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ABSTRACT

Briefing covers unique challenges to sensor emplacement posed by urban terrain. Obstructions, enclosed 3D structures, challenging surfaces, harsh RF environments and dense civilian populations all must be overcome when deploying a sensor grid.

INTRODUCTION

Sensor systems for urban terrain require not only the sensors and communication components, but methods to emplace and attach the sensors in desired locations. Several attachment mechanisms are under evaluation at General Atomics Corporation that may offer warfighters an organic capability to emplace sensors in urban terrain. In addition, General Atomics is looking at the difficult problem of tagging and marking items of interest in urban environments. Both of these capabilities will offer warfighters a greater advantage to gain information and operate from increased standoff.

URBAN CHALLENGES

Urban environments pose significant barriers to the use of autonomous weapons that the US has so heavily relied on to create dominant force. Fixed structures that restrict line-of-sight to targets, dense transient entities that obscure actual moving targets and the close proximity of non-combatants are all effective barriers to today's state-of-the-art precision weapons. Additionally, the capabilities of ground forces are limited to line-of-sight. This requires warfighters to operate in such close proximity to the enemy that casualty rates are extreme. Emplacing sensors in urban terrain offers an approach to close the gap between human-in-the-loop target discrimination and the use of standoff weapons. The ability to observe and mark a target using human visual contact for later action when the opportunity to use standoff munitions becomes available is an important step to bringing dominant force to bear in urban terrain.

SPLATS

OBJECTIVE

The Sensor Platforms that Launch and Attach to Substrates (SPLATS) is an internal research and development project focused on building and testing several unique attachment designs that can be packaged into a low velocity 40 mm munition. The objective is to create an organic capability for warfighters to emplace sensors that can extend their line-of-sight for real-time observations in urban settings. The targeted areas for emplacement are typical urban features, fixed structures such as buildings and rooftops as well as poles, wires and other protrusions.

EXTENSION OF LINE-OF-SIGHT

The value of extending line-of-sight (LOS) to the warfighter is intuitively obvious, but is as difficult to quantify as the “typical” city. A recent RAND study [1] suggests that utilizing UAVs to extend LOS only offers partial viewing due a certain amount of occlusion caused by the look angle of the UAV. For instance a UAV facing north will only view the south facade of buildings. The answer for continual coverage is a large number of UAVs or a similar number of emplaced sensors. A rooftop or high elevation sensor provides value for aerial coverage as well as communications reachback to command and control assets to a warfighter in a hide location. Finally, the emplaced sensor can provide target offset information for future “marked” targets in the real-time urban sensor to shooter scenario.

ATTACHMENT

Several projects sponsored by the DARPA Unattended Ground Sensor (UGS) program have demonstrated 40 mm grenade launched sensors with devices for impalement onto common building materials limited success [2]. These systems successfully packaged wireless camera systems into functional live grenade rounds. The approach to impalement was generally based on a penetrator or “nail gun” of some sort attached to the nose of the device that would activate on impact of the wall. Difficulties were faced in shock mitigation, penetration matched for a wide range of surfaces, as well as matching the ballistics of the current M203 rounds. General Atomics is approaching the past lessons learned by concentrating on mechanisms that control the amount of energy in the projectile on impact. Tuning the energy on impact to the potential target is critical to successful emplacement. A built-in differential impact control capability is most desired while maintaining highly reliable ballistics. The available options for a “controlled” impact are mass shedding, velocity drag mechanisms, or materials that retard pressure on impact. General Atomics has several designs underway addressing each of these areas.

INITIAL RESEARCH

General Atomics has begun some initial research on a variety of projectile designs. The upcoming months are expected to result in statistical datasets classifying performance relative to a range of building materials for each approach. Controlled testing will be conducted utilizing gas gun facility that is being constructed at General Atomics Inertial Fusion Technology Division. This facility has gas guns ranging from one used for controlled launch and observation of fragile, precision built inertial fusion energy targets to a small one used to screen attachment adhesives. The former gun launches targets at speeds up to 400 m/s, see Figure 1. It's 3-dimensional, 20 micron precision tracking capability extends 100 ft from launch to impact. This capability allows for observation and test of ballistics effects for a myriad of mechanical as well as active terminal phase devices such as retarding mechanisms. A successful attachment of a projectile launched from the later gas gun has been accomplished at low velocities. For instance a 149 gm, 40 mm diameter projectile has been attached to a concrete substrate at 10 m/s. Initially successful designs will migrate into actual rounds built under partnership with TSG Ammo.

Figure 1. A gas gun for launching inertial fusion energy targets.

OTHER APPLICATIONS

SPLATS are designed to be both modular and organic to the field soldier or squad. The general utility of SPLATS can extend beyond providing extended visual and LOS to target range. SPLATS may also one day provide a short range reconnaissance capability. The warfighter will have the capability to peer around a building, enter a room, or sense for deadly chemicals or biological agents prior to advancing into an area. Another important aspect of SPLATS is that they can be ballistically emplaced onto elevated features that would otherwise be prohibitively difficult to access. This in turn makes them extremely difficult to tamper with or counter.

The attachment technology can be applied in other arenas to enable rapid emplacement of large numbers of sensors for networks. In concept, Forward Launched Attaching Glider Sensors (FLAGS) are small gliders carrying sensor payloads with SPLATS-like attachment mechanisms. They would be in the size range of and M203 round. Large UAV's, such as a Predator, could carry and deploy hundreds of FLAGS. FLAGS would home-in on a laser pointer directed from the UAV in conjunction with the UAV's E/O and/or SAR sensors. This enables accurate reliable placement. This further enables the network topology to be pre-configured into the FLAGS prior to deployment. This obviates the need for self-configuring networks. Long glide ranges will allow emplacement without direct fly-over of the target by the UAV. Payload power sources only need to supply power to sensors and communications. Locomotive power having been supplied by the gravitation potential energy imparted to the glider by the elevation provided by the UAV.

Rapid placement of future networked sensors can be carefully controlled, to increase survivability and functionality. The many benefits of successful emplacement will enable warfighters to make significant strides against the enemy in the extremely harsh challenge of urban security.

MBIT

OBJECTIVE

The Micro-Shell Barcode Identification Tag (MBIT) is an internal research and development project heading aimed at the development and test of dispersal methods for taggant materials that can be packaged into a standard 40 mm ammunition round. Utilizing a proprietary technique, the rounds upon proximity to the target will initiate the micro-shell deployment resulting in a controlled "dispersal pattern." Each individual round would be manufactured to disperse a unique pattern and coded with a unique serial number. Also under development is a similar ordnance to be mounted and activated on small UAV's. The MBIT tags will enable standoff "hunters" and "killers" to uniquely discriminate a vehicle or entity of interest long after it has been tagged.

ADVANTAGES

Tagging non-cooperative targets is one option for the application of overwhelming force in urban situations. Often the opportunity to identify a target of interest may exist when the target is in close proximity to non-combatants or other collateral. Utilizing the organic tag can enable a warfighter to designate a target and move to safety or otherwise wait until a standoff weapon can safely act upon it. The ability to positively ID for later action is a useful tool in urban scenarios where direct action by ground forces can result in unintended casualties or unmitigated risk.

CONCLUSION

General Atomics is committed to utilizing its unique resources to create transformational technologies for urban applications. General Atomics traditionally aspires to bring concepts to development in order to best serve the warfighters of today.

ACKNOWLEDGMENTS

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