TSS

Threat Signal Simulator
Based on AWAACS™ Technology

V 2020-12

Creation of realistic signals environment

Description

The TSS, part of the Electronic Warfare Laboratory Suite (EWLS), is a modular approach to generate threats for Radar & EW & ECCM (Electronic counter-countermeasures) waveforms using building blocks and COTS plug-in modules.

The main objective of the TSS is to create realistic signals environment.

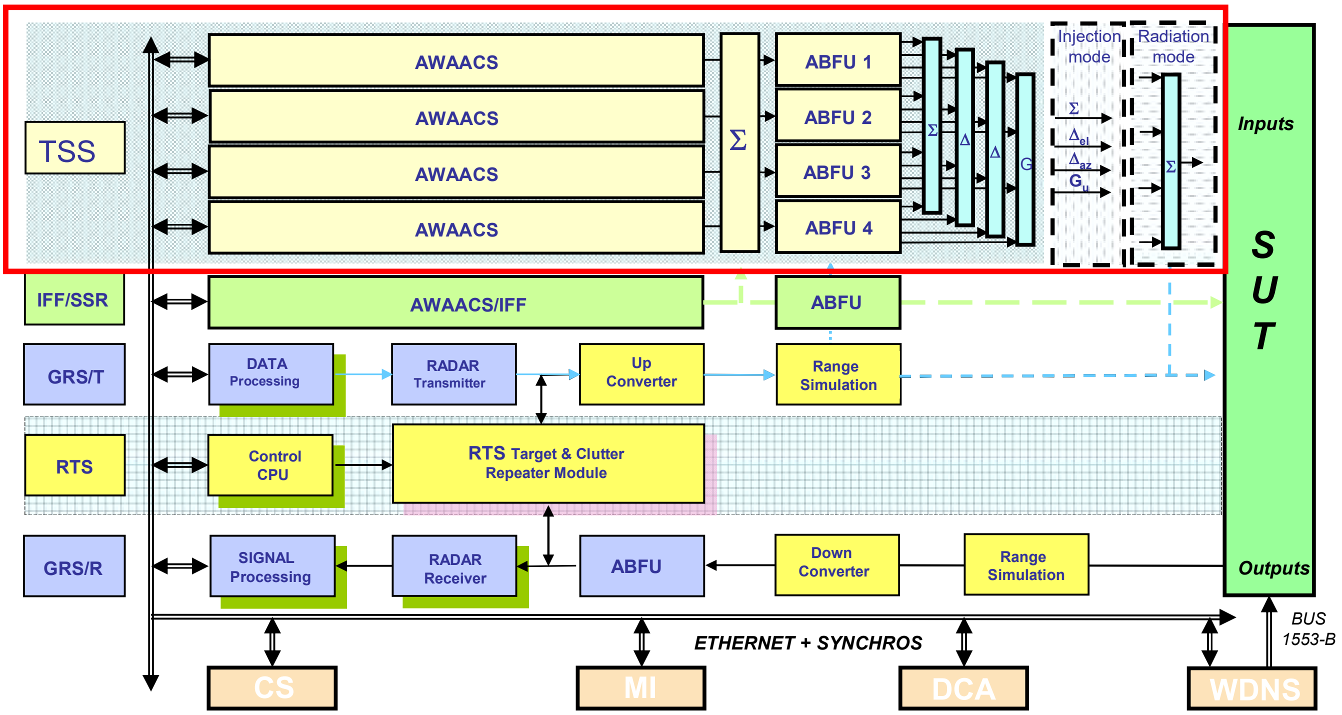
Our TSS solution can be combined with a high-fidelity RF scene rendering software solution such as SE-Workbench-RF from OKTAL-SE (partner of SYNOPSIS)

The major applications are for scientific research, signal library development, performance evaluation of both radar and EW systems, but also for training purpose.

The TSS is based on AWAACS™ (Arbitrary Waveform And Agile Coherent Synthesizer) technology developed by Synopsis Corporation Group.

The AWAACS product family combines the flexibility of an Arbitrary Waveform Generator (AWG) with the accuracy and the agility of a Direct Digital Synthesizer (DDS). This unique design provides unusual flexibility, broadband frequency and RF parameters with an incomparable frequency and phase and amplitude resolutions.

TSS is frequently used combined with the Radar Target Simulator (RTS) to create input signals to target illuminator radars or direction of arrival, in coherence and synchronized association with the RTS.



SYNOPSIS CORPORATION GROUP

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Main features

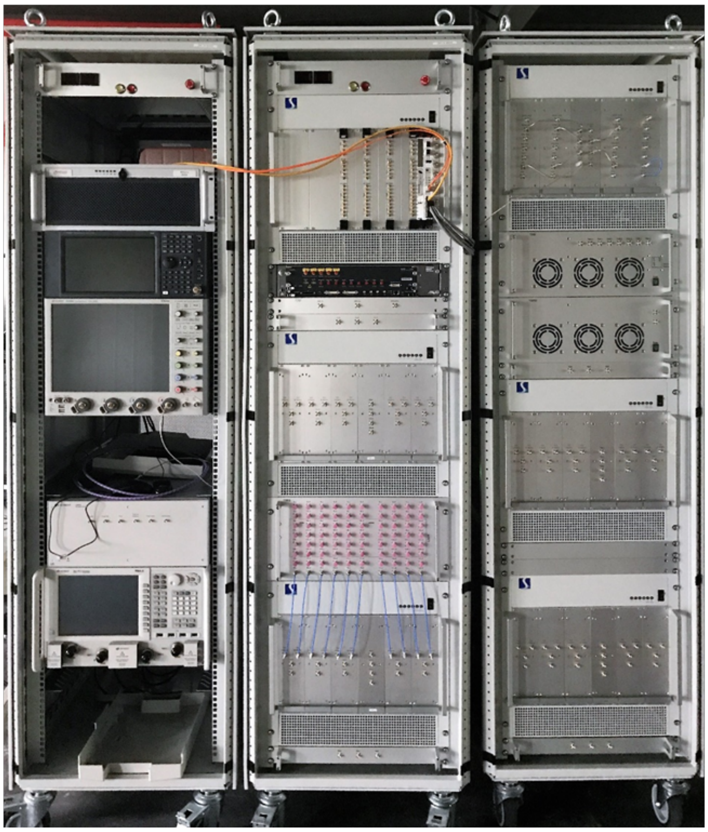
- Frequency range:
  - ✓ 0.1 to 40 GHz (standard)
  - ✓ Up to 100 GHz (option)
- Frequency resolution < 1 Hz
- Frequency agility < 100 ns
- Direction of Arrival:
  - ✓ Amplitude (ADOA)
  - ✓ Phase (PDOA)
  - ✓ Doppler (DDOA)
  - ✓ Time Difference of Arrival (TDOA)
- Monopulse (Σ, Δ_{EL}, Δ_{AZ}, G_U)
- PDOA accuracy: 1 deg
- ADOA accuracy: 0.1 dB
- TDOA accuracy: 10 ps
- Principle of Operation:
  - ✓ Standalone
  - ✓ Hardware-In-the-Loop (HIL)
  - ✓ Man-In-the-Loop (MIL)

Main capabilities

- Generation of dense and complex electromagnetic RF signals
- Modelling of rich RF environments
- Multiple channels DOA systems modelling
- Fast frequency agility
- Realistic scenario building
- Real-time interactivity with SUT
- Scalable architecture

Applications

- Threat Signal Simulator
- ELINT Analysis / Playback
- ECM Simulators
- EPN / ECM / ECCM Training
- Evaluation of Radar Warning Receiver (RWR)



AWAACS™

The AWAACS™ product family combines the flexibility of an Arbitrary Waveform Generator (AWG) with the accuracy and the agility of a Direct Digital Synthesizer (DDS), in a real time controlled and standalone system.

This unique design provides unusual flexibility, broadband frequency coverage with incomparable frequency and phase and amplitude resolutions.

With the exclusive combination of FPGA, DSP, I/Q vector modulators, AWG and DDS, the AWAACS is well suited to generate extremely complex waveforms with a high degree of resolution and accuracy.

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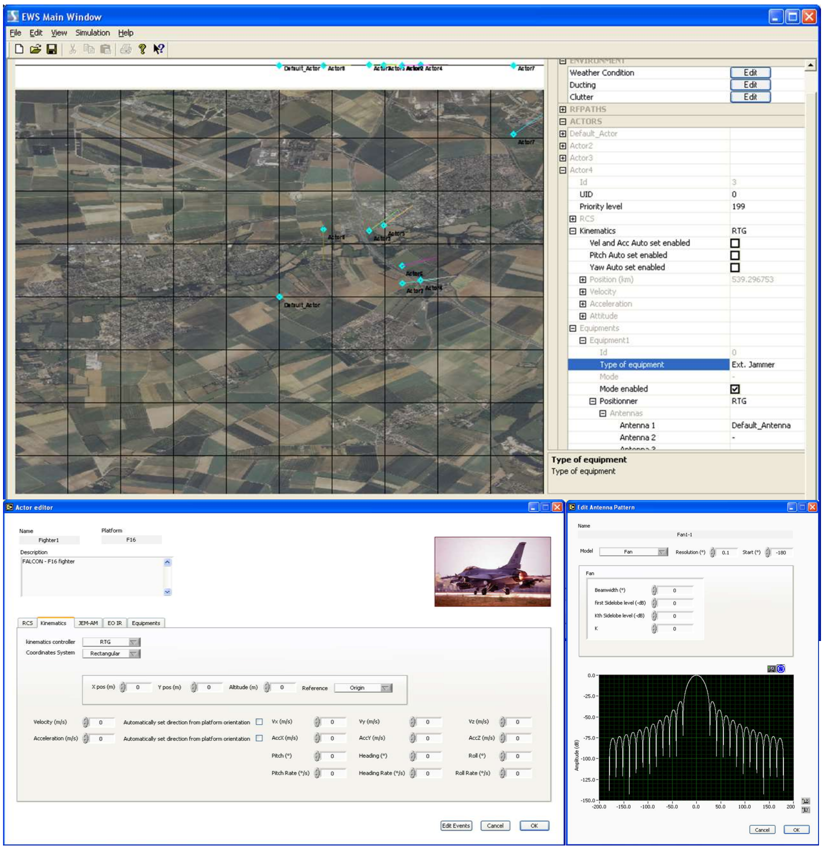
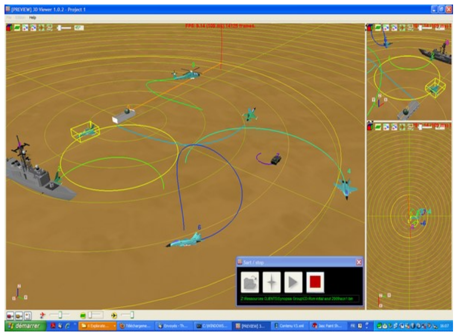
EWS: ADVANCED SCENARIO EDITION SOFTWARE

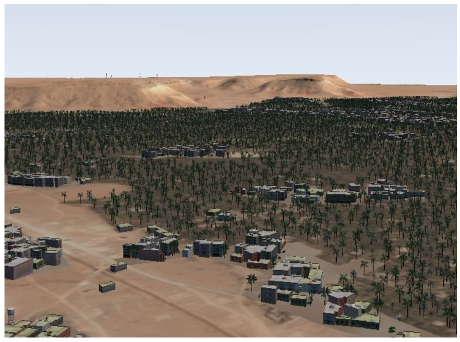
The EWS software, controls in real time and synchronously the TSS simulator and performs the following major tasks:

- Scenario preview (scenario creation without hardware)
- Scenario creation
- Scenario execution in real time
- Backup with time stamping (records external inputs together with real-time parameters)
- Ethernet backup
- Off-line backup interrogation
- Calibration
- BIT

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







Injection and radiation modes

TSS generates low power RF signals for direct injection to the SUT or high power RF for signal radiation (including amplifiers and antennas).

Scenario build

The Scenario Build capability allows the operator to program the characteristics of emitters, platforms and scenarios. Emitter files define the RF characteristics of emitters. Platform files describe the emitters on a platform. Scenario files define the trajectory of several platforms in space and define the emitter's mode in time. The files are saved on hard disk and can be recalled later for editing or can be loaded into the hardware for execution. In a basic TSS simulator, the scenarios can be programmed with up to 450 emitters.

Platforms

A Platform is defined for each actor. Each platform is characterized by its Radar Cross Section and eventually its Jet Engine Modulation. Platforms also serve as equipment containers. Up to 15 equipments can be "attached" to each platform.

Equipment

Each equipment (radar emitter, jammer or receiver) is associated with an antenna positioner which can be oriented anywhere in space according to its scanning mode. For example, several emitters can be declared with different azimuth and elevation offset angles to simulate side looking radars. For reception up to 4 antennas can be defined on the positioner to simulate an antenna array or beam forming.

Scenarios

Scenarios define the trajectory of platforms and the activation sequence of the emitters embedded on each platform. The EWS software provides three modes:

- **Standalone**: TSS operates in a standalone mode, with a pre-programmed flight path
- **Man-In-the-loop**: a 3D joystick controls any actor trajectory during the scenario execution
- **Hardware-In-the-loop**: TSS operates in the HIL mode by receiving antenna, navigation and inertia information from the SUT via a standard low latency interface

For each mode, the TSS output the computed scenario parameters in real-time via a standard interface.

- **Static scenarios**
  - In static scenarios, there is no motion plan or activation sequence. Platforms are positioned in X (longitude), Y (latitude), Altitude with a heading.
  - For own-ship, pitch, roll and yaw angles can also be specified.
  - Platform position remains stationary and only affects the relative geometry as perceived by the own-ship including DOA. The power level (ADOA), the phase (PDOA), the Time difference (TDOA), the Doppler difference (DDOA) are entered by the operator.
- **Dynamic scenarios**

  In "standalone" dynamic scenarios, the motion plan is defined as a series of events that permit to modify the actor's trajectories. Each event is conditioned by either a kinematics parameter (position, orientation of the platform) or time parameter (absolute time instant or delay). Smooth trajectories can be achieved by using the velocity and acceleration vectors to control the motion. Mode events are used in a similar way to modify the emitter's modes in time.