SPIRENT Federal Systems

INTEGRATED GPS/INERTIAL TESTING

SPIRENT SimINERTIAL

INTRODUCTION

The testing of an inertial navigation sensor presents a major challenge in its own right, even before considering GPS integration. The linear and angular sensors are usually characterized separately using centrifuges and angular rate tables respectively. Some limited integrated navigation testing can be performed using rate tables equipped with a lever arm, but establishing full operational performance usually requires expensive and time-consuming field tests on an appropriate moving vehicle platform.

To reduce the need for field trials, operational performance of an Integrated GPS/Inertial (IGI) system can be established in the laboratory using a GPS RF constellation simulator, such as Spirent's GSS8000 product, along with a real-time emulation of the inertial sensor outputs that are coherently generated to exactly match the simulated GPS vehicle trajectory. Typical inertial sensor performance regarding bias and drift, for example, can be established using traditional techniques, and then represented by a sensor error model driven by the simulated motion with appropriate coefficients entered by the user. Some systems require an altitude reference, such as a barometric altimeter for aiding the inertial navigation solution.

The key benefit of this approach is that the stimuli to the navigation algorithms, in the form of GPS pseudorange measurements made by the GPS receiver under test and the emulated linear delta-velocity and angular delta-theta inertial sensor outputs, are under user control in the lab and are extremely repeatable. This allows fine-tuning and debugging of the navigation algorithms across a range of operational test scenarios.

For hybrid navigation sensors that are fully integrated into a single unit (such as Northrop Grumman's LN100 and Honeywell's H-764G), the manufacturer will often provide a suitable test input port to accept the emulated sensor data streams, bypassing the physical sensors in the unit under test.

For GPS/Inertial systems that have the Inertial Measurement Unit (IMU) and GPS in physically separate units, all that is required is to substitute the IMU with an inertial sensor stream conforming to the IMU's defined data output interface, thus emulating the actual IMU.

SimINERTIAL INERTIAL TEST SYSTEMS

The GSS8000 GPS simulator range uses Spirent's state-of-the-art **SimGEN for Windows®** application and modeling software to define and control the test environment. This fully flexible tool is easy to use and is equipped with a comprehensive range of trajectory generators as well as supporting true hardware-in-the-loop applications via acceptance of external vehicle motion data in real time.

SimINERTIAL is housed in a PC platform equipped with the appropriate data interface card. The simulated motion data is streamed from SimGEN via Ethernet to SimINERTIAL, which translates this simulated motion data into representative real-time inertial data streams at the data rate and message format appropriate to the unit interface being tested.

SimINERTIAL is equipped with fully user-configurable sensor error modeling and supports a range of popular inertial formats via a number of separately-priced variants. All variants adopt the same basic architecture as shown in Figure 1.

All SimINERTIAL solutions can be equipped to deliver a barometric altitude output message via a MIL-STD-1553B card installed in the SimGEN controller PC.

Control and data monitoring of the unit-under-test would normally be via the user's own instrumentation interface.
Spirent's optional SimDATA product can also be used to fulfill core Control and Display Unit (CDU) functions. SimDATA may be specified with either MIL-STD-1553B or RS422 interfaces.

SimINERTIAL testing at Spirent's facility

Spirent's SimINERTIAL architecture permits easy expansion of additional inertial interfaces to support transfer alignment and multiple inertial sensor architectures.

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SUPPORTED VARIANTS

EGIs

- Honeywell H-764G EGI, SIGI and NAV100™ IMU
- Northrop Grumman LN100, LN250, LN251 and LN260 EGIs

IMU Emulation

- Honeywell HG-1700, HG-1900 and HG-9900
- Northrop Grumman LN200
- Atlantic Inertial Systems (AIS) SiNAV and SilMU02
- NATO STANAG 4572

SUMMARY

Spirent supports integrated GPS and inertial performance testing by combining its powerful and flexible GPS simulation systems with coherently-generated inertial sensor delta-theta and delta-velocity data.

The SimINERTIAL architecture is readily adapted to other inertial sensor simulations.

Please contact Spirent for more detailed information to meet your specific testing requirements.

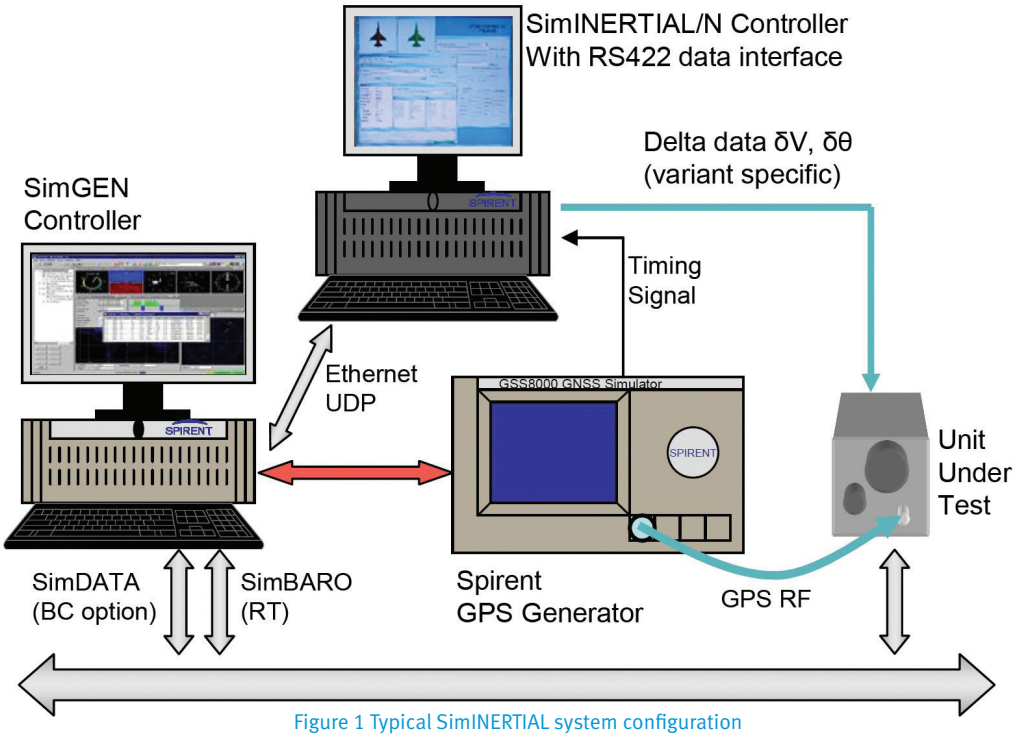

Figure 1 Typical SimINERTIAL system configuration

Product specifications are available upon request.

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For current product data, visit the Spirent websites at www.spirentfederal.com or www.spirent.com.

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