MULTIMODE AIRBORNE RADAR SIMULATOR

The MARS Multimode Airborne Radar Simulator, is a software tool which provides a real-time computer simulation of the principal A/G and A/A radar modes of modern airborne pulsedoppler radars. Designed to be integrated into different flight simulators, the tool is currently in use in the Eurofighter Typhoon simulators for the European Typhoon consortium ASTA.

MAIN FEATURES

Simulation of the principal Air-to-Surface non-coherent modes: Real Beam Ground Mapping (RBGM), Sea Surface Search (SSS), Air to Surface Ranging (ASR)

- Simulation of high resolution radar mapping modes (SAR modes, DBS modes), reproducing the base-band IQ signals of the received echoes and the FFT processing
- Synthetic detection and tracking capabilities: HPRF, MPRF, LPRF detection modes, Ground Moving Target Indicator (GMTI), Range While Search (RWS), Velocity Search (VS), TrackWhile Scan (TWS), Single Target Tracking (STT)
- Parametric models for the antenna gain patterns
- Simulation of sum and difference channels, monopulse measurements
- Customisable simulation of: STC, Pulse compression
- ECM simulation: continuous wave and deception jammers
- Swerling models for target radar cross sections
- Different Weibull statistics for terrain reflectivity.
- Sea reflectivity modelled according to Beafourt scale
- Rayleigh statistics for thermal noise
- Multipath effects: far shore brightening, building edge brightening
- Complex weather simulation: different precipitation types and intensities, arbitrary shaped clouds arbitrarily positioned in the scenario, turbulence and vectorial 3D wind field
- Real-time terrain database viewer facility.

GENERAL DESCRIPTION

MARS implements physical/mathematical models of the radar devices and of the external environment. Its structure allows customisations for the simulation of specific radar equipment. Many parameters from the data package of a real radar apparatus can be inserted directly into the tool configuration files, maximizing the fidelity of the radar simulation. MARS is entirely a SW COTS product and requires standard commercial hardware only.

MARS

It is written in ANSI C/C++ and it is platform independent. It has been released for SGI, Microsoft Windows and Linux distributions. The tool offers the user a shared memory that can be filled at runtime by the simulation host when integrated inside a simulation system (DRLMS) or by the MARS GUI when in a standalone environment. Remote communication for distributed simulations has been foreseen and implemented (UDP, DIS, HLA). The processing of the MARS tool has been paralysed in order to take advantages of the availability of multi-processor platforms.

The MARS DBGS is the offline software tool developed to build the radar scenario database for the MARS real-time system. Designed to import and manipulate several input formats, such as OpenFlight files, DTED files, ESRI shapefiles etc., and to process all of the data to automate the MARS real-time DB generation workflow, it provides numerous options to tailor the DB generation process.

TECHNICAL SPECIFICATION

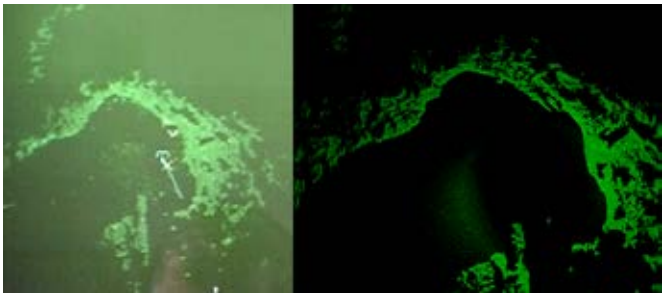
SOFTWARE	
Operating Systems	Windows XP, Windows 7, SGI Irix 6,5, Linux Red Hat Enterprise 5, Linux Suse 11
Communication Protocols	UDP, DIS, HLA
Real-Time Main Modules	Radar Modelling, Terrain Pager, GUI
Off-Line Main Modules	Terrain Editor, Terrain Converter, Weather Editor, DBGS
Terrain Source Data Supported	Lithos, OpenFlight, Terra Vista OpenFlight, Sharpe Files, DTED files, GeoTiff, TIFF+tfw

CONFIGURABLE PARAMETERS	
Antenna	Gain patterns, gimbal limits, scan rates, scan patterns
Transmitter	Wavelength, peak transmitted power, operative temperature, PRF, attenuations and losses
Receiver	Noise figure, STC tables (distance attenuation), pulse compressor efficiency, log amplifier dynamics and threshold CFAR Type
Radar Modes	Minimum and maximum range and rangerates, pulse length, pulse compression ratio, range-rate quantization, number of coherent integrated pulses, binary integration parameters, filter bandwidth, processing loss, probability of false alarms.

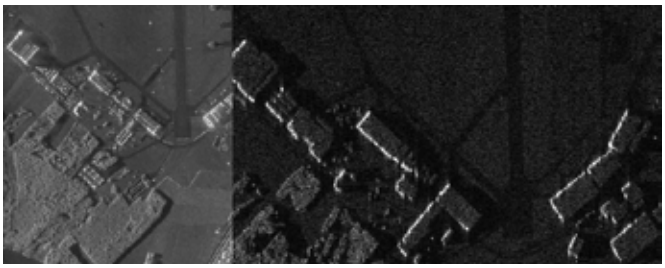
MARS GUI monitoring the Terrain Following (TF) radar mode and ownship slope.

Customisations

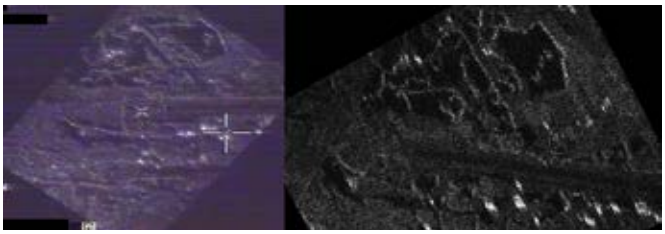
- Captor, mounted on the Eurofighter Typhoon
- MRCA Nose Radar, mounted on the Tornado
- APS 784, mounted on the AW101 helicopter.



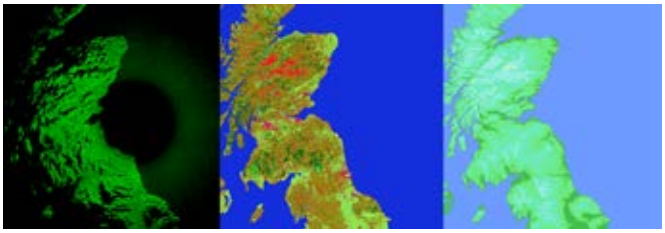
Comparison between a true Real Beam Ground Mapping (RBGM) radar image (left) and the corresponding real-time MARS simulation (right) using a non-coherent processing (Tyrrhenian sea and Coarse island).



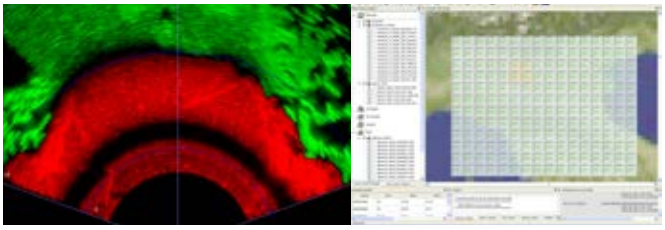
Comparison between a true 90° Spotlight Doppler Beam Sharpening (SpDBS) image (left) and the corresponding real-time MARS simulation (right) using FFT processing (2 meters resolution on the Oberpfaffenhofen airport).



Comparison between a true Squinted Spotlight Doppler Beam Sharpening (SpDBS) image (left) and the corresponding real-time MARS simulation(right) using FFT processing (18 meters resolution on the Manching airport).



MARS can switch at runtime for training purposes from the radar image (left image), to Surface Material Codes used for reflectivity computations (centre image), to altimetry information (right image) used for occultation calculations.



MARS can switch at runtime for training purposes from the radar image (left image), to Surface Material Codes used for reflectivity computations (centre image), to altimetry information (right image) used for occultation calculations.

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