AMERGINT TECHNOLOGIES

satTRAC™ Channel Emulator

Software Specification

The satTRAC Channel Emulator provides the capability to accurately emulate what happens to your satellite signals from the transmit antenna to the receive LNA, for both uplink and downlink. Signals can undergo significant dynamics due to satellite motion, which generates time varying delay, Doppler, and attenuation that the receiver needs to track. Accurately testing performance in these conditions requires emulating the channel. The satTRAC Channel Emulator allows you to easily generate realistic emulation of these effects for typical, actual, or worst-case scenarios.

The Channel Emulator is implemented in software and integrated with the satTRAC modem to provide a more cost-effective and accurate solution than stand-alone RF channel simulators. The satTRAC modulator generates signals in software. These directly feed the Channel Emulator in the same server, eliminating the need for separate hardware. A separate Channel Emulator is also included on the receive path prior to the satTRAC demodulator. This allows emulation of both transmit and receive paths within a single satTRAC modem.

The Channel Emulator includes three main components: 1) time varying delay and Doppler to emulate the effects of motion, 2) time varying amplitude and phase to emulate path loss, rain fades, scintillation and flat fading, and 3) noise to emulate receiver LNA noise floors.

Channel emulation facilitates accurate receiver testing, but it can also be used for training, system analysis, trade-off studies, worst-case analysis, development, integration testing, and system validation. It can be used in any situation where there is value in providing high fidelity emulation of the real signal. Any satellite orbit (GEO, LEO, HEO) can be accurately emulated, as seen by the specifications below.

Delay	Specification
Range	0 to 5.45 seconds depending on allocated memory 0 to 0.325 sec default, allowing simulation of GEO links
Resolution + Accuracy	+/-22 ps
Delay Update Rate	Every 41 ns. Profile points may be 100 µs apart, linear interpolation between profile points
Max Velocity	No practical limit (c/2)
Carrier Doppler	
Range	+/-5 MHz
Resolution	< 1 mHz
Update Rate	Profile points may be 100 µs apart (velocity constant over 100 µs intervals)

Attenuation	Specification
Range	0 to -60 dB
Resolution	16 bit DAC (< 0.01 dB from 0 to -25 dB, 0.1 dB at -45 dB, 0.5 dB at -59 dB)
Rate	Full range in < 1 µs
Carrier Phase	
Range	0 to 360 deg
Resolution	< 0.01 deg
AWGN	
Range	-135 dBm/Hz to -77 dBm/Hz
Resolution	< 0.01 dB
E_b/N_0	
Accuracy	< 0.01 dB

Profile Generators	Type
Delay & Doppler	• Constant Delay, Constant Velocity, or Constant Acceleration • Straight Flight (simulates a vehicle flying in a straight line above the receiver) • TLE (SGP4 implementation, takes ground location and TLE) • File (time, range, and range rate, can be generated from AGI's STK)
Amplitude	• Linear (in dB) ramp or triangle patterns • Square-wave (min, max) pattern • $1/r^2$ from delay (in development) • File (in development)
Amplitude & Phase	• Simple fading for diversity combiner testing

The channel effects are implemented separately from the profile generators, which allows new profile generators to be easily added. Profiles may also be generated in real time.

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