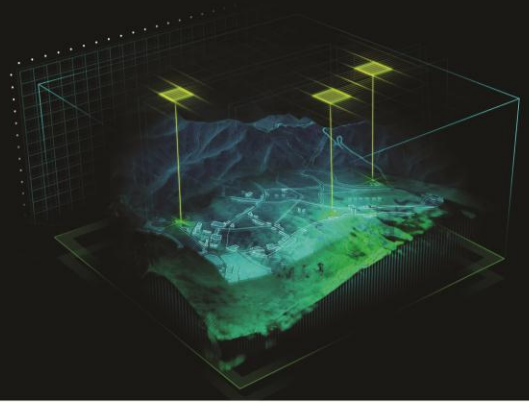
GEO INTELLIGENCE CASE STUDY



NATO CMRE REVOLUTIONIZES REAL-TIME UNDERSEA MINE DETECTION

GPU-Accelerated Mine Hunter Locates, Identifies, and Classifies Mines 50-100x Faster than CPUs

CUSTOMER PROFILE

- NATO's Centre for Maritime Research and Experimentation (CMRE) is a world-class scientific research facility located in La Spezia, Italy

PROJECT CHALLENGE

- Accelerate sonar with GPU to enable real-time processing of data aboard an automous underwater vehicle searching for mines
- Enable the research team to locate, identify, and classify mines in real time

NVIDIA SOLUTION

- NVIDIA® GPU Accelerator with CUDA met all project challenges, outperforming CPUs by 75x

High-resolution, high-frequency synthetic aperture sonar (SAS) with GPU acceleration on the MUSCLE autonomous underwater vehicle is making the seas safer for travel.

"The GPU-accelerated MUSCLE AUV makes mine hunting faster, more affordable, more reliable, and safer for NATO. Without GPU acceleration, real-time detection and classification of munitions was practically unfeasible – the SAS application runs 50-100 times faster on GPUs than on comparable CPUs."

Francesco Baralli, Principal Scientific Assistant
NATO STO Centre for Maritime Resesarch and Exploration

NATO Uses MUSCLE to Make The Seas Safer

In the Adriatic and other European seas, the seafloor is littered with tens of thousands of mines, bombs and other munitions that were lost or abandoned after World War I and II. Because of the risk of explosion or the release of toxic chemicals such as mustard gas, these mines pose a constant danger to commercial shipping and fishermen, not to mention the environment and the food chain. Clearing the mines is an economic imperative given the fact that 80% of all commercial trade travels by sea.

The Centre for Maritime Research and Experimentation (CMRE) is a world-class NATO scientific research and experimentation facility located in La Spezia, Italy. CMRE is addressing this challenge using their state-of-the-art autonomous underwater vehicle dubbed MUSCLE (Minehunting UUV for Shallow water Covert Littoral Expeditions). With high-resolution, high-frequency synthetic aperture sonar (SAS) technology accelerated by NVIDIA Tesla GPUs, MUSCLE is equipped with superb object recognition, on-board processing and intelligent decision making capabilities to locate, identify, and classify mines in real time.

SAS with GPU Acceleration Enables Real-Time Mine Detection

Traditional AUVs run in pre-planned survey routes and record all the data for off-line processing. They don't have flexibility to adapt to environmental conditions and sonar performance. GPU acceleration increased the level of autonomy, allowing adaptive behaviors. "The GPU-accelerated MUSCLE AUV makes mine hunting faster, more affordable, more reliable, and safer for NATO," said Francesco Baralli, Principal Scientific Assistant at CMRE. "Without GPU acceleration, real-time detection and classification of munitions was practically unfeasible – the SAS application runs 50-100 times faster on GPUs than on comparable CPUs."

> "With GPU acceleration, our missions are more productive, and our sonar imaging results are dramatically improved, with GPUs outperforming CPUs by 75x during sea trials. It is rewarding work to make the seas a safer place."
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> *Francesco Baralli, Principal Scientific Assistant*
> *NATO STO Centre for Maritime Resesarch and Exploration*

GPU acceleration also enables MUSCLE to make real-time course corrections to maximize its effectiveness in the limited amount of time (6 hours) it can spend in the water before requiring a re-charge. The AUV can react to what it sees and adjust its course to provide a closer look, or even return for a second pass if obstacles are blocking its ability to search the terrain. MUSCLE can help protect vessels in mine-infested waters by sending warning beacons alerting ships in real-time of munitions in their path.

The on-board Tesla GPU processing capability replaced racks of CPU-based servers (36 nodes) that were previously required to analyze and classify mines back on the launch ship. "Previous work with AUV mine hunters was slow and inefficient," said Baralli. "We could not analyze any data until hours later on the launch ship, and the AUV would have to be re-deployed if the images identified the wrong object or were blurry or damaged. With GPU acceleration, our missions are more productive, and our SAS imaging results are dramatically improved, with GPUs outperforming CPUs by 75x during sea trials. It is rewarding work to make the seas a safer place."

Next Steps – New Applications and Real-time, High-Resolution Output

CMRE believes the technology advancements they have achieved with GPU-accelerated AUV object identification and classification can potentially be applied to other areas, such as object location after a natural disaster (e.g., debris from a tsunami). Based on the results of the MUSCLE program to date, the CMRE team is already working on plans to upgrade the on-board GPU to calculate in real time and high resolution. In addition, they are continuing development on multi-GPU versions for their research computers on land.