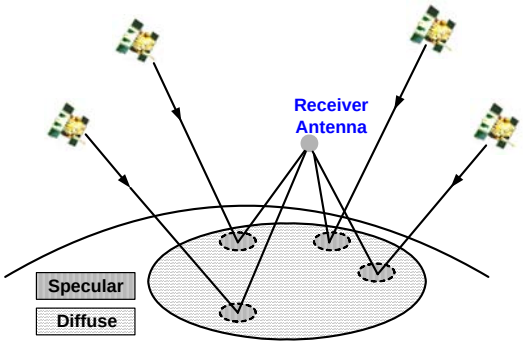
navsys

EXCELLENCE IN GPS PRODUCTS & SERVICES

# Bistatic GPS for Intelligence, Surveillance and Reconnaissance (ISR)

GPS bistatic signals have applications for remote sensing in collecting data such as soil moisture content, surface altitude, or wave speed. Prior research using these signals has been limited by the low signal power of the bistatic GPS signals. NAVSYS Corporation has developed an advanced bistatic GPS receiver that uses a 96-element GPS antenna array and digital beam steering to provide gain to increase the ability to detect the weak bistatic GPS signals. This provides up to 20 dB of gain over previous receivers which use single element tracking.

Because of the extremely low power level of the returned bistatic GPS signals, this previous research has focused primarily on the strong specular static signals. NAVSYS has developed a Digital Beam-Steering GPS receiver, the High-gain Advanced GPS Receiver (HAGR), which can be used to increase the received signal/noise ratio from these weak bistatic signal returns allowing improved detection of both specular and diffuse GPS signals thus increasing the coverage as shown in the accompanying figure.




**GPS Bistatic Geometry with Specular Reflection Points**

## Digital Beam-Steering GPS Receiver

The NAVSYS High-gain Advanced GPS Receiver (HAGR) is a digital beam steering receiver designed for GPS satellite radio navigation and other spread spectrum applications. This is installed in a rugged Compact PCI chassis suitable for aircraft flight tests. The signal from each antenna element is first digitized using a Digital Front-End (DFE). Each DFE card includes the capability to sample signals from 8 antenna inputs. These can be cascaded together to allow beam steering to be performed from a larger antenna array. The complete set of DFE digital signals is then used to create the composite digital beam-steered signal input by applying a complex weight to combine the antenna array outputs. The HAGR can be configured with a variable number of antenna elements up to a total of 96-elements. Through the HAGR digital control, these beams can be directed at any point on the surface of the earth for data collection. The area they cover is a function of the beam width and the aircraft altitude. Up to 5 beams each, with +20 dB gain, can be independently directed by the HAGR signal processing.

**High-gain Advanced GPS Receiver**

**Test Aircraft**

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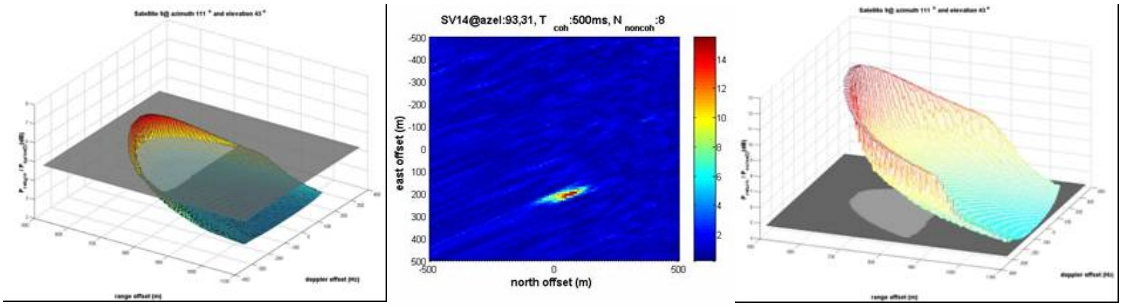
**96 Element Antenna Mounted on Aircraft**

### 96 Element Antenna

The 96 element antenna is configured in a symmetrical pattern on its ground plane as shown here.

## ISR Flight Tests

Land and Maritime flight test data has been collected, processed and analyzed. The simulation of the 96 element array was verified. The data demonstrates the ability of the HAGR/Array Antenna to improve the GPS bistatic remote sensing capability by using digital beam steering to allow the weak diffuse bistatic GPS signal to be detected over a larger area. The following figure shows the results of the analysis when the target was a barge in the Gulf of Mexico.




## Characteristics:

| | |
|---|---|
| Antenna Elements | 96 |
| Center Frequency | 1575.42 MHz (L1, L2 could be added) |
| Code | C/A or P(Y) |
| Other Applications | Soil Moisture Measurement, Surface Altitude, Wave Speed, Anti-Jam, Interference Rejection, and Multipath Mitigation |

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