KVH

Case Study

Frontline Robotics Turns to CNS-5000 to Keep Unmanned Security Vehicles On Track

Summary

Frontline Robotics' GRUNT AUGVs (Autonomous Unmanned Ground Vehicles) are robots that perform perimeter patrols and other security tasks to enhance the efficiency within airports, container yards, and other critical security locations, as well as improving overall safety for soldiers or guards. The GRUNTs (short for (unmanned) GRound UNiTs) rely on Frontline's ROC™ (Robot Open Control) operating system, which enables multiple AUGVs to collaborate and further improve security and reconnaissance over large areas. KVH Industries' CNS-5000 Continuous Navigation System is a key component of the GRUNT, providing critical navigation and position data via a combination of KVH's fiber optic gyro (FOG)-based inertial measurement technology and NovAtel's global positioning system (GPS) technology.

Frontline Robotics' GRUNT AUGVs perform security tasks and improve safety for human security personnel.

Challenges

Navigation and position are critical to AUGVs for successful autonomous decision-making and plan implementation. Since each vehicle in a team of vehicles is preprogrammed to complete missions and achieve conditional goals, it is important that the vehicle knows precisely where it is and where it is going at all times. This can be difficult, especially in areas where terrain is unpredictable or GPS is fully or partially blocked.

The Solution: KVH's CNS-5000 Continuous Navigation System

The CNS-5000 combines FOG-based inertial measurement technology with NovAtel's GPS technology to provide higher reliability and improved performance compared to other navigation solutions. Its deeply coupled design affords superior bridging capability between the two technologies when GPS reception is obstructed or unavailable. This allows the CNS-5000 to switch effectively between an optimal combination of GPS and inertial measurements when GPS is available and reliable inertial data when it is not (for example, in urban settings or heavily wooded areas). The CNS-5000 can rapidly reacquire the satellite signal when it becomes available after an outage, and can continuously deliver the most accurate and precise position, velocity, and attitude information possible in any situation.

"Frontline Robotics has been building turn-key autonomous unmanned ground vehicles using KVH and NovAtel sensors for four years," says Jeremy James, President and CEO of Frontline Robotics. "The data from these separate sensors was fused by algorithms executing in our proprietary control computer. The fused data provide localization for the automatic navigation software. The CNS-5000 physically integrates the functional capabilities of the KVH inertial and NovAtel GPS sensors into a single package. Furthermore, the CNS-5000 fuses the data from these sensors internally and provides this information directly to the control computer of an autonomous UGV. The combination of these fundamental sensing capabilities along with data fusion is a cost-effective solution for our autonomous unmanned ground vehicles."

Company Info

Frontline Robotics
Ottawa, Ontario, Canada

Mission: Frontline Robotics is committed to keeping people out of harm's way with intelligent, mobile robots. If the task is dull, dangerous or dirty, robots should be in the front line. Our mission is to elevate the robotics industry to address the serious threats faced by our society. We will do this with integrity, imagination and a sense of adventure.

Frontline ROBOTICS

Autonomous Perimeter Security

Frontline Robotics Builds a Variety of Solutions for:

- Homeland Security
- Defense Applications
- Airport Perimeter Security
- Border Patrol
- Robot Ambulances (MedEvac)
- Detention and Containment
- Perimeter Surveillance/Asset Protection

www.Frontline-Robotics.com

Additional Resources

KVH's CNS-5000 Continuous Navigation System:
http://www.kvh.com/cns5000

Frontline Robotics AUGVs:
http://www.frontline-robotics.com/RoboticsTechnology/platforms

Frontline Robotics' Robot Open Control (ROC™):
http://www.frontline-robotics.com/RoboticsTechnology/roc

Case Study

Frontline Robotics Keeps Security On Track with CNS-5000

Critical Attributes

Integrated navigational tools allow multiple GRUNT units to work in robotic synergy, using a "hive mind" that is controlled by the ROC. This can double or even triple perimeter reconnaissance or security capacity, replacing soldiers or guards and keeping human security forces out of harm's way in the event of a breach or assault on the facility. GRUNT units use navigational data from the CNS-5000 in conjunction with input from optical platforms to resolve "safe" structures and landmarks from possible intruders or foreign objects. This provides maximum efficiency in perimeter patrols and monitoring while maintaining full and efficient perimeter coverage, regardless of the environment.

In critical and dangerous situations, GRUNTs can be equipped with both lethal and non-lethal payloads. When an intruder is identified, the CNS-5000's navigation technology works in conjunction with data from optical sensors to help the GRUNT identify the exact position of the threat and allow for accurate assessment in determining the appropriate action, using force only as necessary to secure the area or await support personnel. The combination of inertial measurement and GPS provides continuous location and position information, contributing to 100% situational awareness. This information is invaluable in rapidly developing critical situations where security is compromised and the safety of the facility may be at risk. The CNS-5000's rapid signal reaquisition means that the GRUNT uses the most accurate location information available in real time, while constantly maintaining precise navigation.

"Frontline Robotics' core capabilities are in algorithms for autonomous and collaborative behaviors of unmanned vehicles. We rely upon the expertise of sensor manufacturers such as KVH to provide quality sensor data," Mr. James explains. "If sensors are made more intelligent, there are significant benefits for Frontline because we can leverage the investments in sensor technology that KVH and NovAtel have made and will make to support our client base and market. The result is fused data that is smoother and more reliable than the data from our own data fusion algorithms. Therefore, Frontline AUGVs deploying the CNS-5000 will have more reliable location-based positioning data. Furthermore, the CNS-5000 offloads data fusion algorithmic computations from our own control computer so that the vehicle's control computer can do more application-specific work."

Results/Impact

By integrating KVH's CNS-5000 into the design of the GRUNT AUGV, Frontline Robotics was able to build 100% situational awareness into each AUGV, along with outstanding reliability when GPS is partially or completely unavailable. The CNS-5000's rugged, small form-factor design simplified the integration into the larger structure, which is a key benefit as Frontline Robotics often builds custom platforms to suit their customers' security needs.

"The CNS-5000 is commercial-off-the-shelf technology integrated into a compact, robust enclosure that is well suited to the demands of 24/7 operation in a variety of environmental conditions on a vehicle. In the existing form, the CNS-5000 meets current and future requirements for our target market which is AUGVs for the perimeter security of critical infrastructure," says Mr. James. "These include, for example, the perimeters of airports, borders, nuclear power stations, and military bases."

CNS-5000

IMU Specification

Gyro Technology	FOG
Gyro Bias (deg/hr, 1σ)	± 1
Gyro Bias Repeatability (deg/hr, 1σ)	± 3
Gyro Angle Random Walk (deg/√hr)	0.0667 Max
Accel Technology	MEMS
Accel Bias Offset (total, mg)	± 50
Accel Bias Stability (mg)	± 0.75
Accel Velocity Random Walk (m/s/√hr)	0.0053 Max

System Accuracy

Position Accuracy (CEP)	RTK (2 cm + 1 PPM) DGPS (0.5 m) Single Point (1.8 m)
Velocity Accuracy (m/s, CEP)	0.02
Heading Accuracy (Yaw) (degrees, RMS)	0.1
Roll & Pitch Accuracy (degrees, RMS)	0.05

For CNS-5000 sales and technical inquiries, contact:
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