Keysight Technologies
Propsim Channel Emulation Aerospace, Satellite and Airborne Radio System Testing

KEYSIGHT
TECHNOLOGIES

Unlocking Measurement Insights

Actual Performance of a Critical Communication System with Keysight's Future-Proof Integrated Test Solution

Propsim aerospace channel emulation solution combines Keysight's Propsim F8 channel emulator with its aerospace modeling tool to test aerospace, satellite and airborne radio systems in a lab environment. The Propsim F8 channel emulator from Keysight Technologies enables real-time emulation of wireless radio channels. With the industry's most superior signal integrity, Propsim's file-based emulation of test scenarios guarantees accurate, realistic and repeatable test conditions for wireless aerospace, telemetry, satellite and high-mobility broadband communication applications.

Integrate an advanced terrestrial channel emulator with a satellite channel emulator to form one compact and affordable unit – Keysight's Propsim Aerospace

- Create realistic real-time propagation test environments for aerospace, satellite and airborne radio links testing
- Connect radios for testing end-to-end performance
- Minimize required field testing
- Test single receiver or multiple transceivers simultaneously e.g. handovers
- Conduct virtual testing of unreachable environments
- Create test environments that meet requirements for the highest levels of Doppler and acceleration
- Develop communications systems for the most demanding applications that require superior reliability
- Test radios in aerospace, airborne, terrestrial and indoor propagation environments

Propsim F8 Channel Emulator

Today's complex communications systems are being developed to meet the growing levels of broadband data in aerospace, satellite and airborne applications. One example of such an application is commercial airlines providing inflight broadband services to its customers.

Testing in a controlled laboratory environment provides wireless communications systems developers with a reliable and cost-effective solution for testing air-to-air and air-to-ground communication links using a vast range of use case scenarios. The laboratory set-up allows air and space applications to be exposed to real environment conditions such as high Doppler, long delays and high dynamic range variations.

A failure in a communications link can lead to the loss of life-critical data, which is why aerospace, satellites and airborne radio devices need to meet stringent reliability requirements. It is often very difficult – sometimes virtually impossible – and expensive to repair aerospace and satellite type devices. It is therefore crucial to emulate as accurately as possible all the various phenomena that may affect a radio device in its ultimate environment. This is the only way to guarantee the reliability of the communications links and radio systems. Keysight's Propsim Aerospace channel emulation solution provides the foundation for covering these test requirements.

Propsim Aerospace channel emulation solution provides the highest levels of channel emulation performance and accuracy available on the market. It uniquely integrates the functions of an advanced terrestrial channel emulator with a satellite channel emulator into one compact and affordable unit.

With a single test instrument, you can test airborne gateway links (e.g. LTE) as well as indoor hotspot links (e.g. WiFi), to which end-users are connected.

Keysight's Propsim Aerospace channel emulation solution is the most reliable and cost-effective solution for radio channel testing

- Strengthen the functionality of critical communications links
- Provide realistic conditions for testing radios
- Minimize the need for field testing since most of the testing can be done in the laboratory
- Achieve smooth interoperability between different systems
- Improve quality of service and end-user experience
- Shorten development cycles
- Reduce overall testing and development costs

Emulate aerospace and terrestrial channels in a single box for more time and cost-efficient testing

"The tool allows us to recreate environments in the laboratory to test the performance of communications systems during the critical stages of launch, flight, as well as space station docking procedures and landing of a spacecraft. This helps us to ensure the functionality of critical communications systems prior to launch."

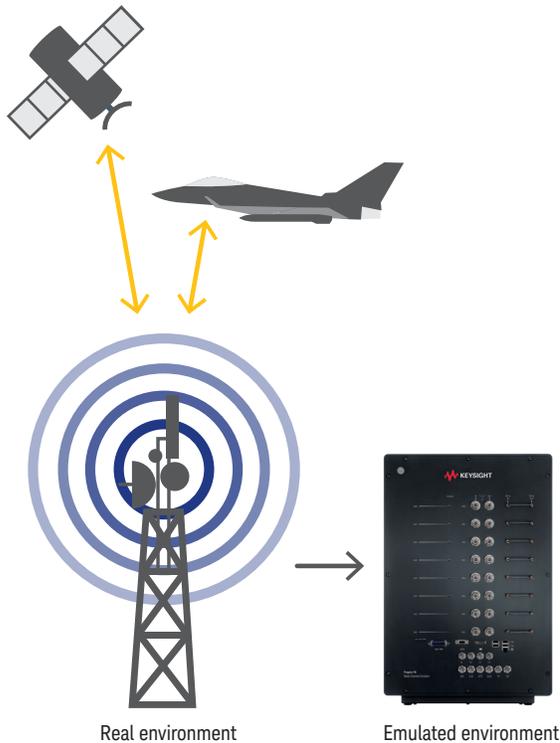*Chatwin Lansdowne, Engineer at NASA Johnson Space Center*
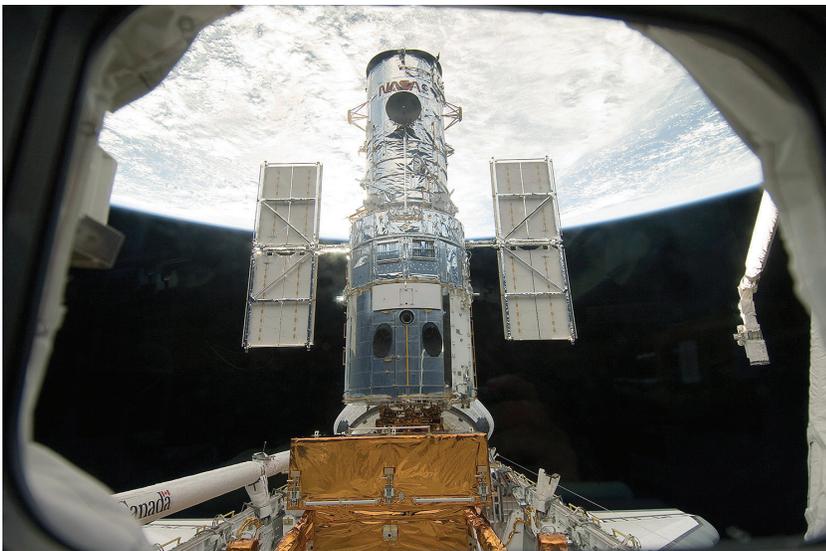
Identify and resolve issues early in the development process to shorten R&D cycles

By identifying issues at an early stage in the development process, Propsim Channel Emulators can ensure that your products are more mature and have fewer errors prior to field verification. This type of approach accelerates R&D cycles and significantly reduces your development and testing costs.

Furthermore, some applications in hard-to-reach locations are practically impossible to test in the field. The accurate and precise laboratory test environment created by Propsim allows you to initiate performance testing of early prototypes that are not yet ready to be tested in a real environment. As a laboratory-based test solution, the Propsim radio channel emulator is a flexible, cost-effective and reliable alternative to more time-consuming and expensive field-based testing.

Improve system integration

Use the Propsim emulated test environment during the system integration phase to verify the seamless operation of various parts of a system. This is especially important when development projects are executed by different organizations. End product quality can be guaranteed as each subsystem is verified to comply with agreed specifications. The operational life-cycle of satellite and airborne radio systems is longer than that of commercial radios. Propsim Aerospace channel emulation solution allows you to ensure the compatibility of new components before you install them into a live system.

Real environment → Emulated environment

Bring real-world radio channel conditions into the lab with Propsim F8 aerospace channel emulation solution

"Bringing the mobile broadband into an aircraft is extremely difficult due to the high speed of the aircraft and much longer dynamic link distances than in a terrestrial environment. Keysight's Propsim aerospace channel emulation solution allows us to test different radio channel environments on aircrafts without ever leaving the ground. Now we are able to offer our clients the quality of service in aircrafts that they are used to having on the ground."

Yong Liu, Senior RF Engineer of Aircell LLC

Create Realistic Aerospace Propagation Conditions for Different Test Scenarios

The Propsim aerospace modeling tool lets you create realistic aerospace propagation conditions for different test scenarios. The tool's graphical editing functionality makes it easy to visualize stationary and moving objects, observe the link conditions and process the Propsim test scenarios.

Rely on Propsim Aerospace for accurate, dependable test results

Test more efficiently at key points in your procedure with Propsim aerospace & satellite modeling tool

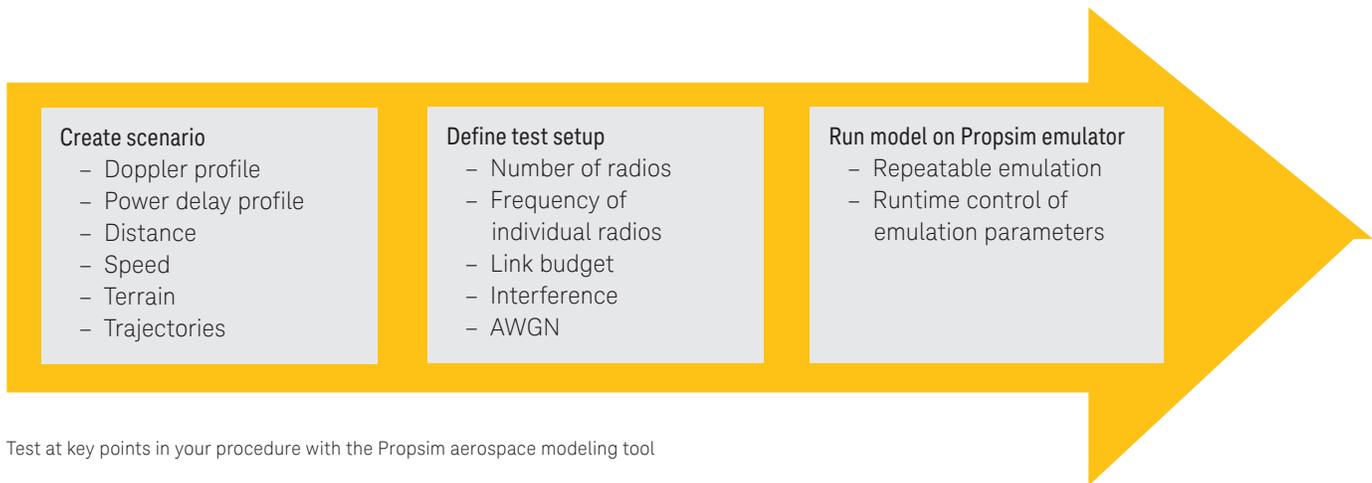## Create aerospace and satellite scenarios using the editor tool or data import functions

The editor tool supports the creation of dynamic multipath scenarios. It provides a file interface which enables the import of customer specific data from third party scenario tools.

Define the test set-up

The editor tool allows linking and connecting multiple radios into one scenario. It also enables AWGN interference sources to be added for each channel independently if necessary.

Run the model in the emulator

The results are guaranteed to be time and RF phase coherent and repeatable due to Propsim's single unit integrated platform architecture.

Create scenario
- Doppler profile
- Power delay profile
- Distance
- Speed
- Terrain
- Trajectories

Define test setup
- Number of radios
- Frequency of individual radios
- Link budget
- Interference
- AWGN

Run model on Propsim emulator
- Repeatable emulation
- Runtime control of emulation parameters

Test at key points in your procedure with the Propsim aerospace modeling tool

Emulate High Doppler, Long Propagation Delays and High Range Rates in a Laboratory Environment

Unique terrestrial and aerospace emulation channels in one piece of equipment

Keysight is the only test solution supplier who provides emulation of aerospace and terrestrial channels in a single box. The Propsim aerospace modeling tool is uniquely integrated with the industry-leading wide band fading emulator Propsim F8, enabling you to easily switch between the aerospace and terrestrial operating modes as well as use a wide set of features not available in traditional satellite simulators. These features include a selection of sophisticated channel modeling tools, standard model libraries and MIMO emulations up to 8x8.

Multichannel emulation capability

The Propsim aerospace channel emulation solution is able to emulate situations in which a wide range of different applications communicate with each other or in which several systems utilize the same radio channels. The communicating devices may be point-to-point, point-to-multipoint, high speed data applications, broadcasting applications, specific radar applications, jamming applications or counter measures against jamming.

Accurate aerospace channel emulation

Keysight's aerospace solution enables realistic emulation of all relevant radio channel phenomena.

High Doppler

The Doppler shift is proportional to the velocity and carrier frequency in use. Propsim with aerospace modeling tool independently emulates Doppler phenomena for each path of the channel while consistently maintaining the phase continuity in dynamic delay variations. This preserves realistic chip rate variations, which are necessary when testing satellite receiver performance.

Long delays

Compared to terrestrial links, aerospace links generally have longer link spans. Precise emulation of delay is important in ranging telemetry applications. Extreme accuracy is needed in applications such as object guidance or tracking, where it is important to know where the device was when the signal was transmitted and to make estimations about its new location. Propsim with aerospace modeling tool emulates delays and positions between moving objects and reflectors with extremely high accuracy.

Range rate

High range rate creates dynamic effects on radio link amplitude, delay and Doppler. Depending on the application, the rate range can be function based, linear or sinusoidal or completely arbitrary, as is the case with maneuvering fighter aircrafts. Accelerations and changing direction create sudden changes in Doppler, delay and amplitude values. Propsim aerospace & satellite modeling tool accurately and synchronously emulates radio links with up to 1.5 MHz maximum Doppler and up to 100 g acceleration.

Application Scenarios

Tactical data links

Tactical data links ("TDL") are used in military communications networks. TDLs are used in communications between aircrafts, ships and ground platforms. TDLs are capable of providing secure and jam-resistant high throughput connections over relatively long distances.


Satellite communications

In satellite-to-ground communication (whether stationary or mobile), accurate repetition of path loss, delay, Doppler and terrestrial multipath phenomena is important to evaluate coverage and Quality of Service. Satellite-to-ground communication is used for data communication and navigation purposes.
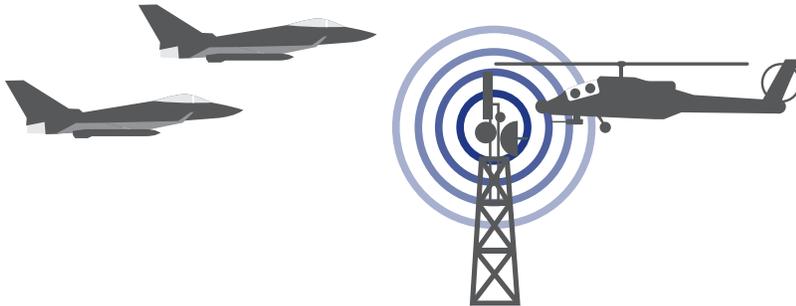
Commercial aviation: wireless broadband for in-flight services

Broadband data to commercial aircrafts is transmitted and received through ground stations. Situations similar to cellular terrestrial network occur at higher velocities and over longer distances.
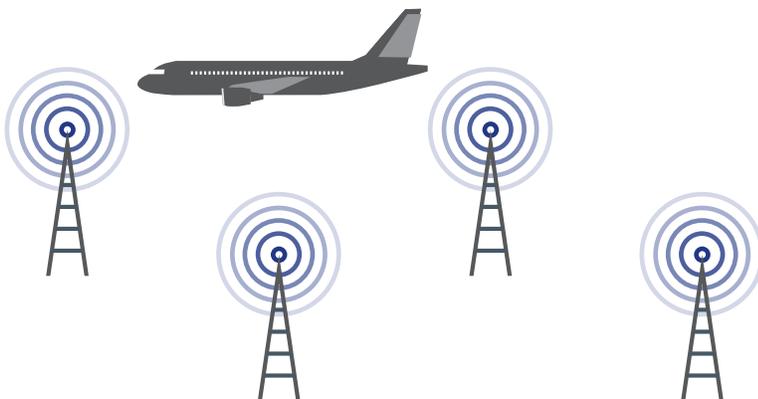
Propsim Aerospace Channel Emulation Solution Features

Propsim F8 Channel Emulator

– Number of channels: up to 8
– Number of fading paths: 1 (LOS) +3 (reflectors) paths/channel
– RF input signal frequency range: 220 MHz – 6 GHz
– RF bandwidth: Up to 160 MHz
– Propagation delay: Up to 1300 ms
– Range rate: 20 km/s
– Acceleration: 100 g
– Doppler shift: up to +/-1.5 MHz
– Interference generator: AWGN, independent per channel
– EVM: OFDMA 20 MHz BW < – 45 dB

Superior RF and digital performance

Propsim aerospace channel emulation solution features a channel modeling interface with up to eight channels and up to 160 MHz signal bandwidth. This is directly within an RF input signal frequency range of 220 MHz to 6 GHz, making external RF down/up conversion redundant. Systems operating on up to 27 GHz are supported with IF or external RF down/up conversion. The solution provides 100 g acceleration emulation capability and up to 1300 ms propagation delay.

GUI supporting file import from external tool

The graphical user interface of Propsim aerospace modeling tool enables you to generate, edit and visualize emulation models.

Open text-based file format

Keysight's Propsim aerospace modeling tool supports any user-defined routes or built-in functions for periodic models. The open text-based file format allows the import of customer-specific radio channel and location parameters, such as satellite orbital information or any airborne route information. The Propsim aerospace & satellite modeling tool can take input in two different formats of channel model data (e.g. from software simulation tools). This allows you to define and emulate the communications links of flight routes or test the wireless connection on an aircraft with link emulations based on virtual links or recorded link databases.

Propsim aerospace modeling tool enables you to create and edit different types of channel models with periodic curves

– Coordinate-based model – you define coordinate points and gain values for the transmitter, receiver and reflectors. Delay, range rate and Doppler parameters are calculated from the movement between given coordinate points.

– Function-based model – Doppler is defined based on linear, sinusoidal or triangular function. The delay is calculated from Doppler. You can define minimum and maximum values for gain.

– Arbitrary model – Doppler, delay and gain values in time are included and the values are given separately for the transmitter, receiver and reflectors.

Propsim F8 Channel Emulator

Visualization

Propsim aerospace modeling tool allows you to create illustrations of user-defined emulation models based on the geometry between and the speeds of transceivers and receivers as well as the locations of multipath reflectors. The geometric graphs display the channel parameter curves as a three-dimensional movement.

Validation

Propsim aerospace modeling tool checks the integrity of the imported data and validates the model format and data values. If the model is too complex to fit into the emulator, the data can easily be modified into a more suitable format.

Replay

The playback functionality allows the viewing of the model evolution as a time series demonstration. The models can be repeated as many times as needed. For example, you can create a radio channel environment once and replay it in the laboratory and improve the performance and functionality of the live wireless network at different cruising altitudes

Evolving

Our unique combination of hardware, software, support, and people can help you reach your next breakthrough. We are unlocking the future of technology.

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