Drones in Humanitarian Action
Case Study **No.11**: Natural disaster / Acute emergency / Search and Rescue

Simulation – Drones for Search and Rescue in **Emergency Response Simulation**

A three-day emergency response simulation tested the use of drones in support of search and rescue operations in a hypothetical country affected by a severe refugee crisis while being hit by a hurricane with subsequent flooding and landslides. The test showed that drones were of limited use in this simulation but that they have potential to become part of the emergency response toolkit for very specific tasks.

Background

The Trimodex 2 exercise was a three-day emergency response simulation sponsored by the European Union Civil Protection Mechanism (EUCPM), organized by the Dutch crisis management firm Trimension and hosted in France by Entente Valabre[1]. 316 participants including five search and rescue teams from six countries attended. The aim of the exercise was to provide a hands-on learning opportunity for various search and rescue and civil protection teams from across Europe. Trimodex 2 also allowed participants to implement agreed standards of cooperation in civil protection interventions and to improve how civil protection entities work together in disaster response.

CartONG and the Swiss Foundation for Mine Action (FSD) participated to test the use of drones to enhance situational awareness in emergency response, specifically in support of search and rescue operations. Drones have been involved in emergency response for over a decade but they are not yet part of the standard toolkit for search and rescue. Around the world there are few countries that have institutionalized the use of drones in emergency

Figure 1 The Croatian team using drones to fly over the site. An orthophoto was used to inform planning after the drone flights took place. Feb 2016.

1 The Entente Valabre is a public institution that works to protect people and their environment from natural disasters.

response, with active drone units only in parts of the United States and the United Kingdom.[2] There has been much speculation, however, on their potential, and this exercise was able to provide further support in this regard.

The disaster scenario tested during Trimodex 2 was a complex crisis. A hypothetical country was affected by a severe refugee crisis while being hit by a hurricane with subsequent flooding and landslides. The deployments took place from 25-28 February 2016 in and around Valabre, France.

The exercise consisted of several phases: pre-alert, mobilization, response and deployment and demobilization of six international search and rescue teams. The structure of the response followed the configuration developed by the United Nations and the International Search and Rescue Advisory Group network, which maintains at the centre of the response the On-Site Operations Coordination Centre (OSOCC). The OSOCC is set up to help local authorities in a disaster-affected country to coordinate international relief and is typically established by the first arriving international urban search and rescue team. All operations, including the drone deployments, were carried out at the level just below the OSOCC coordination level and included technical experts.

The two sites where the drones were active were site 2, managed by a Croatian civil protection team and site 13, managed by their French counterparts. Both sites included damaged buildings and survivors of the disaster who needed to be rescued.

Figure 2 Participants in the Trimodex disaster response simulation fly an Albris quadcopter over a building. February 2016.

Implementation

Three models of drones were tested during the exercise: one eBee, one albris (formerly called eXom) and one MD4-200 microdrone. All models are available on the commercial civilian drone market.[3] The Swiss-made eBee is a fixed-wing drone, made for high-resolution mapping. The albris (also made in Switzerland) and the German-made microdrones are quadcopters, which use four rotors to take-off and land like a helicopter.

Each of the drones was fitted with at least one standard RGB high-definition (HD) camera, and some drones were fitted with thermal cameras.

Prior to the exercise, both sites (2 and 13) were mapped with an eBee at a pixel resolution of 2.5 centimeters. These maps were printed on paper and shared with the search and rescue teams. The albris flew inside the two damaged buildings and provided a live feed video with both normal and thermal cameras to support the search for survivors. The microdrone MD4-200 was flown with a live feed thermal camera outside to test survivor recognition in one of the sites.

Figure 3 The Albris quadcopter drone by Sensefly piloted during the Trimodex exercise in Valabre, France. Image: SenseFly, February 2016.

2 *Disaster Robotics*, by Robin R. Murphy (2014); not yet released Case Study with Manchester Fire Department; 2016.

3 Some drones specific to search and rescue operations are currently developed but were not yet available on the market at the time of this exercise.

Figure 4 An image of the printed basemap for site 13. Before the exercise began, drones took aerial images and allowed CartONG to produce and print 11 maps that could be used by the teams during Trimodex. Feb 2016

The drone teams played a role in all phases of the simulation, first by creating and distributing maps the night before the exercise began, then, together with search and rescue teams, providing drone support as requested.

The rescue teams were briefed that drones and pilots were on standby, and both the Croatian and French teams requested the drones. Both teams' sites included buildings that required inspection and survivors that needed assistance.

The drones were used in a recovery simulation on site 13, where the French team led the response. The search and rescue team used the maps produced with the drones before the exercise to conduct an initial assessment on foot. After this initial walk-through, the team deployed the albris above the area and the building to look for potential survivors who may have been overlooked. On the basis of thermal camera images, the ground crew and rescue dogs were then directed to check specific areas. The video-feed provided by the albris enabled them to determine how urgent the situation was and helped to determine how many people or other assets (such as dogs) might be needed for a further ground assessment.

The most significant added value, according to the French team, was the capacity to assess the sites with live video. This allowed them to see zones that were inaccessible or too dangerous to enter for humans or dogs.

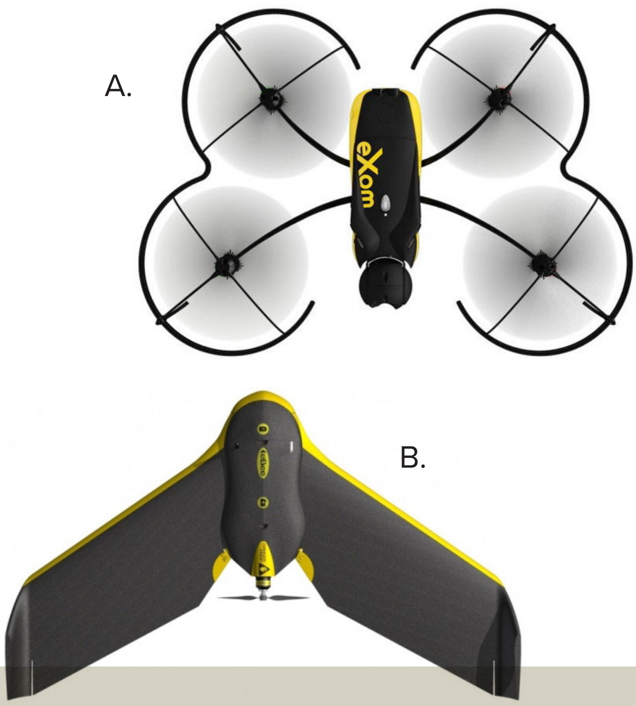

Figure 5 Drones used during Trimodex
Figure A: Albris by Sensfly
Figure B: eBee by Sensfly

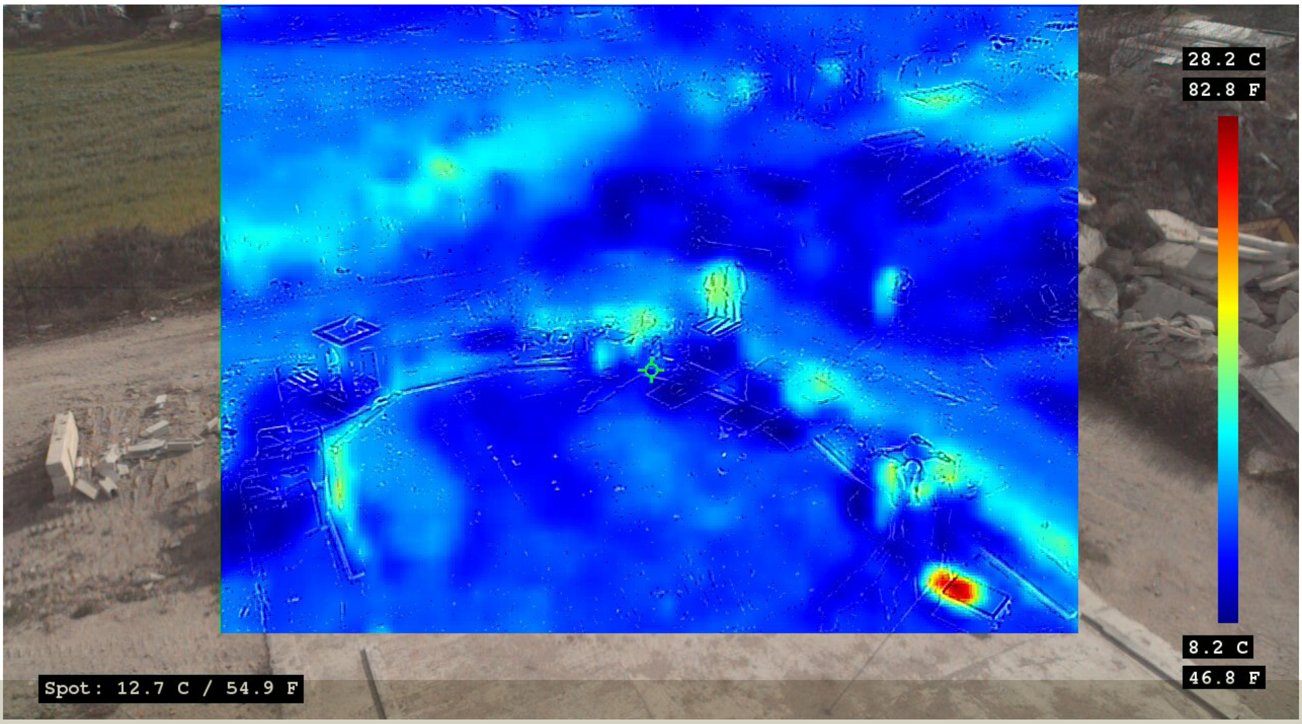

Figure 6 An image captured by the Albris' infrared sensor which enabled teams to more easily see where humans were located. Feb. 2016.

Figure 7 About 1.5 hours after flying overhead of site 2 this orthophoto was ready, providing teams with a clear overview of the area. Feb 2016

Figure 8 A 3D model created of site 2.

The Croatian team managing site 2 also requested the use of the drones to look for individuals trapped inside one of the buildings. The live feed and thermal camera on the albris showed a potential survivor and the search and rescue teams deployed on the ground to verify and provide assistance. In this instance the drone did not replace any other method, but provided additional support to their operations. According to Milan Macut from the Croatian team, “The hotspot was not super clear and it was not easy to evaluate the situation using the thermal view.” At the site, rescue teams confirmed that the hotspot was a survivor, but also found that there were two other survivor present that were not visible via the camera.

Evaluation

This exercise faced challenges related to the technological limitations associated with the uses of drones as well as questions linked to the interest in the adoption of drones as a tool for search and rescue. Participants reported that the production of the high-definition maps that were distributed to the teams could not likely be produced on an ad hoc basis in scenarios where such maps do not already exist. While these limitations are noteworthy, when these maps were available, the ground teams frequently preferred them to satellite base maps.

When the thermal camera was used for search and rescue during the daytime, the feed was somewhat difficult to read, primarily because the signal was not clearly differentiating a warm surface from a human body. Participants stressed that this difficulty would be greater for someone not trained in or accustomed to viewing thermal imagery. The qualitative differences in various thermal cameras were noted, and those that are used for inspection purposes (such as the ones that were used in this exercise) may not be ideal for the search and rescue of people. Early in the day, when the body temperature of a human is still significantly higher than ambient temperatures, was the only time when participants could sufficiently differentiate heat signatures to find potential survivors. Later in the day, when ambient temperatures rose to similar levels as body temperatures, it became notably difficult to use heat cameras to find people.

Information sharing met relatively few challenges, but the question of costs came up. An initial request by the OSOCC for a live feed of all areas viewed by the drones provoked some resistance due to the costs involved. To carry out the live feed, a powerful Internet or satellite connection would have been required as well as an HD wireless transmitter and receiver retrofitted for the drones. The OSOCC was located some 2 km from the sites, so the technology would have had to have the broadcast capacity for that distance. Such equipment costs about 8,400 Euro which was too costly for this particular exercise.

Maintaining a live video feed from the drone to the coordination cell is possible if sufficient equipment and funding are available. However organizing such a feed is not operationally important enough at the level of senior decision makers to justify the high costs. Instead data was shared in other ways, mainly through printed maps, and after the exercise through downloaded data – such as aerial videos, digital maps, and 3D building models.

Finally, there were some challenges regarding interest in the adoption of drones as a new tool for search and rescue. One of the challenges was ensuring that drone pilots are well trained, not only with regard to how to use their equipment, but also on how to understand the disaster response structure. According to Audrey Lessard-Fontaine of CartONG, “It’s important to train pilots on operational emergency response, on what is a humanitarian operation and to inform pilots of their specific roles.” Piloting a drone in an emergency already requires a focused mind and keen attention to detail; learning all the acronyms and structures at the same time is not ideal.

Search and rescue teams have established methods that they have tested over time and in numerous emergency contexts. The use of dogs or other animals for search and rescue is effective and even with the technology currently available, drones cannot match the precision and ability of animals. This was clear when considering the technological limitations of infrared cameras, but also non-visual cues like scent and sound, that are more evident to a search and rescue dog than to a drone. In addition, teams such as Finland did not even consider testing the use of drones, simply because drones are not part of their existing toolkit.

Teams on the ground agreed that drones were useful in this simulation and that they have the potential to become a part of the emergency response toolkit. The French team noted how useful it was to have the capacity to assess sites with live video and to do so in areas that are too dangerous for humans or search and rescue dogs to enter.

Capitain Thibaut Grieshaber, a structural engineer and planning officer from France, had requested drone support to evaluate the interior of one of the damaged buildings. Following the drone deployment, he highlighted how useful it was to have the drone enter the building to better understand what obstacles exist and develop a strategy to avoid or overcome them.

Information provided by the drones prepared the teams better before they commenced a search and rescue mission in a partially destroyed building. Most of the teams agreed that the drone could not entirely replace the existing tools for search and rescue – trained dogs and other animals – but they welcomed the addition. It was the high-resolution maps that proved the real added value, and provided clearer and more immediate information in this emergency response context. But these maps would have to be already available by the time first responders arrive at a site.

Most of the “survivors” said that they were not scared or surprised to see drones, but one did mention concern that the whirring sound of the drone might drown out a cry for help. Overall it was thought that smaller drones, which produce less noise and are somewhat less intimidating due to their small size, may well be the best option for search and rescue emergency response.

The integration of drones as part of the search and rescue toolkit is growing more common. In the UK, for example, the Manchester Fire Department, in order to reduce risk to first responders, has adopted the use of drones to assess fire sites before firefighters enter. In Belgium, the civil protection agency has adopted the use of drones and has even deployed them to identify displaced landmines and other unexploded ordinance following flooding in Bosnia and Herzegovina.

Figure 9 At site 2, the printed map was laid out near the search area. Feb 2016

Resources

Trimodex website
http://www.trimodex.eu/

Compilation Video summarizing the Trimodex 2Exercise
https://www.youtube.com/watch?v=R17lHGEVfzI

Summary of the Trimodex 2 Exercise UAV component
http://drones.fsd.ch/en/2016/02/29/using-drones-in-search-and-rescue-scenarios-first-impressions-from-the-trimodex-exercise/

Footage from the heat camera used during the exercise
https://youtu.be/C7U7qr2Nk1Q

ICARUS Unmanned Search and Rescue Project
http://www.fp7-icarus.eu/

Technical Specifications & Credits

Type of system: albris, eBee, MD4-200
Deploying Agency: CartONG/FSD
Piloting Agency: Omnisight, Drone Adventures
Dates of Deployment: February 2016
Author: Jessica DuPlessis, Audrey Lessard-Fontaine, Denise Soesilo ed.

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