

Radar Target Simulator Based on Digital RF Memories

V 2020-10

Target, Clutter & ECM Simulation

Description

RTS (Radar Target Simulator) solutions are designed to evaluate or test radar systems in complex and potentially hazardous situations.

Fundamental to the concept of RTS is the capture of the radar emission in order to analyze it and generate radar echoes that are coherent with the radar emitted waveform. RTS generates radar echoes with amplitude, range (delay), Doppler and direction of arrival (DOA) that are representatives of the scenario defined by the user. To make it in a more realistic way, our RTS solution can be combined with a high-fidelity RF scene rendering software solution such as SE-Workbench-RF from OKTAL-SE (partner of SYNOPSIS).

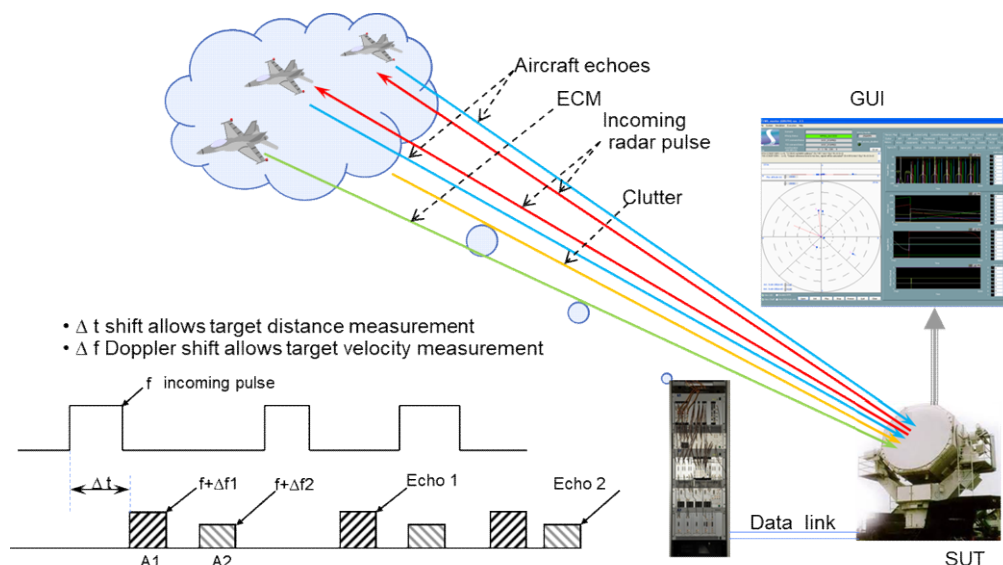
Based on DRFM (Digital RF Memory) or PDDL (Programmable Digital Delay Line) and high-speed digital controls throughout FPGA (Field Programmable Gate Array) and Digital Signal Processors (DSP), RTS brings a high level of flexibility and allows the following functions performed in real-time:

- Complex targets generation, coherent with radar waveform
- False targets generation & noise jamming
- Clutter generation with different operational modes
- Jamming and anti-jamming techniques

RTS provides the following functionalities through the MMI (Man-Machine-Interface):

- Target description software
- Jammer description software
- Events based, dynamic and static scenario editor software with map function

RTS is based on a modular architecture and then easily expandable.



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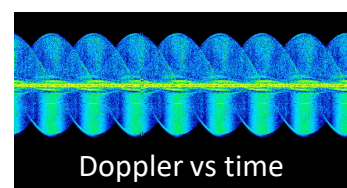
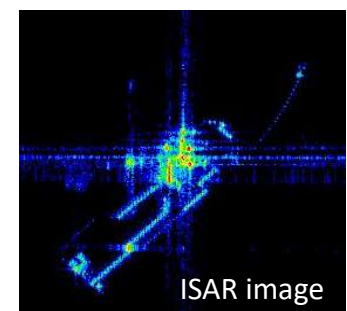
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Main features

- Frequency range (typical):
 - ✓ 2 to 18 GHz
 - ✓ 0.5 to 40 GHz
 - ✓ Customized up to 96 GHz
- Up to 200 MHz/500 MHz/1 GHz Instantaneous Bandwidth
- Range: min 200 m / max 300 km
- 4 ns (60 cm) range resolution (10 ps as option)
- Doppler: ± 10 MHz max
- Doppler resolution: 1 Hz, Doppler accuracy: < 1 Hz
- RF output total dynamic range: > 90 dB
- 12/16 bit Digital RF Memory (DRFM)
- AWG capability (4 GBytes memory)
- Coherent moving target generator
- Complex target modelling, Swerling fluctuation models, Glint & Jet Engine Modulation (JEM) simulation
- Multi-target capability (up to 100 targets in the scenario)
- Clutter (ground, sea, volume) generation with different operational modes
- Exceptional Up/Down converter
 - ✓ Very wide band: 0.1 to 100GHz
 - ✓ Very agile : 100ns, 10 μ s or 10ms
 - ✓ Step frequency: 1Hz
 - ✓ Fully phase coherent
- Testing modes: injection & radiation
- Principle of Operation:
 - ✓ Standalone
 - ✓ Hardware-In-the-Loop (HIL)
 - ✓ Man-In-the-Loop (MIL)
- Real-time scenario execution based on GPU/FPGA
- Jamming: RGPO/I, VGPO/I, Synchronized RVGPO/I, Noise jamming, Range and Velocity Bin Masking, Inverse gain...
- Adapted to many types of input signals like chirp, polyphase codes, frequency agility, PRI staggers ...
- Multi-channels system
- I&Q implementation (optional)
- Programmable memory mapping for multi-targets per channel for time-multiplexed targets
- Digital Doppler generator
- Real-time external parameters control capability
- Time-stamped data recorder
- Data and Signal Analysis
- Reflective memory for simulator's network with real-time management
- HW extension: DLVA, Filters bank, variable threshold ...

Applications

- Radar Target Simulator
- Radar System Test & Evaluation
- Radar System Calibration
- ECM Simulators
- EPN / ECM / ECM Training
- ELINT Analysis / Playback



HIGH-FIDELITY RADAR SCENE MODELLING

SYNOPSIS RTS can be combined with SE-RAY-EM, an electromagnetic simulation code edited by OKTAL-SE based on ray tracing and asymptotic methods, developed jointly by OKTAL-SE and ONERA, dedicated to the simulation of raw data of large-scale environments including complex targets for several kinds of radar.

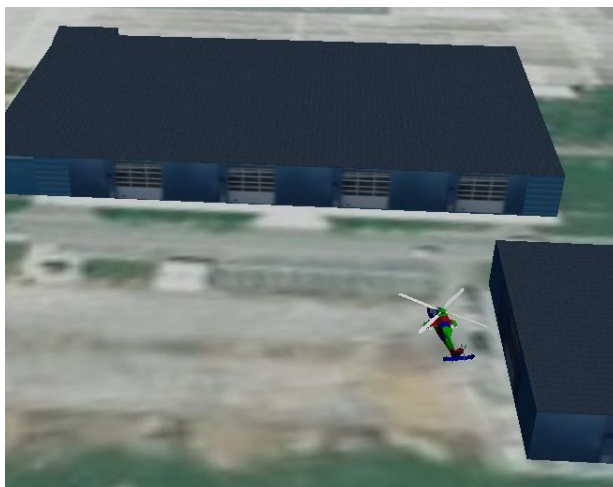
SE-RAY-EM takes advantage of the recent improvements in the field of 3D graphics (GP GPU) to compute the RF fields in a complex 3D synthetic environment.

The powerful and innovative engine of SE-RAY-EM combines the shooting and bouncing forward ray technique (SBR) with the RF asymptotic approach (Geometrical Optics, Physical Optics, Equivalent Current Method) to compute complete electromagnetic response of a scene including propagation, scattering, reflection and edge diffraction.

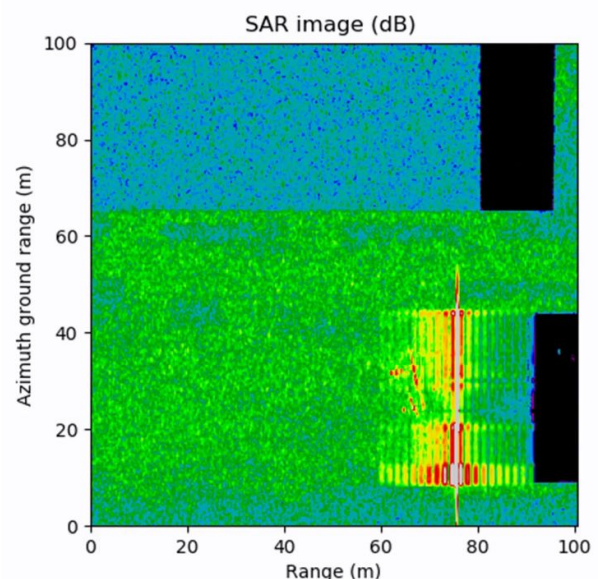
A set of rays representing the incident wave is launched toward the observed 3D scene that can be made of several million polygons, including very complex objects and targets tessellated with triangles.

The main features of SE-RAY-EM are the following:

- The interactions between targets and the 3D environment are fully addressed (no separated treatment)
- Can compute masking and multipath due to the terrain (ghost echoes)
- Can compute coupling between target and ground, especially in sea environment
- Moving targets and moving radar carriers can be considered
- Can compute objects coated with dielectric layers, including diffraction by their edges
- Compatible with almost all popular CAD formats thanks to its associated 3dsMax®, Sketchup® and Blender plug-ins
- RF models validated by ONERA in France, FOI in Sweden and Fraunhofer FHR in Germany.



Helicopter surrounded by buildings



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ADVANCED SCENARIO EDITION SOFTWARE

The RTS MMI (Man-Machine-Interface) main functionalities are the following:

- Target description software, including dynamics (trajectories)
- Jammer description software
- Events based, dynamic and static scenario editor software with map function
- Chaff/decoy description software (optional).

The scenario can be previsualized/played in 2D, in a symbolic war or on a map background, or in 3D as illustrated below.

