Air Force SBIR/STTR

Transition

An example of Air Force supported SBIR technology that has been transitioned into an Air Force or other DoD system or subsystem or used by Air Force test ranges and facilities or maintenance depots.

SBIR Topic Number:
AF98-284

Title:
High Performance Modulation for Telemetry (HyperMod)

Contract Number:
F04611-99-C-0062

SBIR Company:
NOVA Engineering Co., Cincinnati, OH

Technical Project Office:
412TW/ENTI, Edwards AFB, CA

Transition Office:
412TW/ENTI, Edwards AFB, CA

High Performance Modulation for Telemetry to Increase Test Range Availability and Support (HyperMod)

- Air Force telemetry requirements call for fitting more telemetry users into smaller amounts of available spectrum
- Still in evaluation, the system looks like a promising solution to the problem
- A package of related equipment (airborne, telemetry transmitter and ground station demodulator) was developed to meet requirements

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Air Force Requirements

The auctioning of parts of government allocated aeronautical telemetry bands to the private sector decreased the amount of useable radio frequency (RF) available to test programs. This, coupled with the increasing bandwidth requirements of test programs, required a solution to fit existing telemetry users and higher bandwidth users into this smaller amount of spectrum. Also, increased performance and robustness of these telemetry links was sought by the Air Force.

SBIR Technology

SBIR contracts helped NOVA Engineering develop HyperMod. The HyperMod project consisted of the airborne segment, the telemetry transmitter, and the ground segment, the ground station demodulator. The program looked to fit more users into the available spectrum through higher order modulation and detection schemes. The first modulation scheme developed, Shaped Offset Quadrature Phase Shift Keying (SOQPSK), gave a 50% improvement in spectral occupancy. The second waveform developed, multi-h Continuous Phase Modulation (CPM) provided an additional 30% reduction in occupied bandwidth over SOQPSK while basically maintaining the performance of the legacy waveform, Continuous Phase Frequency Shift Key (CPFSK), commonly known as PCM/FM.

The ground demodulator was developed first. Due to the complexity of demodulating the multi-h CPM waveform, a quite powerful demodulator was required. During the design and technical paper research, a multi-symbol PCM/FM demodulator was found and developed which gave the user an increase of ~3dB of detection efficiency over traditional methods.

The transmitter developed is a multimode (CPFSK, SOQPSK, CPM), tunable (L or S-Band) in 500kHz steps, 10W, serial or discrete controllable transmitter that allows input data rates from 100kbps to 28Mbps (14Mbps in CPFSK mode). This allows the mission planner to tailor frequency and modulation mode depending upon the mission requirements and available spectrum.

Air Force Technology Payoff

The development of the ground demodulator preceded the airborne transmitter so ground stations have had the opportunity to use the HyperMod demodulator in real world testing. Because the proliferation of the higher order modulation schemes has not been large as of yet, the demodulator has been used mostly with the legacy CPFSK waveform. The additional 3dB of detection performance has made the demodulator a big hit in the telemetry community allowing the test article to fly out to greater slant ranges.

As the acceptance of higher bandwidth efficient modulation scheme takes hold, so will the popularity of these products. When this happens, more test vehicles will be able to be tested at once, increasing range availability and support, which ultimately leads to test programs completing in a shorter amount of time and getting the end item to the warfighter more quickly.

Company Impact

The SBIR project led to the creation of an entirely new, strategic, Telemetry Business Unit. This allowed the company to capitalize on its development of telemetry physical link technologies to include: advanced signal processing, adaptive equalization, Forward Error Correction/Turbo Product Coding, high performance networking, and, a three times improvement in waveform spectral efficiencies over legacy systems. Nova Engineering was able to offer a Hypermod series of telemetry transmitters and demodulators capable of meeting flight test telemetry needs within the constraints of a fixed and already cramped RF spectrum. Among larger orders in which the Hypermod development resulted was a $1.5 million sale of the Hypermod telemetry demodulators to the US Army's White Sands Missile Range. The US Air Force Hypermod transmitter development led to a miniaturized missile transmitter development contract with the Navy and there were subsequent commercial off the shelf sales for both the transmitter and demodulator. This project gave the company a considerable technology boost and propelled it into becoming a leader in flight test instrumentation.

U.S. AIR FORCE

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