# "HATS" Off to AFRL SBIR Advance

*AFRL Small Business Innovation Research contractor Appareo Systems developed this Head Attitude Tracking System (HATS) to provide warfighters with reliable heading reference in any outdoor environment. Pictured is a backside view of the HATS helmet with attached headset. (Air Force photo)*

In response to urgent Air Force (AF) and F-35 Lightning II Joint Strike Fighter (JSF) demand for a highly specialized head orientation sensing system satisfying a host of exacting requirements, AFRL Small Business Innovation Research (SBIR) contractor Appareo Systems created the Head Attitude Tracking System (HATS). The novel head-mounted technology comprises an ultra-short-baseline (USBL) Global Positioning System (GPS) receiver and a miniaturized Inertial Navigation System (INS), a tightly coupled GPS/INS combination providing reliable heading reference in any outdoor environment and meanwhile meeting rigorous weight and size constraints.

The SBIR-enabled HATS technology provides the first viable means for measuring the dismounted warfighter's head position. It overcomes the implementation challenges and technical shortfalls of earlier systems, many of which leverage fixed-reference (beacon) and magnetometer-based solutions that render them not only impractical for in-theater implementation but also prone to performance degradation in the presence of strong radio frequency emitters (e.g., radar, communications systems) and/or ferrous metals. Based on precise AF and JSF technical specifications, the rugged, lightweight, low-power, and man-mounted HATS can operate in electromagnetic fields up to 200 V/m, with 1° resolution and accuracy and with a minimum 60 updates per second over a Universal Serial Bus or other standard interface suitable for a three-dimensional (3-D) audio display system.

Appareo's NaviCube INS technology is the heart of HATS. As a microelectro-mechanical systems (MEMS) technology, the NaviCube relies on miniaturized gyros, accelerometers, and a magnetic compass to gather attitude information. The resulting INS, which is more accurate than any other MEMS-based system on the market, weighs just 1.44 oz and is less than 1 $in^3$ in size. Its tight coupling with the USBL GPS provides an ideal platform for supporting a wide range of man- or vehicle-mounted applications of import to AF (and other military) operations. Summarily, the technology's versatility as a compact, lightweight guidance system, combined with its relative ease of integration into current and future systems, sets the stage for possible expansion of HATS usage beyond the original project scope.

As an added benefit, Appareo has been able to use several HATS components in advancing various other technologies of prospective military merit, including the new ALERTS [Aircraft Logging and Event Recording for Training and Safety] Vision 1000—a lightweight flight data management device developed in partnership with Eurocopter for light and legacy aircraft. The company has also secured US Army and Ultra Electronics projects that will exploit a multifunctional unit called the GAU 3000, which relies heavily on technology developed for HATS.