Base protection with autonomous systems

Jens Inge Hyndøy
Idar Dyrdal
Solveig Bruvoll
FFI
Norway

Jens-Inge.Hyndoy@ffi.no

ABSTRACT

This paper for the NATO IST-166 Specialists' Meeting on Mission Assurance for Autonomous Unmanned Systems is relevant to the following topics of the meeting:

Mission Concepts integrating unmanned and autonomous systems

- *Scenarios for current and future applications of unmanned and autonomous systems*
- *Training the human-machine work force*

Continuous protection of a military base is a challenging and resource demanding task. Traditionally this is done by a combination of surveillance cameras and patrolling guards, but it is challenging for a human to stay alert over time when monitoring several camera feeds. In a few years it is likely that autonomous systems and automatic sensors play a key role in base protection. This type of scenario is a well suited case for exploration of cooperation between humans and autonomous systems.

1.0 BACKGROUND

During the exercise Trident Juncture '18 in Norway this fall we will demonstrate base protection by a team of humans, UGV, USV, and drones, including sensors and remote weapon stations. The demonstration is a joint effort by the Norwegian Defense Research Establishment (FFI), KONGSBERG, and the Norwegian Defense. We will also cooperate with the NATO Allied Command Transformation (ACT), which works with implementation of new military technologies.

2.0 SCENARIO

The scenario for Trident Juncture concerns a base protected by cooperating autonomous systems and humans. The crux is that automatic sensors and semi-autonomous vehicles can do continuous surveillance, sort the collected data, and report threats and detections that the human operators need to respond to. This enables the guards to check that the systems are functioning and handle detections and alarms. With the support from the network of sensors and vehicles, the guards are capable of surveilling larger areas with better endurance.

3.0 SENSOR SYSTEMS

Several sensors are placed at strategic places around the base to support the human operators. Gunshot sensors report shots and calculate where they were fired from, and seismic ground sensors report approaching people or vehicles. Remotely controlled weapon stations with daylight (visible light) and

infrared cameras are programmed to detect and follow vehicles and people. The weapons will be manually controlled from the control room.

If an alarm is set off, small drones can respond quickly by approaching the area to gather information about the situation at hand. This information can be used to determine how to respond to the situation.

The USV can monitor the sea surrounding the base, reporting any relevant activity in this area to the human operators. It can also respond to alerts from other sensors regarding approaching vehicles in this area.

4.0 UNMANNED GROUND VEHICLE (UGV)

Here we will focus on the UGV. The role of the UGV in this scenario is to autonomously patrol the area, detect if a situation occurs that needs to be reported, and in such cases report it. The UGV should also respond to situations reported by other vehicles and sensors. This requires the UGV to interpret the environment well enough to reach all relevant areas of the base and its surroundings without getting stuck or crashing.

We will use our UGV OLAV (Off-road Light Autonomous Vehicle) for the demonstration (see figure 1-1).

Figure 1-1: OLAV (Off-road Light Autonomous Vehicle).

The sensors on OLAV include a LIDAR, monochrome stereo cameras and a color camera, and we are working on adding a radar. These sensors are used to interpret the immediate surroundings of the vehicle. OLAV also has a weapon station mounted, which is used to detect objects and situations on further distance, and possibly engage detected threats. It is possible to extend the set of sensors with for example a detector for dangerous gasses.

To successfully handle the base protection mission OLAV will use autonomy in several ways, including autonomous interpretation of its surroundings, path planning, sensor fusion, and evaluation of threats. OLAV

should be able to execute its mission over long periods of time without assistance from human operators. For the demonstration this fall we plan that human operators will take the final decision to use the weapon station on a detected threat, and that the weapon station will be remotely controlled as opposed to autonomous.

The human operators in the control room monitors the situational picture based on the information gathered from all sensors and vehicles. Before the information is presented to the operators, irrelevant and redundant information is removed, reducing the information to a manageable amount for humans. This enables the humans to focus on the relevant parts of the situation and handle them appropriately.