Advanced Electronics for Active Aperture Array Architectures

ONR Program Code 31

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At a Glance

What is it?

- This research program develops innovative electronics technologies that will enable the revolutionary architectures and capabilities of future electronically scanned array (ESA) apertures. The emphasis is on enabling affordable solutions without sacrificing advanced performance at radio frequencies (RF) from microwave through millimeter wave.

How does it work?

- The underlying electronics component technology and advanced architectures form the backbone of an interface between the warfighter and the electromagnetic spectrum. Future all-digital architectures will increase efficiency and reduce size weight, and power consumption by eliminating costly RF analog components.

What will it accomplish?

- The research will ultimately achieve the following ESA performance benefits: reduced life cycle cost by 50 percent, increased bandwidth by a factor of five; increased beam simultaneity by a factor of 10, and; improved dynamic range by 30 dB

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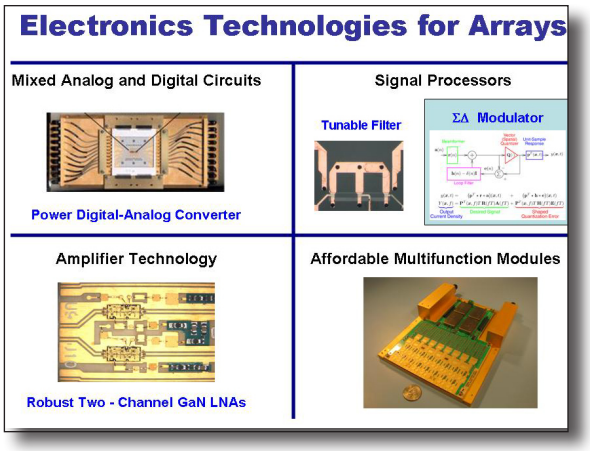

For decades, the Office of Naval Research (ONR) has made significant and pioneering investments in basic solid state electronics materials, devices and technologies. ONR funded the first monolithic microwave direct digital synthesizer, the first 500 GHz InP transistor, the first decade bandwidth GaN high-power monolith microwave integrated circuit amplifier, and the first high-power, digital-to-analog converter operating at microwave frequencies.

For receive apertures, the key issues are dynamic range, bandwidth and noise reduction. Novel tunable filters, frequency channelizers and analog-to-digital converters are the key enablers of multifunction array architectures. Robust, ultra low-loss receiver front ends are sought after and present a significant challenge for the dense electromagnetic environment of Navy systems. For high-power transmit arrays, wideband gap amplifiers must operate efficiently reduce thermal management requirements and allow for higher power levels for sensing, electronic warfare and communications. This is especially challenging for bandwidths exceeding one octave. Highly innovative approaches, based on digital switching amplifier and power digital-to-analog conversion technologies, are enabling both greater efficiency and ability to operate in a multifunction simultaneous beam mode.

Increases in "scale of integration" will enable single chip solutions for receiver and transmitter chains thus reducing total parts count and increasing affordability. Signal processing components, architectures and techniques will improve system linearity and dynamic range allowing multifunction modes of operation. Research thrusts that include optimization of components in an integrated chain will demonstrate feasibility of future affordable ESA technologies. Basic objective metrics are to double the overall efficiency and reduce size, weight and power consumption by a factor of two.

Research Challenges and Opportunities:

- Improvement of solid state device parameters including: switching speed, bandwidth, noise, dynamic range, linearity and robustness to dense signal environments
- Increasing the performance and efficiency of component technologies via advanced semiconductor III-V materials such as InP, GaN, SiC and others such as evolving nanotechnology materials
- Demonstrate size reduction of components needed to fit within an array lattice
- Mixed analog and digital conversion circuits and signal processing architectures