AVERT robotic Mission Planning & Operations (AVERT-MPO) to support Physical Security Posture

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ABSTRACT

The rapidly evolving robotic technology provides unprecedented capabilities to supplement, perform and potentially replace activities that in the past were only performed by humans. Robots have been deployed in many markets outside of nuclear from manufacturing assemble to work that must be performed in environments hazardous to humans. The military and other mission critical markets are researching the use of robots to support security and other mission critical applications. ARES Security Corporation (ARES) is actively expanding the AVERT software suite by developing a robotic Mission Planning & Operations (MPO) applications for the military, commercial nuclear and others called AVERT-MPO.

AVERT-MPO couples together the AVERT 3D-Digital Twin, with the pathfinding capabilities of AVERT Physical Security (AVERT-PS) and the command and control of AVERT-C2 with autonomous robots. AVERT-PS is actively deployed at 65% of the US commercial nuclear fleet, at government organizations and within other commercial markets. AVERT's pathing algorithms which include unique capability such as cover and concealment, avoid firepower and avoid detection have been validated by both the DOD and DOE. AVERT-C2 has been in active use since first deployed in 2005. It is currently used in 35 Major US Ports. Along with servicing ports, AVERT-C2 is also used in the Transportation Industry as well as Law Enforcement Agencies across the Country. The concept of operations (CONOPS) is that AVERT-MPO is the operational robot master that tasks the robot, obtains information captured by the robot and propagates that information out to the end user. This paper will introduce the AVERT-MPO software, provide example use cases and define the benefits of using robotic technology to support physical security posture.

Introduction

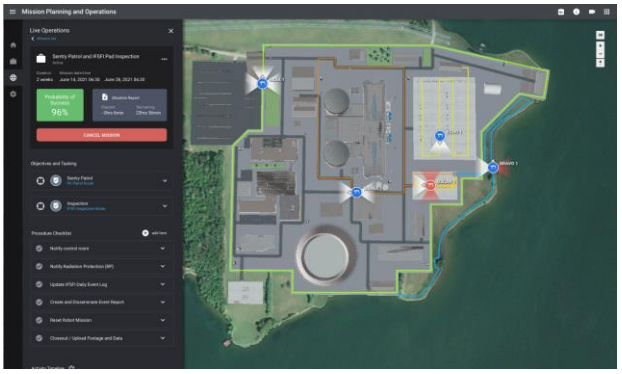
The ability to effectively leverage robots to perform missions and tasks can increase performance, reduce fatigue, perform tasks not well suited for humans and improve personnel life safety all while having the potential to generate cost savings. Robotic technology has been leveraged to minimize onsite operations and security personnel in many commercial and government markets and sectors. Take for example the automobile manufacturing industry. The manufacturing of vehicles that was initially performed only by humans quickly started to incorporate technology. Today's vehicles are designed with computer software, using materials sourced worldwide while being manufactured and assembled by human supervised robots. The efficiencies gained, improving and repeatable quality along with impressive safety records are testament to the benefits gained by using robotic technology. This same type of robotic revolution can be applied to improve and enhance physical security posture.

For physical security applications, robots can be thought of as both an offensive (deterrence systems, visual/IR identification, etc.) and defensive (detection tools, etc.) mobile sensing, reporting and response platforms. Tying robots together with an integrated robotic mission planning and operations (MPO) software solution provides the ability to supplement, perform and potentially replace activities that in the past were only performed by humans.

The evolution of robotic technology has been rapidly evolving over the years. Robots were initially tethered to a complicated, but very simple control system with limited capabilities. Control of robots has progressed from tethered systems, to wireless (but still tethered system) to semi-autonomous and now fully autonomous control. For some operations, the ability to tether to the report can have an advantage, but in many cases the ability to perform semi or completely autonomous appears to be the wave of the future.

AVERT-MPO Introduction

The AVERT Mission Planning & Operations (AVERT-MPO) software provides planning, deployment, interactions and reporting of robotic missions and tasks at the fingertips of the user. AVERT-MPO can deploy both semi-autonomous and fully autonomous robot missions depending upon the needed application. The AVERT-MPO software is open architecture so it can be coupled to any robotic system. For the purposes of this paper, our partner – Ghost Robotics' Quadruped Unmanned Ground Vehicle (Q-UGV) Robotic Dog (GR-Dog) will be discussed.



The AVERT-MPO software, leverages ARES technology that has numerous years of successfully serving industry to provide the user with current generation technology and features to easily accomplish robotic missions. The AVERT-MPO software utilizes the same 3D Digital Twin model that is used with both the AVERT Physical Security (AVERT-PS) and AVERT Virtual Tabletop (AVERT-VT) software solutions. The AVERT 3D Digital Twin is a geo-spatial model that includes interior and exterior features or structures, access points and

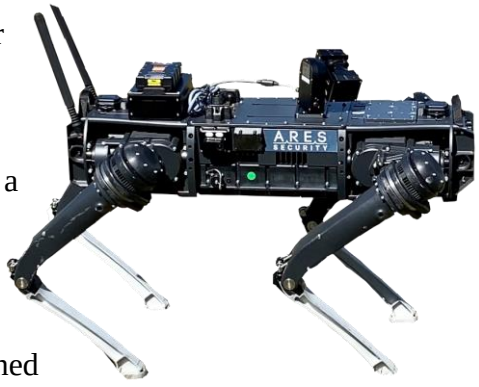
entrances, natural features, and the placement of both defensive tactics (i.e., active and passive barriers and detection tools) and offensive tactics (i.e., guards and deterrence systems).

AVERT-MPO utilizes an ARES exclusive automated pathing algorithm to determine the various pathways that robots can take to perform a given task. Evaluations are performed to determine various routes including the fastest path to an objective, path to an objective to remain undetected, and others. In addition, the automated pathing algorithm is used when the robot encounters and obstacle within in its path. Unlike the early home vacuum robots that when an obstruction occurs, the robot would bounce back and forth trying to find its way, AVERT-MPO empowers the robot with a thought out route, based upon the information within the 3D Digital Twin and the size and configuration of the obstruction.

The AVERT-MPO automated pathing algorithms are also employed to ensure mission success. Like humans, robots need and consume energy to perform a task. Humans have the knowledge and ability to determine how much work can be performed prior to needing food or water. Robots need to have that type of intelligence fed to them to assure mission success. That task is performed by AVERT-MPO by using the 3D Digital Twin and the automated pathing to calculate how much energy will be expelled during a given mission and comparing that to the available energy level. These activities together with the sensor feed assimilation leveraged from the AVERT command and control (AVERT-C2) software, provide a complete package to assure robot mission success.

AVERT-MPO leverages the open architecture and extensive sensor fusion that has been successfully deployed in AVERT-C2 systems to provide one common operating system. AVERT-C2 has been in active production since first deployed in 2005. It is currently used in 35 Major US Ports. It is also used by the Transportation Industry as well as Law Enforcement Agencies across the Country. Sensor integration is a core AVERT-C2 technology that is used by AVERT-MPO to integrate robot sensor feeds with the end user. The big value here is that the operation of the robot and the sensor feed from the robot can be integrated as a part of a state-of-the-art common operational solution. This integration is essential to eliminating stand-a-lone technology solutions, improving automation, and opens the door to cost reductions that can be achieved with AVERT-MPO for fleet wide heterogeneous robotic systems.

Ghost Robotics - Quadruped Unmanned Ground Vehicle



Ghost Robotics is revolutionizing legged robotics and the market for highly agile and fast tele-operated and autonomous unmanned ground vehicles (UGVs) for military, homeland security, public safety, commercial inspection, and security applications. The Q-UGVs, or GR-Dogs, are unstoppable and designed to operate across a broad range of terrains that a wheeled or tracked robotic platform and even competitive robotic platforms, would have difficulty managing. Beyond all-terrain stability, even during failure or lack of extra proprioceptive sensing (blind-mode), and operation in a broad range of environments, the Ghost robotic platforms are designed for warfighting, general military, nuclear, mining, oil & gas, and other rugged environments were design simplicity, high reliability, and field repairability are crucial. By reducing

complexity, GR-Dogs inherently increase durability, agility, and endurance as well as reduce the cost to deploy and maintain ground robots. The modular design even supports field swapping any sub-assembly within minutes. Users can leverage any NVIDIA autonomy or AI application with onboard NVIDIA Xavier to build a fully functional solution for situational awareness, EOD/Bomb disposal, collection, and analysis of data as an edge mobile IoT device, deploy mesh communication networks, or deliver payloads, including UAVs. Solution specific GR-Dogs be equipped for virtually any use-case with their choice of sensors, radios, and even size the robot to suit their specific requirements. Ghost Robotics customers include a broad range of US and allied military, homeland, intelligence, public safety agencies, defense and industrial enterprises, universities, and leading research organizations.

Leveraging Robotics to Enhance Physical Security Posture

ARES is currently working on or has proposed several robotic projects. These projects range from establishing a security perimeter, to measuring and generating 3D Digital Twin models of areas not conducive to humans and performing daily security and operational activities at a nuclear power plant. The following are brief summaries of each project.

ARES is pleased to have been included in a $950M ceiling indefinite-delivery/indefinite-quantity contract for the maturation, demonstration, and proliferation of capability across platforms and domains, leveraging open systems design, modern software and algorithm development in order to enable Joint All Domain Command and Control (JADC2). For this project, ARES Security has partnered with Ghost Robotics to provide mission planning and sensor fusion for GR-Dogs through the ARES developed machine-machine and human-machine interfaces. The solution, developed on open interfaces, provides mission planning, automated navigation, and pathing intelligence for the GR-Dog as well as the integration of the GR-Dog sensors / video data within the framework of a Common Operational Picture and operational C2 platform. One of the missions planned as part of this project is to deploy GR-Dogs into unknown, potentially hostile locations to survey and establish a secure perimeter. Once established the GR-Dogs would then perform sentry duty along with establishing a local communications network. The AVERT-MPO software is the operational Robotic Dog master that tasks the GR-Dog, obtains information captured by the dog and propagates that information out to the end user.

The benefits of using a robotic solution for this application are numerous. First off, human life safety. In this type of potentially hostile environment, the potential for human infliction or death can be very high. By using a robotic solution, this item is not a concern. Given the robotic system is in essence a mobile sensing platform, it can be equipped with a large multitude of sensors and instrumentation to provide the same and potentially expanded upon those that a human sentry could provide. Since the data collected

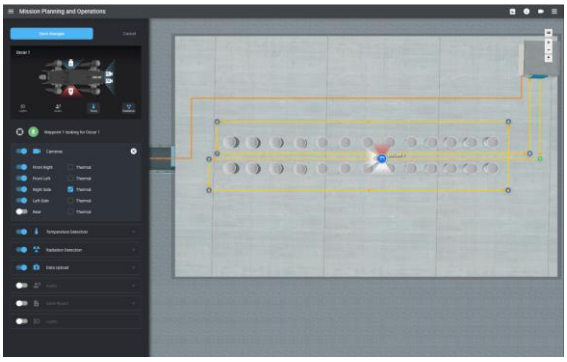
from the field robot is stored and streamed to the end user, instantaneous intelligence is provide to the end user. In addition, the robot can be equipped to take defensive actions if warranted. For example, if during the survey the robot identifies a dangerous explosive device, it can take countermeasures to explode the device or quarantine it until the proper actions can be taken. The beauty of the entire system is that the mission planning and operations of the robot is all safely performed remotely using AVERT-MPO.

ARES is talking with a confidential client to deploy AVERT-MPO, GR-Dogs and a few other robots to perform engineering evaluations and operations for buildings and environments that could pose health effects to humans. The proposed GR-Dog would have several configurations, based upon the mission on a given day. These configurations include:

- Visual and Infrared cameras and scanners to identify and document areas of concern (i.e., liquid leaks, corrosion, etc.)
- Multi-axis robotic arm attached to GR-Dog that can be used to penetrate remote locations and provide close and up front inspection possibilities
- 3D LIDAR scanner that will be used to generate a 3D Digital Twin of facilities and buildings and confirm/develop engineering drawings of facilities
- Chemical and radiation scanners and sensors to measure, record and document conditions within the environment to determine the potential for human activities within the environment
- Multitude of instrumentation and sensors to perform various tasks

The decision to consider the use of robotic technology over the routine use of humans was due to the hazardous environment that will be encountered to perform the work. The environment along with the rigorous tasks of inspecting, measuring and documenting each location will also be very time consuming and expensive to perform. As experience is gained over time, the robotic solution is anticipated to be a cost saving measure both in physical costs and human health savings.

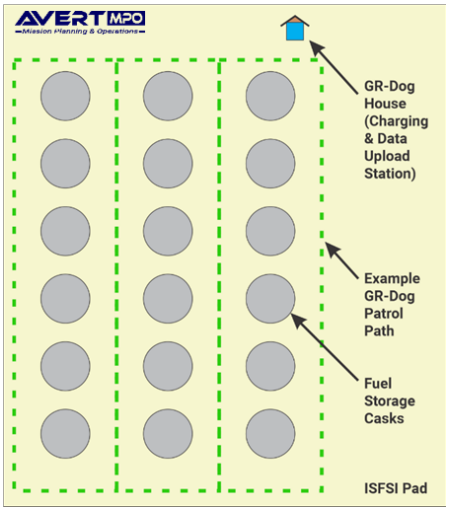
ARES is talking to with several confidential clients about the deployment of AVERT-MPO and several GR-Dogs to support the activities required at a nuclear power plant Independent Spent Fuel Storage Installation (ISFSI) facility. The ISFSI facility is an area on the site at which spent used nuclear fuel, which have attained US Nuclear Regulatory Commission (NRC) regulator conditions (i.e., extended duration of time since removed from the core) are stored in secure casks to await final disposition.



The location of the ISFSI facilities at a commercial nuclear power plants vary. Some ISFSI facilities are located within the plant protected area (PA). Others are located adjacent or close to the original PA. The ISFSI facility is typically an open concrete pad at which the spent fuel

casks are stored. If the ISFSI is not located within the original PA, fencing and other security features are used to contain the ISFSI.

To meet NRC ISFSI licensing requirement, the utility is required to be under 24/7 surveillance and have regular operational inspections to assure the casks are maintaining their integrity. The types of operations inspections include looking for leaks and measuring for cask surface temperature changes. Depending upon where the ISFSI pad is sited, security may have to escort operations during the inspection process.



The proposed solution to supplement and potentially replace the security and operations personnel that protect and inspect the IFSFI pad, is to site a GR-Dog at the site to perform the same activities as it's human counterparts. The GR-Dog would be positioned at the ISFSI pad to perform its task. When the tasks are completed, GR-Dog would be available via AVERT-MPO to perform additional tasks as called upon.

The benefits to using a robotic solution for this task include optimizing resources to accomplished required tasks. For this benefit, the GR-Dog can be thought of as having some traits similar to a living dog. One trait the real and robotic dog have in common is that both view events as if they are brand new. For the real dog, think of a postal person delivering mail daily. When that event occurs, many dogs will run to great them. In the case of GR-Dog, since it will be using sensors and instrumentation to perform assessment, it will not glaze over slowly occurring degradation like a human potentially could, it will "behave" similar to an actual dog. Since the GR-Dog "eyes" are video cameras & IR scanners (among others), a permanent record is established which can be reviewed using Artificial Intelligence (AI) and Machine Learning (ML) techniques, along with being cataloged for later human review.

The use of robotic technology also reduces head count, while still performing required activities. Granted there are costs associated with maintaining a robotic fleet, but these can and will become more cost effective as the technology is accepted and adopted. Like the other two project examples have each stated, removing humans from potentially dangerous situations is a significant benefit.

Conclusion

There are nice opportunities for the inclusion of robotic technology to support physical security posture. As presented above, AVERT-MPO and a GR-Dog provides unique capabilities to supplement, perform and potentially replace activities that in the past were only performed by humans.