Test and Evaluation (T&E) ranges. The need for such a system is critical since the existing test truth sources are no longer accurate enough to score the performance of sophisticated aircraft and weapon navigation systems, the accuracy of which continues to increase rapidly. This paper will describe the CRIIS TSPI system architecture based on advanced GPS and IMU data processing algorithms, and discuss the results of a comprehensive test program to demonstrate the technical maturity of this system in a relevant high The CRIIS program office, under the sponsorship of the Central Test and Evaluation Investment Program (CTEIP) office, is developing the next generation Time Space Position Information (TSPI) system ‘Truth Standard’ for the Tri-Service dynamic environment (linear and rotational).

The CRIIS TSPI system is being designed/produced by the prime contractor Rockwell-Collins Inc (RCI). It consists of hardware and software components that are integrated to produce the highly accurate TSPI data consisting of position, velocity, acceleration, attitude and attitude rate of the participant. The participant package consists of a SAASM-based GPS receiver integrated with a tactical grade IMU using the ultra-tight coupling (UTC) methodology. The stringent sub-meter position accuracy requirements under high dynamics demanded the use of real-time kinematic (RTK) GPS measurements as well as the highly accurate satellite ephemeris and clock data corrections provided by wide-area differential correction systems such as StarFireTM. The StarFireTM itself uses measurement data from a large number of GPS reference receivers around the globe. The RTK algorithm uses carrier-phase measurements data transmitted to the participant from a reference receiver (RR) via a data link over a range of up to 50 nautical miles. A differential RTK algorithm, that differences the carrier-phase measurements of the SAASM receiver with the corresponding measurements from a RR is implemented in the participant package. Trade studies and GPS/IMU error characterizations were used to develop algorithms to meet non-positional (velocity, acceleration, attitude and attitude rate) parameter accuracy requirements.

The purpose of the demonstration phase of the CRIIS system was to show the design solution maturity to a Technical Readiness Level of six (TRL-6) as defined by the DoD 5000.2-R document. This was accomplished by carrying out a comprehensive incremental test program consisting of three phases: Crawl, Walk and Run. The Crawl phase consisted of Lab testing using model-based simulation and RF Simulator based Hardware-In-The-Loop simulation. The Walk phase consisted of van and roller-coaster testing. Finally, the Run phase employed a high
dynamic aircraft (AT-38B) to conduct dynamic testing at the 746th Test Squadron at Holloman AFB, NM. This paper will discuss some of the results and lessons learned from the Crawl and Walk phases, and then provide the real-time dynamic test results of the Run phase which showed that the CRIIS program accuracy requirements were achieved.

To establish that the CRIIS system under test (SUT) met the program’s accuracy requirements in a relevant environment, data from two CRIIS SUTs, a NovAtel Synchronized Position Attitude and Navigation (SPAN) system and a Honeywell aircraft Embedded GPS/INS (EGI) system was collected and analyzed. The data reduction methodology, Truth Source considerations and reliability check procedures are discussed. Finally, statistical performance data for a variety of aircraft flight high dynamic scenarios is presented, demonstrating the success of the design.