Anti-Jam System Maintains Precision Timing for GNSS Receivers

By Barry Manz

The Department of Defense has emphasized reductions in size, weight, and power (SWaP) for nearly two decades, but the proliferation of small UAVs and other small platforms have increased pressure on manufacturers to improve these metrics even further and do it faster.

The need for assured positioning, navigation, and timing (PNT) extends well beyond UAVs. Precision PNT underpins guided munitions, artillery fire control, ISR sensor fusion, distributed maritime operations, satellite communications timing, network synchronization, and autonomous maneuvering. It is also foundational to Joint All-Domain Command and Control (JADC2), where sensor-to-shooter timelines depend on synchronized clocks and accurate geolocation.

One response to this challenge is the CLOAK GPS navigation assurance solution from HII. CLOAK is designed to preserve dependable PNT when GNSS signals are jammed, spoofed, or otherwise denied, enabling continued operations in contested electromagnetic environments. According to HII, CLOAK consumes about one-third the power of other anti-jam systems while delivering about three times the power efficiency. The CLOAK system, according to HII, can be integrated into UAVs, ground vehicles, ships, aircraft, and satellites.

At its core is a four-element controlled reception pattern antenna (CRPA) combined with adaptive signal processing. Unlike a conventional single-element GPS antenna with a fixed hemispherical pattern, a CRPA shapes its receive pattern dynamically. By analyzing phase and amplitude differences across its elements, the system distinguishes legitimate satellite signals from interference.

An astute observer might consider a CRPA simply a phased array by another name, and that would be a good assumption. The difference between the two is that an active electronically steered phased array (AESA) is more of a general-purpose system, as it can be used in a variety of applications. In contrast, a CRPA is optimized specifically for use in GNSS applications. It typically uses a small fraction of the number of elements as an AESA because a GPS satellite constellation doesn’t require them for this system to achieve its goal.

And while CPRAs are not new, they were traditionally used only on weapons platforms that could accommodate their size. However, advances in semiconductor and DSP technology have made products like CLOAK smaller and more affordable. It also allows them to be small enough to fit in almost any type of platform, and that’s a big benefit in terms of high SWAP performance.

To achieve all this, the CLOAK’s processor continuously applies complex weighting across the array, with the result that satellite signals enhanced while those from other sources (i.e., EW systems) are significantly reduced in strength. This application of adaptive spatial filtering allows simultaneous tracking of multiple satellites and allows platforms to maintain precise PNT during broadband jamming or spoofing.

Adaptive spatial filtering can increase effective anti-jam margin by 30 to 60 dB or more, which may determine whether a UAV stays on course, and precision-guided munitions hit their intended targets or whether ISR systems maintain geolocation

accuracy.

The CLOAK system, according to HII, can be integrated into UAVs, ground vehicles, ships, aircraft, and in space. Their benefits of small size and high performance have become made them a standard item owing to Russia’s war on Ukraine.