ONS Overviews

Autonomous Detection Vehicle

- Autonomous route investigation and hazard marking
- Fundamentally an appliqué kit for a vehicle
- Leverage previous work by Night Vision Laboratory

Convoy Logistics

- Kit-based system for Tactical Wheeled Vehicles
- Automated leader-follower
- User assessment at Fort Hood in the September – October timeframe

Robotics Rodeo

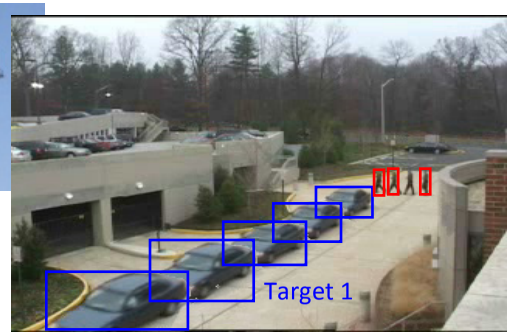
- Input from Army needs (ONS)
- Demonstration of related state of the art technologies
- Provide user and SME feedback to industry

Robotic Wingman

- Large armed robotic platform assumes role as a member of squad / formation
- Leverage existing ARDEC, AMREC, CERDEC technologies and Fort Hood rodeo for target acquisition and engagement capability

Persistent Stare

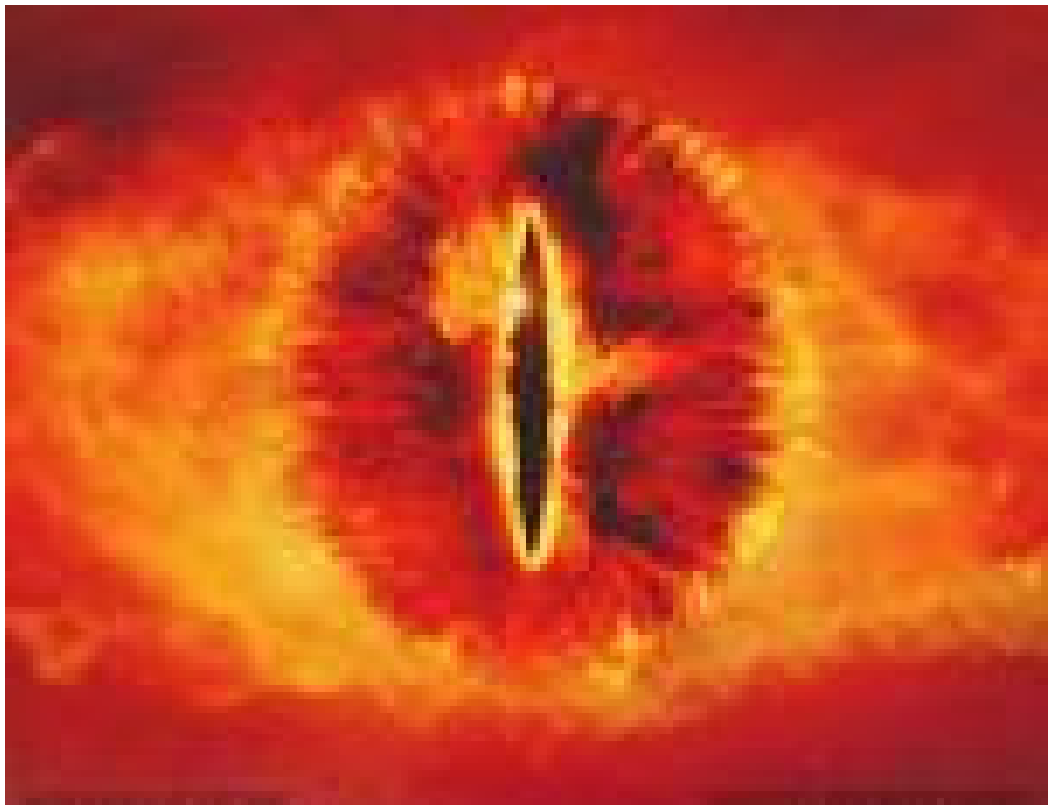
- Small robot with autonomous navigation to perform recon and surveillance
- Utilize robotic rodeo to demonstrate vendor capabilities



VOIED Defeat

- Capability for autonomous VOIED defeat
- Utilize robotic rodeo to demonstrate vendor capabilities
- HMMWV and M113 target platforms

Persistent Stare Scenarios



Open Intersection

Persistent Stare Scenario

This lonely intersection is miles from any populated area. The roads that cross here connect small, isolated villages. The enemy knows that by disrupting this intersection they can keep the villages isolated and hinder attempts to build national unity.

A method is needed to monitor an intersection in a desolate location and determine when suspicious activity takes place. This includes pedestrian traffic, vehicles that loiter, vehicles that discharge or pick up pedestrians, or vehicles that pass at unusual times of the day. Additionally, national reconstruction agencies would like to know the frequency and direction of vehicular traffic.

Urban Alley

Persistent Stare Scenario

This narrow, confined space is a frequent haunt for covert enemy operations. Visibility is obscured by passing vehicles, pedestrians, and animals. Acoustic information is often a good clue in this difficult environment. Given the tight space, threats appear suddenly and are difficult to distinguish from benign or petty criminal activity.

The alley is also a window into enemy intelligence activity. When civilians suddenly start making cell phone calls as coalition forces approach, it is safe to assume the enemy has been apprised of our movements. If fist fights break out, there may be tension between locals and insurgents.

The alley is also an outlet for propaganda. It would be helpful to know who is putting up posters or handing out leaflets and when they are doing it.

The utility of all these observations are greatly reduced if the enemy knows he is being watched.

Rural Safe House

Persistent Stare Scenario

It is believed that this residence provides shelter and support to transient enemy operatives. There are long periods when the only observable activity is the normal life of a civilian family. Occasionally a strange vehicle or individual arrives at the house, stays a few days, then leaves. These visits by apparent strangers could be part of benign, domestic life or signs of a clandestine transportation network. Only a remote, military intelligence fusion center can make that determination.

The work of the intelligence center would be enhanced if information such as vehicle make, model, and year could be determined and the faces of the visitors photographed. The movement of goods is also a clue. A group of civilians struggling with a heavy box may mean a new refrigerator has been purchased or a load of explosives has arrived.

If the enemy learns that this house is under observation, they will abandon it or exploit that knowledge to generate misinformation. If the determination to raid the safe house is made, persistent surveillance continues to play a role. The observation of “squirters,” individuals who jump out of windows or run out back doors, helps contain the situation.

Public Building

Persistent Stare Scenario

This high-profile building has governmental, cultural, or religious significance. It is recognized by both enemy and friendly forces that damage to this building will advance enemy objectives. As a result, no one is surprised that it is under constant surveillance. This surveillance, however, puts troops in danger and their presence inflames the local population. The most likely threat to this building is a car bomb.

Useful observations performed on the building include: number of pedestrians and packages entering and leaving, movement of vehicles, and the audio content of public address announcements. Analysis of public address content is useful to determine if insurgents have turned local officials to their side.

Public Market

Persistent Stare Scenario

The high density of pedestrian traffic in the public market is an irresistible target. The enemy kills scores of civilians at a time with human and vehicle borne explosives. The turbulent throng of innocent buyers and sellers with their benign packages masks enemy operation.

Techniques are needed that point out potentially hazardous people and push carts based on appearance, ground path, speed, or any other remotely observable characteristic.

Country Road

Persistent Stare Scenario

This country road is a village's life line. It carries vehicles, animals, and pedestrians. The terrain through which it passes is such that any given vantage point commands only a fraction of its length. Enemy mines kill villagers and reduce local confidence in the Army's ability to create domestic security. Existing anti-IED equipment easily clears the road but the enemy, just as easily, plants new mines.

A method is needed to determine when new mine emplacements have been made without risking Soldiers on continuous patrol. A promising approach might be to compare images of road segments at different points through time to detect the addition of IED triggering devices, reuse of old IED detonation craters, phony road repairs, and other evidence of disturbed earth.

Bridge

Persistent Stare Scenario

This traditional military target takes on new complexity when it must be defended from an enemy that moves invisibly through the local civilian population. A bridge has many facets and there is no single vantage point from which all vulnerable points can be seen. Direct threats to the bridge come from vehicles passing both over and under it.

It may be possible to detect these vehicles from telltale signs of excessive loads such as inappropriate tire or suspension compression. Delayed threats are also posed from explosives surreptitiously attached to the bridge and detonated at a time advantageous to the enemy.

Checkpoint

Persistent Stare Scenario

At this checkpoint, vehicles can queue up for hundreds of meters waiting for inspection. Monitoring the vehicle queue for suspicious behavior using dismounted troops spreads them very thin. The troops monitoring the queue are targets and, due to the separation distance, have difficulty coming to each other's aid.

A way is needed to monitor the queued and queuing vehicles such that the troops operating the checkpoint can be alerted to suspicious activity. Activity of note might be exchange of money or packages between vehicle occupants and pedestrians, detection of airborne chemicals associated with explosives, or erratic vehicle operation. It may also be useful to archive video records of checkpoint operation to help adjudicate allegations of corruption.

Lofty Perch

Persistent Stare Scenario

Occasionally terrain or tethered balloons afford a vista from which a large area can be surveyed. It is tedious and error prone work to scan the scene hour after hour looking for suspicious activity.

Multiple fields of view are needed: broad to exploit the wide vista and narrow to zoom in on interesting targets. Additionally, there could be parallel targets of interest requiring multiple, narrow fields of view. Automation is needed to create an unblinking eye that can recognize interesting events, such as smoke plumes or muzzle flashes, and bring them to the attention of remote human observers. These remote observers would also be served by automation that correlates and registers incoming C2 information and other geospatial data with the images sent from the lofty perch.

Robot Convoy Scenarios

Combat Outpost

Robot Convoy Scenario

The modern battlefield requires a logistical network. The network has depots supplied from ports and airfields by large, well-defended convoys. Forward operating bases (FOBs) are supplied from depots using similar but smaller convoys. The next link in the chain is the transfer of supplies from an FOB to one of its Combat Outposts. These small transfers are made by a single truck and do not warrant the risk and expense of a multi-vehicle, armed escort.

The enemy cannot predict when these single trucks will carry supplies from the FOB to a Combat Outpost but if they do encounter one by chance, it would be a tempting target.

A way is needed for single, unattended trucks to follow or lead an armed escort vehicle as it makes the trip from FOB to Combat Outpost.

Truck Train

Robot Convoy Scenario

At regular intervals, large supply shipments arrive at seaports for transportation by convoy to Army depots. The convoy routes are long and well known to the enemy. These large convoys are escorted by armed ground and air assets but the enemy still manages an occasional IED or rocket-propelled grenade attack. These infrequent vehicle losses are of no military consequence but the loss of a single Soldier is unacceptable.

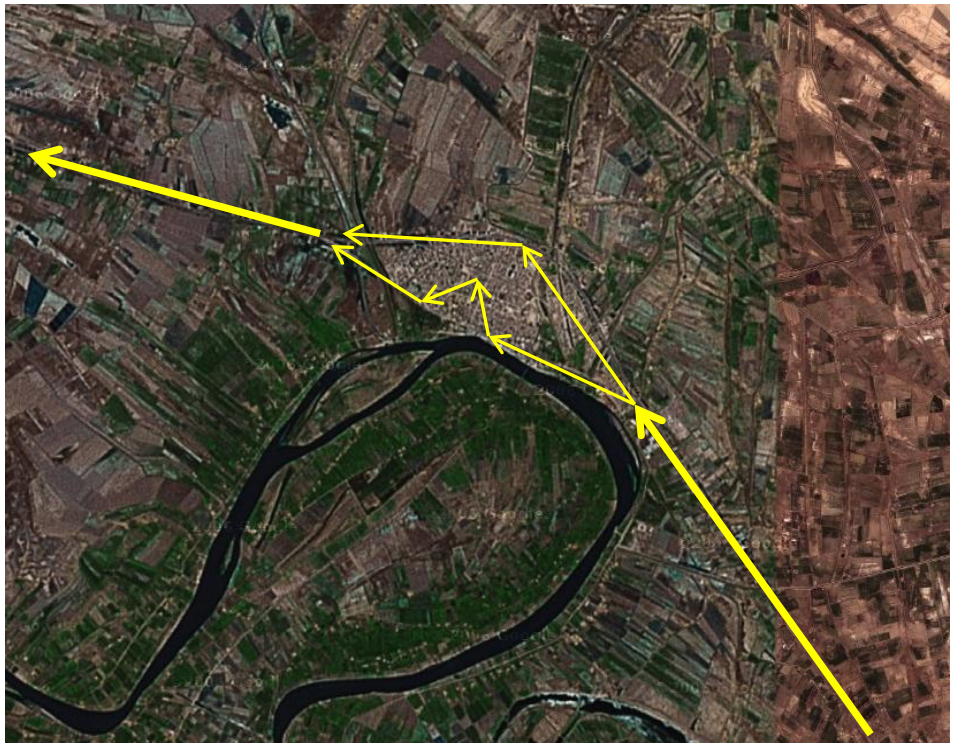
A way is needed to form a truck train that requires only a small number of people to manage a large number of trucks. Additionally, it would be advantageous if it were difficult for the enemy to know where the Soldiers managing the truck train were located.

Urban Passage

Robot Convoy Scenario

A ten-vehicle, supply convoy approaches a small town from the southeast where a street festival is taking place. As the convoy enters town, civilian pedestrian traffic breaks up the integrity of the convoy, placing convoy elements and Soldiers at risk as stationary targets.

Technology is needed to break up the convoy into multiple segments so that all convoy elements remain in motion and avoid becoming stationary targets. The convey vehicles make their way through the busy streets by several paths that converge on the main road at the northwest side of town. Once out of town, the ten vehicles recompose themselves into a single convoy and proceed to their destination.



Combat Follower

Robot Convoy Scenario

Military effectiveness is increased when Soldiers can focus more on combat and less on logistics. Robotic vehicles are needed that can accompany Soldiers into combat while carrying food, fuel, ammunition, fortification materials, and combat engineering equipment. These robot vehicles must serve the Soldier and not add to their physical or cognitive burden.

The robot must negotiate terrain by its own means and follow the combatants at an appropriate distance. This may include following in the tire tracks of a lead vehicle to avoid IEDs. If a Soldier's attention is drawn away from the fight by concerns for the robot vehicles, the robot has failed.

Robot VOIED Defeat Scenarios

Remote Supervisor

Robot VOIED Defeat Scenario

Supervision of autonomous systems is often performed by a Soldier in a moving vehicle. To maintain situational awareness and provide proper oversight, the Soldier must cope with the motion of the vehicle on which he is riding and the motion of the vehicle he is monitoring.

The disparity between the reported motion of the monitored vehicle and the physical motion experienced by the Soldier can create problems similar to vertigo. Techniques are needed to reduce the Soldier's mental stress in this demanding situation.

Blended Control

Robot VOIED Defeat Scenario

One component of the VOIED defeat strategy is to trigger the IED in a way that prevents loss of life. Minimizing casualties removes the strategic value of IEDs to our enemies. Operation of vehicles that clear routes by attempting to detonate IEDs is obviously hazardous. The Soldier tasked with the supervision of a route clearing robot vehicle must be located beyond the physical effect of an exploding IED but close enough to understand the environment in which the robot is operating. Additionally, mission duration requirements discourage the use of low level, fatigue inducing, teleoperation.

Techniques are needed that blend the high level reasoning of a remote human supervisor with the local autonomous capability of a robot to provide effective, long term mission performance.

Remote Presence

Robot VOIED Defeat Scenario

Even as sensors improve, there remains a desire to be physically present when assessing a new situation. Human intuition and reasoning are powerful tools that can see through the enemy's plan when given the right information. Unfortunately, if the enemy plan you wish to understand involves IEDs, then being physically present may risk lives.

Autonomous robots can maneuver into dangerous situations without endangering Soldiers. Robotic sensors can measure the environment with precision beyond human capability. The challenge is to put all this information at the disposal of an innovative Soldier's mind. Unfortunately, the communication between an autonomous robot and a remote Soldier is limited. Continuous video feeds are bandwidth intensive and static in their perspective.

Technology is needed that respects bandwidth limitations while giving a remote investigator the feeling of being physically present.

Robot Wingman Scenarios

Lead Vehicle

Robot Wingman Scenario

An armored column departs a Forward Operating Base en route to its objective 20 kilometers away. The Robot Wingman leads the column of manned vehicles by 150 meters. It transmits tactical intelligence to the armored column commander prior to the exposure of manned vehicles. As the column advances, the commander directs the attention of the Wingman sensors to suspicious areas and occasionally redirects the Wingman's path to gain a better view.

Robotic command and control technology is needed that allows a commander to communicate a desired route of advance to the Wingman using the same concepts and level of detail employed when directing a comparable manned vehicle. Additionally, dynamic modifications to a plan should be easy to create and should not interfere with other unrelated aspects of the plan.

Ambush

Robot Wingman Scenario

While leading a manned column of armored vehicles, the Robot Wingman is attacked by an enemy laying in wait 300 meters from the road. Fortunately, the Wingman was far enough in front of the column that the manned elements were not exposed when the attack began. The Wingman survived the heavy machine gun assault, trained its weapon on the ambushers, and awaits permission to return fire.

The Wingman must have sensors and geospatial reasoning that can determine the origin and nature of the fire it received. This situational assessment is used by the Wingman to quickly preposition its weapon and is also relayed to the column commander to plan a tactical response.

Lethal Force

Robot Wingman Scenario

The Robot Wingman is an armed combat vehicle capable of dispensing deadly force in support of mission objectives. The Wingman respects the conventions, rules, and doctrine that regulate the use of deadly force by human Soldiers. The Wingman should not create a hazard to the physical safety of friendly forces and noncombatants or increase battlefield uncertainty for the unit commander.

In the near term, the management of robotic deadly force should be left to supervising Soldiers, well versed in the rules of engagement. Techniques are needed to ensure the tactical correctness of a decision to use robotic deadly force without sacrificing the inherent speed advantages of autonomous target acquisition, tracking, and weapon operation.

Teaming

Robot Wingman Scenario

The Robotic Wingman may be teamed with another armored vehicle such as a Bradley or Abrams. The Wingman will maintain appropriate distance and orientation to its lead vehicle while traveling to a military objective. The Wingman is expected to detect and avoid obstacles en route while tracking and following its lead vehicle. In congested situations, the Wingman must distinguish individual armored vehicles to stay with its leader. In addition to fire power, the Wingman contributes sensor information to its leader to improve situational awareness.

Sensor and algorithmic technology is needed to enable the Wingman to determine the appropriate ground path. The Wingman needs a high fidelity, internal world model that accounts for all vehicles of interest and salient terrain features.