ADLINK
Leading EDGE COMPUTING

White Paper

Rugged Solutions for Radar and Sonar Processing

Meeting Military Data Signal Analysis Imperatives

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Radar Processing

Synthetic aperture radar (SAR), phased array radar, and hybrid radar systems are prevalent in military information gathering. Applications include air-defense systems, antimissile systems, aircraft anti-collision systems, ocean surveillance systems, altimetry and flight control systems, and guided missile target locating systems. The suitability for GPGPU acceleration in this space dates back nearly a decade. Consider the benchmarking results of Peter Morris, et. al.,from India's Defense Research & Development Organization, which compared an Intel® Xeon® processor-based system with eight NVIDIA Quadro FX 3800 GPUs (launched in 2009) against a PowerPC equivalent. The GPGPU-driven system realized acceleration rates for various radar tasks (data conditioning, MTI, Doppler processing, etc.) from 16X to 82X.

Consider just one example of current developments in military radar applications: The U.S. Navy recently announced a $3 million contract to design a GPGPU-based upgrade to the Lockheed Martin F-35 Lightning II joint strike fighter's Block 4 radar. Upgrades will include a wide-area, high-resolution SAR mode to the craft's existing Northrup Grumman APG-81 radar. The resulting upgrades, due in two stages in 2021 and 2023, will yield "Big SAR" capability able to capture a significantly larger ground area than what is possible with current systems. This will aid in reconnaissance and targeting, with GPGPU-driven processing allowing the system to handle the much larger data load.

Within the military computing space, VPX (also known as VITA 46, of which there are now many sub-specifications) has emerged as a popular Eurocard/ backplane/chassis technology for highly compact, dense computing platforms. VPX switched fabric backplanes provide high data throughput that allows for simultaneous operations on large data sets. ADLINK is one of the key members of the VME International Trade Association (VITA) VPX Working Group that designs and promotes VPX specifications, and ADLINK maintains an ever-evolving roster of VPX and similar computing products well-suited to military signal analysis applications. ADLINK GPGPU-based products provide high tech radar systems with digital signal processing and machine learning capabilities able to extract useful information from very high noise levels. These products include:

VPX3010

Designed for rugged 3U enclosures, the VPX3010 processor blade features three CPU options: the Intel® Xeon® D-1559 (12-core, 45W TDP), Intel® Xeon® D-1539 (8-core, 35W TDP), and Intel® Pentium® D1519 (4-core, 25W TDP). The VPX3010 provides a power-efficient processor base on which can be added a complementary GPU solution, such as the VPX3G10 or the XMC-G1050TI through the XMC interface.

VPX Graphics Card

The 3U VPX GPGPU blade embeds dual-channel GDDR5 memory alongside the NVIDIA GPU. Featuring hundreds of processing cores and CUDA compatibility, the VPX graphics card is available in conduction-cooled (R) and air-cooled (A) variants.

cPCI-6940

For various reasons, including legacy investment support, some solutions may fare better using CompactPCI rather than VPX. Like the VPX3010, the ADLINK cPCI-6940 processor blade with Intel® Xeon® processor D-1500 and AMD Radeon™ E8860 GPU in 6U form factor offers a high-performance foundation for radar processing systems.

Sonar Processing

Within the sonar sphere, digital signal processing can extend to analysis of signals from towed and fixed acoustic arrays, sonobuoys, torpedo guidance, and other systems. Applications include the MK-48 torpedo, the Poseidon P-8, and autonomous underwater vehicles (AUVs). As with radar, GPGPU processing can perform the herculean task of cutting through “salt and pepper noise” in a far faster, efficient manner than CPU-only computation. This was proven by the University of Catania’s Placido Salvatore Battiato when he benchmarked real-time image and acoustic workloads comparing Intel® Core™ i7-4510U (2 cores), NVIDIA GeForce 820M (96 cores, entry-level at the time), and NVIDIA GeForce GTX 480 (480 cores, mid-level at the time) platforms. Not surprisingly, the GTX 480 trounced its rivals.

ADLINK’s broad range of GPGPU products provide sonar receiver designers with multiple processing options based on SWaP considerations. A sampling of these includes:

VPX6000

When SWaP priorities allow for more leniency in form factor, the 6U VPX form factor delivers the most compute performance per rack unit for GPGPU applications. ADLINK’s VPX6000 harnesses up to two Intel® Core™ i7-4700EQ (4-core, 47W TDP), providing significant processing horsepower that remains within the bounds of conduction-based cooling. However, as the Core™ i7 only provides integrated Intel graphics, a companion GPU card is still required for a full GPGPU solution.

XMC Graphics Module

The XMC standard, also known as Switched Mezzanine Card, is one type of PCI Mezzanine Card (PMC) defined by the VITA 42 standard. XMC specifies multiple high-speed serial connection formats and offers an easy way to add modular, cutting-edge I/O options to a platform without the heavy investments of a custom solution. ADLINK’s XMC features surface-mounted GDDR5 memory and an NVIDIA GPU. Various SKUs offer display output options as well as conduction or air cooling.

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