
- Northrop Grumman
- Boeing
- NASA
- Raytheon
- L-3
- Bell Helicopter
- Rockwell Collins
- CAE
- ST Electronics
- Indra
- Northwest Airlines
- Pilatus

Radar Toolkit® Laboratory Usage:

Many government labs and commercial labs have used Compro radar simulators for previous programs, including the JSF program. Listed below is a sample of some of the laboratories that have used the Radar Toolkit®:

- Lockheed Martin JSF Man-Tactical Simulator
- JSF Software Development Station Team
- Northrop Grumman Force Level Labs
- Northrop Grumman Radar Simulations
- Air Force Research Laboratory (AFRL)
- U.S. Navy Manned Flight Simulator
- U.S. Navy Test Pilot School
- China Lake Laboratories
- National Test Pilot School
- NASA – Langley and Ames
- Rockwell Collins Research Laboratories
- MIT – Lincoln Laboratories
- Mitsubishi Heavy Industries Maritime Patrol Program
- BAE Eurofighter Laboratories
- QinetiQ – United Kingdom
- Defence Science and Technology Laboratory (DSTL) – United Kingdom
- Saab Aerospace – Sweden
- Ultra Electronics – United Kingdom

RTK Installed on PC

Standard RTK

The Radar Toolkit® is a radar simulation SDK, but it is also a radar simulation in and of itself.

Out-of-the-box, the RTK can be run as a standalone generic radar simulation modeling dozens of A/G, A/A and A/S radar modes – in fact, it is used this way for classroom training applications. The RTK can be menu driven or integrated into the user's training system and driven remotely via an interface with a Host computer.

The RTK is delivered with a Graphical User Interface (GUI) that enables the user to modify the characteristics of the simulated radar system and control the environment (weather, targets, jammers, beacons, etc.).

Host and Display Interfaces

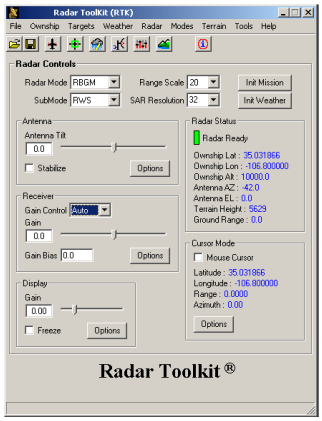
In integrated applications, the RTK runs on its own computer and interfaces to the Host computer and radar display using standard protocols and data formats.

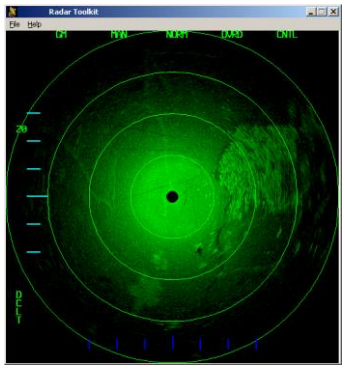
The Host interface is typically Ethernet UDP, but can also be TCP/IP, shared memory, reflective memory, DIS, HLA, CIGI, hardware busses such as ARINC or 1553, or any combination of the above. Data transmitted includes both radar control parameters and simulation/environmental data. Radar control data includes parameters such as radar range scale and radar mode. Simulation and environment data includes positional information for the ownship and targets as well as information about jammers, beacons, emitters and weather cells in the environment.

The default RTK ICD is large because it covers parameters for every potential radar mode and data for every supported environmental feature. In most cases, only a subset of the ICD is required for a given radar simulation. For customized radar simulations, Compro can tailor the ICD to the program requirements.

The RTK typically runs at a 30 Hz frame rate, but the RTK frame rate is configurable and frame rates up to 60 Hz are supported.

The basic RTK uses OpenGL to render the radar imagery, however, customized displays can be written to display the radar output in whatever manner is needed. Radar video can be provided via DVI, VGA or through access to the frame buffer. Another common strategy is to feed VGA or DVI output to a scan converter to produce RS-170, STANAG or EIA-343 video, or to use a frame grabber in order to blend the radar video with other system video.





RTK Modeling

The modeling techniques employed by a radar simulator are an important component in producing a realistic radar display. Only through a comprehensive understanding of the underlying principles and theories of radar systems engineering is it possible to provide realistic simulation.

The modeling approach used in the Radar Toolkit® incorporates a detailed database and a realistic treatment of the interaction of the simulated radar with the landmass, targets, jammers and weather. All appropriate radar phenomena and effects are accounted for in the RTK solution.

Simulated Radar Effects

Compro's software is an object-oriented design that is based on the physical components being simulated. The component based design provides ease of use and allows a user familiar with radar systems to quickly prototype complex radar systems and modes which include ground, weather, aircraft, ships, and ground vehicle returns.

Simulated Radar Parameters and Signal Processing Effects

All relevant radar parameters are accounted for in the RTK software. These parameters include frequency, transmit power, antenna gain and beam width, scan rate, pulse width, Pulse Repetition Frequency (PRF), frequency band, integration time, and other mode specific parameters. Each of the following radar effects is simulated:

- Sensitivity Time Control (STC)
- Receiver Gain, including AGC
- Jamming
- Stabilization
- Receiver Detection
- Post Detection Integration
- Log Compression
- Antenna (scan rate, beam patterns, gimbal limits and turnaround, tilt angle)
- Radar Resolution (up to 4096 range bins)
- Range Scales
- Pulse Length effects
- False Alarm control
- Receiver Noise
- Scan Conversion effects
- Geometric Distortion
- Frequency Band
- Transmitter Power

In certain radar modes, such as Single Target Track (STT), Fixed Target Track (FTT), Ground Moving Target Indication (GMTI), and Ground Moving Target Track (GMTT), additional signal processing is required to simulate the performance of the radar realistically. Key areas include target detection and target tracking.

Target detection utilizes a floating threshold based on power within a defined acquisition or tracking gate in range and/or Doppler frequency. As a result of performing actual detections on raw signal data, correct operation of the radar simulation when a track gate includes landmass or jammer interference is assured. Detections are then correlated to track files; and target position, velocity, and heading are computed for display.

Environmental Effects

The RTK package is capable of simulating various environmental effects that may be available in a tactical scenario. These effects include the following:

Weather. Weather radar simulation is supported in the Basic Radar Toolkit® by a weather model that provides irregularly shaped rain cells with multiple levels of precipitation. This enables such radar weather modes as Iso-Echo. Multiple weather scenarios can be displayed simultaneously. Rain cells interact accurately with the other components of the simulation. Rain cells generate radar returns and attenuate returns from other rain cells, returns from targets, returns from terrain, and emissions from jammers. The weather patterns can be placed anywhere in the gaming area and may move dynamically based on host inputs such as the wind direction and wind speed.

Ground Clutter. Ground clutter is simulated, affecting detect and track modes appropriately. There is also a ground clutter suppression mode that is commonly used in weather radar systems.

Sea Clutter and Sea State Effects. Sea clutter is included in the environment ground model, affecting water areas that are marked as "subject to sea state." This inhibits sea state on lakes and protected waters. Sea clutter is pseudo-random noise, and is a function of both wind direction and sea state. The sea state has a user control from 0 to 9.

The sea clutter simulation has been validated by both the U.S. military organizations and foreign organizations.

Jammers. These are provided by modeling the logic of the radar control computer to implement frequency agility, coherent modes, and power management. Jammers may be combined in any manner, with correct operation and effects on the simulated radar. Parameters such as power, sweep period, frequency, delay, walk rate and relative position are tailored to allow real-time control of each jammer.

Targets

The basic RTK supports up to 256 active targets, though this number can be increased if required. In real-beam and A/A radar modes, targets are modeled as point features using Radar Cross Section (RCS). Vertical and horizontal target aspect is incorporated in the computation of signal return. The effect is incorporated by varying the target RCS according to the target aspect and then using the aspect dependent RCS in the radar equation to compute the signal return. Target RCS can be defined at one degree intervals in all directions and is user configurable. Also, the user has the capability to change the target RCS value in real-time.

In high-resolution mapping modes, targets are modeled using material-encoded polygons based on OpenFlight models. The RTK is delivered with 10 models from our standard model library. These models represent a selection of ground, sea and airborne vehicles. Additional models can be created using RTK Database Tools or can be purchased directly from Compro.

The user, via the RTK interface, has complete control over the movement of ownship and targets. This enables the user to build target scenarios and the RTK will provide realistic radar images and responses.

Radar Landmass Database

An air-to-ground radar simulation requires a landmass database covering the simulation gaming area. The Radar Toolkit® uses a proprietary Runtime Format (RTF) landmass database built from OpenFlight terrain files. Reflectivity data is derived from material-encoded polygons or from geo-typical or geo-specific imagery, or from a combination of these.

The process of generating a radar landmass database starts with building OpenFlight terrain tiles. Typically Terra Vista or a similar terrain database generation tool is used to export OpenFlight from ESRI source formats such as DTED, DFAD, SRTM and VMAP. Imagery is included in the source data if desired and if available.

Hi-Fidelity Weather Option

The hi-fidelity weather option enhances the basic weather simulation that is provided with the basic Radar Toolkit®.

The weather model consists of multiple three-dimensional, time-varying contours that define the specified rain rates. The Compro weather simulation includes multi-contour clouds with up to 16 levels of precipitation and up to 16 levels of turbulence. The storm scenarios used with the Radar Toolkit® can consist of an unlimited number of clouds within the storm scenario. Storm scenarios can be combined to form storm fronts.

The growth and decay of the storm clouds can be controlled by the user. The position and movement of the storm scenarios is also controlled by the user.

The storm scenarios have four levels of clouds and the altitudes of these levels are controllable by the user.

The user also has real-time controls for the RCS and rain rate scale factors so that the storm scenarios can be modified and tuned in real-time.

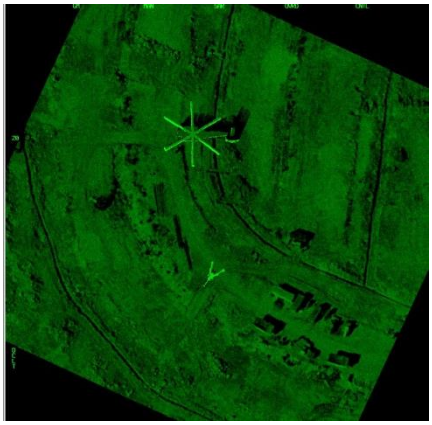
The Radar Toolkit® is delivered with 20 storm scenarios that have been certified for use in FAA Level D trainers.

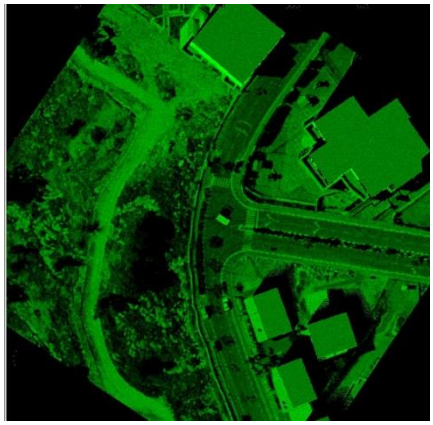
Any number of active, real-time storm scenarios can be within the gaming area. Storm scenarios can overlap each other as well.

The user can specify the rotation of the storm, position of the storm scenario, and movement of the storm scenario. Additionally, the RTK includes a real-time input for adjusting the intensity of the storm scenario.

Hi-Resolution Mapping Option

The hi-resolution mapping option uses the same basic radar model which is used to generate the real beam ground map images with specific effects level enhancements to simulate image artifacts which occur in high resolution image radar imagery. The hi-resolution maps can be provided in either constant angular resolution (a patch PPI display format) or in constant cross range resolutions (a B-scan or rotated B-scan format) display formats. User definable levels of image noise and both range and cross range azimuth blurring can be set through the RTK menus and can be adjusted in real time to match the performance of the radar system which is being simulated.





Sea Search with ISAR Display Option

The RTK provides a highly representative ISAR simulation based on a model that consists of multiple point source reflectors and masking information. A realistic implementation of the radar signal interaction with the moving target and of the internal signal processing representative of real radars is provided.

The sea state, target motion, and target model are used to periodically calculate a line-of-sight range and doppler for each scatterer in the target model that is not shadowed. The radar equations are used to produce a relative signal strength for each scatterer.

Airborne Targets Option

The RTK airborne targets option is set-up to support the simulation of the core air to air modes of a fire control radar system.

RTK Licensing

The RTK can be purchased with either a run-time license or a development license. Permanent licenses are normally provided on hardware USB dongles.

A run-time License enables the user to run one instance of validated RTK executables.

The development license enables the user to modify the RTK and create new validated executable files. Additionally, the development license enables the user to run one instance of RTK executables, as if it were a run-time license. A development license is delivered with a build environment and source code for the RTK host interface, front-end application and radar display, as well as an HTML programmer's guide. This gives the user the ability to quickly modify the default RTK application to suit their requirements, or even to start from scratch and write a new radar application.

Export Requirements

The RTK software described above is an export controlled item. A Technical Assistance Agreement (TAA) and/or an export license is necessary if the software is to be transferred or exported to a non-US user.

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