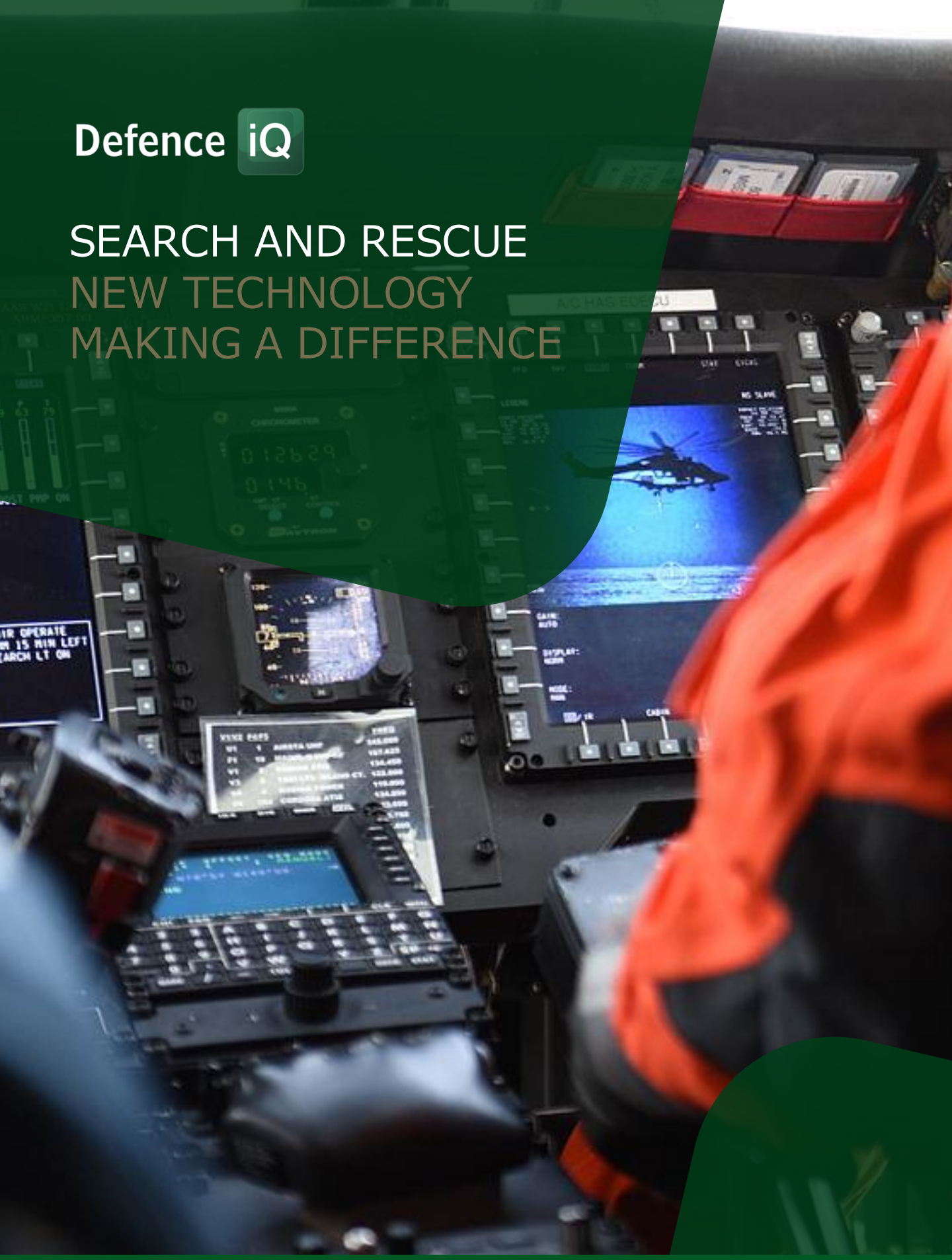
Defence iQ

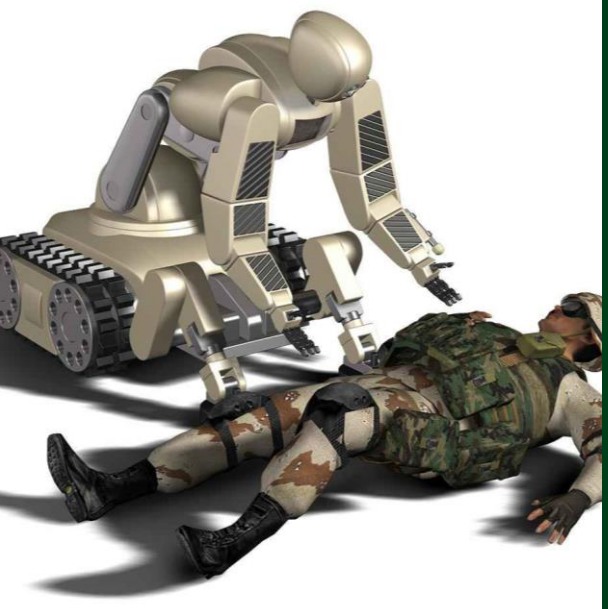
SEARCH AND RESCUE
NEW TECHNOLOGY MAKING A DIFFERENCE



IN ASSOCIATION WITH SEARCH RESCUE EUROPE

30 May – 1 June, 2017
London, United Kingdom

SAR TECH



This year's Search and Rescue conference will bring together world-leading SAR professionals and innovative equipment manufacturers, in a forum which will deliver fresh ideas and options to first responders.

This high-level meeting will also share crucial insight into the strategic elements of Search and Rescue, including planning, procurement and budget prioritisation. International attendees from the likes of the Norwegian, Canadian and UK Coast Guards, will look into the vessels and air platforms utilised in SAR missions, and how their capabilities can be augmented and adapted to meet certain mission requirements. Expert contributors from industry and NGO's will also provide updates on the use of Unmanned Systems in SAR operations, and the legislative hurdles that must be overcome before they can be utilised to their full potential.

Before the discussion begins, we look at some of the technology said to be revolutionising SAR efforts, from airborne navigation systems to human-like robots...

"A new UAV has the unique characteristic of being able to lift ten times more than most other UAS systems on the market while flying the payload for up to 45 minutes."

Small UAVs...

Few would argue that for the past several years, the introduction of small, affordable unmanned aerial vehicles (UAVs) into the commercial market has been the biggest game-changer to the SAR domain. As cost continues to fall and capability to rise, the boost these devices will give to authorities and agencies when it comes to saving lives should not be underestimated. But how far can the technology go?

Researchers in Switzerland have recently developed a SAR-specific UAV that boasts navigation software with a 'deep learning' neural network said to mimic the human brain. The purpose of this is to enable the drone to process and recall visual experiences, allowing it to fly autonomously as it recognizes trails which may have been used or created by hikers. The research team tested the prototype in 2016 by releasing the drone into the Alps. It digested around 20,000 separate images, identifying trails with an 85 percent accuracy rate, which is 3 percent more accurate than humans attempting the same visual recall on foot.

The team behind the software wants to further develop the algorithms with facial recognition, thereby locating specific people and even monitoring levels of distress, before relaying the information back to responders to undertake the rescue.

...And not-so-small UAVs

Unmanned systems are not only benefiting SAR in a search (reconnaissance) capacity. The ability to play an active role in the physical rescue effort is the next natural step to extending the capability of this technology.

Griff Aviation launched its Griff 300 in December 2016, with – according to the data provided – the unique characteristic of being able to lift ten times more than most other UAS systems on the market while flying the payload for up to 45 minutes. At 165 lbs and boasting 8 propellers, the device is being called a 'megadrone', potentially being able to lift and carry at least one person (up to a gross weight of 660 lbs or 300 kg – hence its designation) to safety. The company also has a Griff 800 in development, which is expected to be able to operate at up to 800 kg (1,764 lbs).

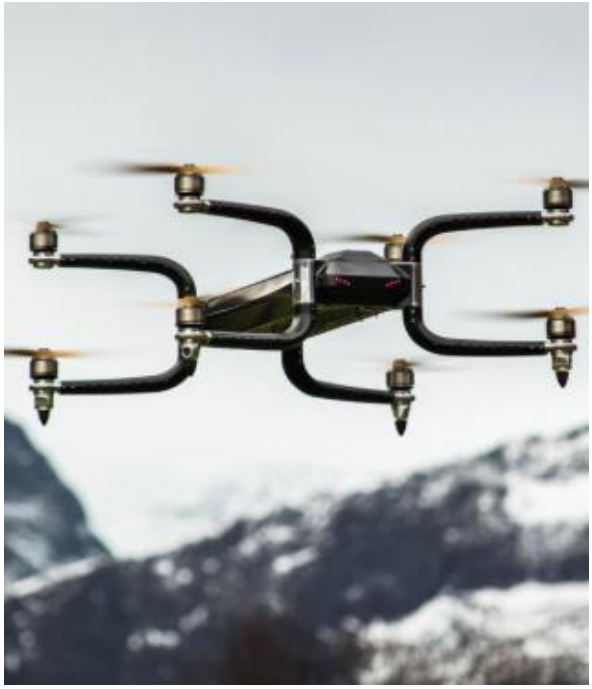
The Griffin payloads are customisable, so while SAR is one of the top applications being touted, the UAS could also be employed for the likes of far-reaching maintenance and fire-fighting tasks, or to deliver cargo to people in hard-to-reach places.

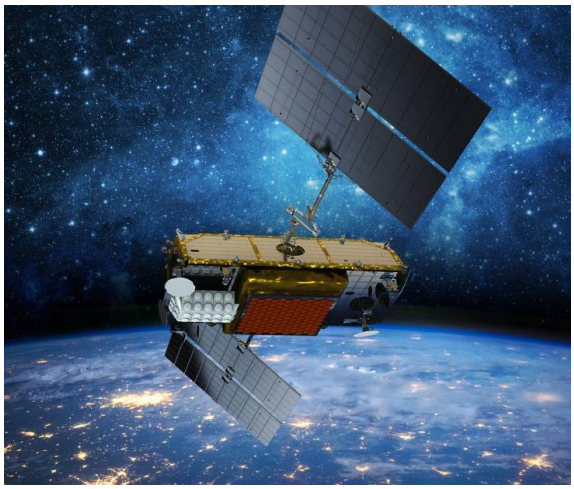
Firefighter tracking

The reliability of GPS tracking and communications within a multi-storey burning building is limited. Many first responders have been killed by an inability to see exits or to plot their course in the heat of action.

In an effort to help firefighters navigate within such an environment – both for their safety as well as those they are rescuing – a team at NASA's Jet Propulsion Laboratory (JPL) in Pasadena, California, has developed a tracking system called POINTER (Precision Outdoor and Indoor Navigation and Tracking for Emergency Responders).

The system was funded by the Department of Homeland Security Science and Technology Directorate and early demonstrations have been described as 'successful'. Months earlier, U.S. fire department representatives were also on hand to witness a demo, in which one battalion chief described the technology as "very exciting."





POINTER is possible thanks to a eureka moment discovered by a JPL researcher, solving a scientific problem dating back to the 1970s. While radio waves have the advantage of propagating energy over long distances, making them ideal for communications and sensory technologies, they are unpredictable within an enclosed environment due to the interference of thick walls and objects. The researcher instead explored the possibilities of using electromagnetic (quasistatic) fields, in spite of their short range of just a few hundred metres. These fields however have an advantage over radio waves because they are not hundred by walls and because its constant, static nature enables it to identify movement and direction of people behind those walls in ways radio cannot.

Before it hits the market, the system is being developed to reduce its size for easy carry. Aside to SAR, it may well also see use in military and space robotics applications, according to its designers.

More GPS alternatives

This is not to say that GPS is generally an unreliable tool for SAR operators. Indeed, it is frequently invaluable.

Orolia, a worldwide provider in Resilient Positioning, Navigation and Timing (PNT) solutions, recently formed a strategic alliance with Satelles Inc. to develop, market and sell these solutions based on the latter's Satellite Time and Location (STL) signal technology. This is a unique space-based PNT technology that provides location and timing data independent from traditional GPS and other GNSS satellite signals, in order to reduce the vulnerabilities – spoofing, interference and jamming – associated with GPS/GNSS. The developers call it 'fail-safe'.

Given the life-or-death need for SAR operations to be void of such disruption, use of GPS or GNSS can be well complemented by STL. Indian SAR teams have been using PNT technologies for critical applications for several years, with Orolia equipping ground stations with (international satellite SAR system) COSPAS-SARSAT. These stations detect the emission of distress signals and to calculate the position of beacons triggered in the event of danger to human life. The company's aeronautical distress beacons are already used by major Indian airlines and testing is now being conducted with the ADA (Aeronautical Development Agency) for military distress beacons used by fighter pilots.

Airborne sensor improvements

Owing to its vast and varied terrain, Canada has a significant need to invest heavily in SAR year-round. Amid its latest high-profile spending, the Government has selected Airbus Defence and Space to provide a new fleet of 16 C295W twin turboprop fixed-wing aircraft configured for Royal Canadian Air Force SAR missions, replacing the existing fleet of six CC-115 Buffalo and ten CC-130H Hercules aircraft. The new platforms will have to stand the rigors of long-haul Arctic flights and exhibit cutting-edge capabilities to deal with the Northern wilderness.

As part of its offering, the C295Ws will be equipped with L-3 Wescam's MX-15 multi-sensor imaging system to localise, track, identify and detect targets in day / night and difficult weather conditions. The payload system can house up to six

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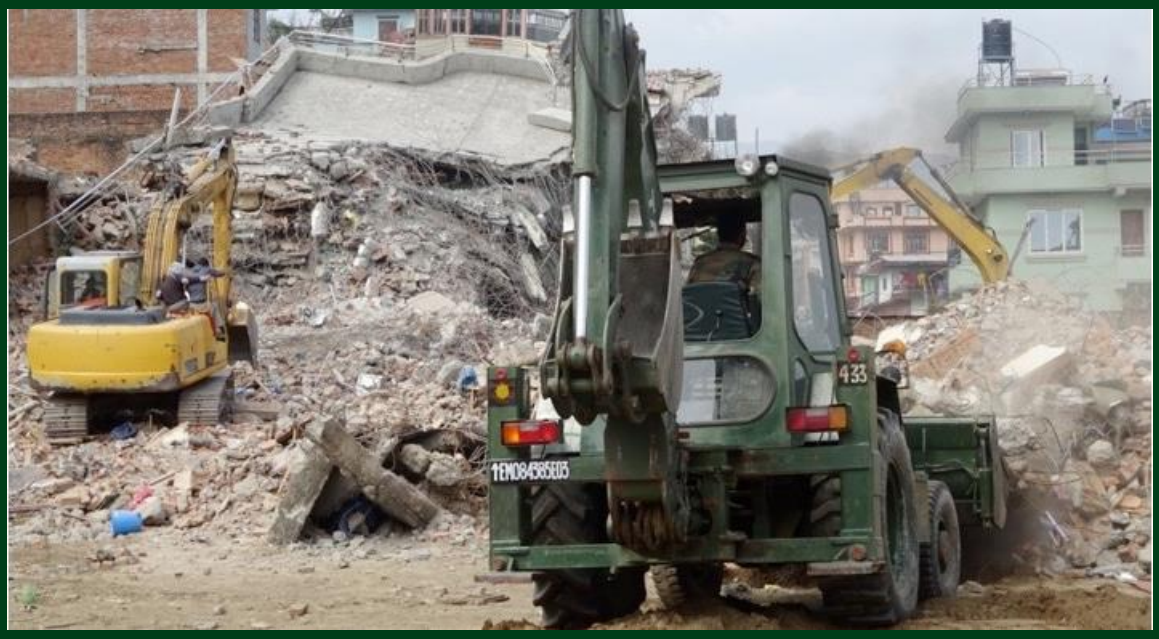


Crowdsourcing and Machine Learning

Hannah Pathak, **Rescue Global**

In the immediate aftermath of a disaster, an array of critical needs emerge: food, water, shelter, and the ability to locate loved ones. Another urgent need, which may be less evident to those outside of civil, government or military response entities, is for information. Yet without information, responding to urgent relief needs is difficult or ineffective, as priorities cannot be identified. Further, in order for information to be actionable intelligence it must also be verified and reliable.

All that was known about an area, settlement or community prior to the disaster event is now secondary data. It may no longer be true. And until it is verified it cannot be reliably acted upon. Added to the challenge of holding this potentially inaccurate knowledge about the situation prior to the event are sudden gaps in information: where has damage been sustained? Where are on-going hazards, such as flooding, instability or contamination as a result of the disaster?

In the short period following a critical event, but during the phase where lives may still be saved, this data void is a key challenge. Conversely, responders at both strategic and operational level are increasingly seeing a data overload occurring, particularly from social media and news outlets. The challenge here is how to turn this glut of rapidly created data from disparate sources into actionable intelligence.

At Rescue Global, an international NGO and not-for-profit, our mission is to save life; we do this by empowering decision-makers at the strategic level working across disaster risk reduction and response. We put significant emphasis and effort into tackling the challenge of being able to gather, speed up and verify information following a critical event in order to create actionable intelligence that can be used to support prioritisation and action that saves lives in disasters. Our goal is to achieve a Commonly Recognised Information Picture (CRIP) that integrates multiple data sources and can be shared across diverse responding agencies. In order for this to be effective, it must be rapidly stood-up following a disaster, must be able to include non-homogenous data sources (for example, images and text), and must include the ability to attribute data sources and assign them with provenance and reliability scores.

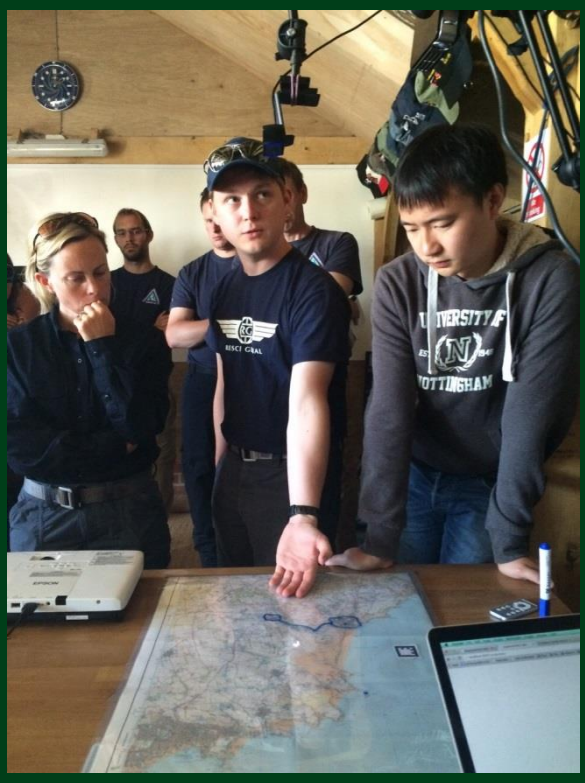
We have been working with partners in academia and industry on both real world and pilot projects to develop this concept, using Machine Learning (ML), Artificial Intelligence (AI) and Human Agent Collectives (HACs) to manage big data, and speed up and improve decision-making in disasters.

These tools were used in a real-world situation following the 2015 earthquakes in Nepal, where Rescue Global and academics from the Orchid Project (a technology collaboration between Rescue Global and the Universities of Oxford, Nottingham, and Southampton and other partners) took pre and post-disaster imagery, utilised crowdsourced data analysis and machine learning, to identify locations affected by the quakes that had not yet been assessed or received aid. This information was integrated into 'heat maps' to visualise humanitarian response priorities based on this information, and shared with SAR groups to facilitate their decision-making and activities. This work was recently showcased at the World Economic Forum 2017.

A recent pilot project, funded by the Defence Growth Partnership (DGP) Innovation Challenge, to further this work was in collaboration with BMT Defence Services Ltd. and University of Oxford. The project investigated methods to properly vet and then exploit information generated from crowd-sourced data. The project used recent developments in machine learning and data provenance to build 'trust' in crowd input, increasing the utility of the crowd as a resource. The pilot used a large volume of satellite imagery from a disaster area, allocated tasks to humans and machines to review the data, and then aggregated and scored this information to create 'heat maps' identifying infrastructure damage.

The project also examined optimal task allocation between human subject matter experts (who will likely be limited in number), crowd-sourced data analysis input (the 'crowd' is likely to consist of a large number of non expert individuals) and Machine Learning tools. Collectively, these are Human Agent Collectives. Each resource is best suited to different tasks, but bringing them together significantly increases the rapidity, volume and accuracy of information. This information, when Artificial Intelligence is applied to assign provenance and credibility, and exclude erroneous information, becomes actionable intelligence.

The potential for such technology in the realm of disaster response is undeniable and truly exciting. Ultimately, as it is further developed and fielded, it will be a tool to give disaster response leaders an informed, clearer, single-view of a disaster area, which will ultimately save lives in a crisis.



The ORCHID Project processes crowdsourced data

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> *"One of the chief capabilities robotics can bring to SAR is in providing access to places that human crews and rescue dogs cannot reach."*

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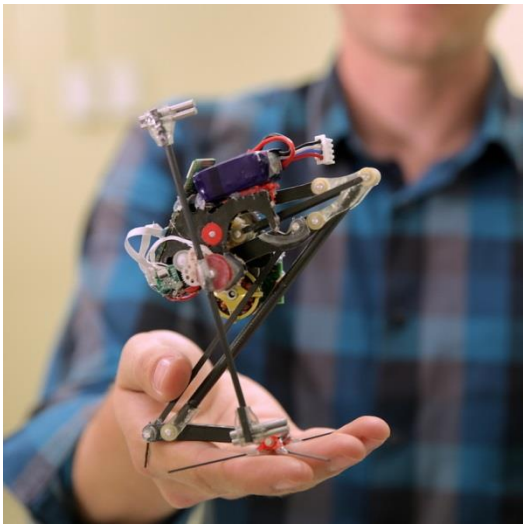
a laser rangefinder, a laser illuminator, and electro-optical / infrared (EO / IR) cameras. Multi-mode search radar will also be fitted under the fuselage to provide an unobstructed 360° field of view, which can detect, recognise, classify and track both land and water-based objects such as fishing vessels, merchant ships, inflatable boats and small craft up to a distance of 200nm.

Based on the success of its , L-3 Wescam has recently been awarded a number of contracts totaling $90 million to supply its MX-series EO/IR imaging systems to customers, including the Royal Thai Navy, US Navy, US DHS and the Royal Australian Air Force.



Rescue Bot future

According to the director of the Center for Robot-Assisted Search and Rescue (CRASAR) at Texas A&M University, robots were first used in real SAR efforts on 9/11, and development of these systems have been progressing at pace ever since.

One of the chief capabilities robotics can bring to the work is in providing access to places that human crews and rescue dogs cannot reach. A team at the University of California, Berkeley, have developed SALTO (saltatorial locomotion on terrain obstacles), the world's highest-jumping untethered robot, capable of a vertical one metre jump *[pictured]*. The robot was designed after researchers witnessed the challenges first responders face in moving quickly across urban disaster sites. The technology could soon be applicable in live scenarios.

Similarly, other 'super mobile' robots with are known to be in the works. This includes the Italian 'Walk-Man' programme that sees a 6 ft tall humanoid robot with powerful joints intended to accompany and assist SAR teams. The system is understood to be capable of lifting collapsed buildings and masonry with the help of human-adapted tools, operating a 3D laser scanner and stereo vision to make sense of an environment. Further development of the prototype has been aimed at providing greater manipulation skills (such as for prying obstacles apart) and reflexive behavior to allow it to walk through uneven terrain.

SEARCH RESCUE EUROPE

Defence iQ

30 May - 1 June, 2017
Copenhagen, Denmark

SAVING LIVES THROUGH COORDINATION, COOPERATION AND INNOVATION

The 5th Annual Search and Rescue 2017 Summit presents an important opportunity to form longterm relationships with fellow SAR operators, industry leaders and Subject Matter Experts who are driving change and innovation in the field of SAR operations, strategy and supply.

SAR experts including Rear Admiral Larusson, Commander of the Icelandic Coastguard, will be delivering briefings on recent SAR missions, as well as technological and operational innovations; including solutions to the challenges of communicating at extreme latitudes and terrain, and of coordinating complex multi-agency/national missions.

This high-level meeting will also share crucial insight into the strategic elements of Search and Rescue, including planning, procurement and budget prioritisation. International attendees from the likes of the Norwegian, Canadian and UK Coast Guards, will look into the vessels and air platforms utilised in SAR missions, and how their capabilities can be augmented and adapted to meet certain mission requirements. Expert contributors from industry and NGO's will also provide updates on the use of Unmanned Systems in SAR operations, and the legislative hurdles that must be overcome before they can be utilised to their full potential.

- Insight and expertise from Arctic LiVEX16, including lessons on: international interoperability, communication and mission coordination, and the performance of the latest SAR technology on the "front line"of operations.
- Leading SAR experts presenting on key issues such as mass rescue, operating at maximum efficiency on a restricted budget and the latest technological developments.
- Case studies on the **Mediterranean migrant and refugee crisis** and lessons learned in terms of operating procedures, training,and equipment procurement, all from senior SAR professionals who work "on the ground" in that theater currently.
- Hear from the likes of the Royal Canadian Air Force, Icelandic Coast Guard and Italian Coast Guard on latest procurement requirements and technological/equipment priorities.

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