

# UNMANNED

## VEHICLES

[www.UVonline.com](http://www.UVonline.com)

### Mine slaying

Scanning the depths of UUV development

### Theatre-bound

Operational debut for large UGVs

### Locked on

UAV weapons strategy in the US military



*The height of ISR knowledge.*

[www.northropgrumman.com/globalhawk](http://www.northropgrumman.com/globalhawk)

▼ **GLOBAL HAWK**

As the finest unmanned airborne ISR and command control platform in service today, the Northrop Grumman Global Hawk provides unprecedented real-time situational awareness for decision-makers in operations around the world. Able to carry up to 3,000 pounds of payload, the high-altitude, long-endurance Global Hawk brings advanced sensors even more capable of reducing risk to the warfighter.

**Editor**

Darren Lake. [dl@shephard.co.uk](mailto:dl@shephard.co.uk)  
+44 1753 727022

**Deputy Editor**

Andrew White. [aw@shephard.co.uk](mailto:aw@shephard.co.uk)  
+44 1753 727023

**North America Editor**

Scott R Gourley. [srg@shephard.co.uk](mailto:srg@shephard.co.uk)

**Editorial Assistant**

Beth Stevenson. [bcs@shephard.co.uk](mailto:bcs@shephard.co.uk)

**Contributors**

Claire Apthorp, Gordon Arthur,  
Adam Baddeley, Angus Batey,  
Rahul Bedi, Peter Donaldson,  
José Higuera, William F Owen,  
Richard Scott, Tom Withington

**Production Department Manager**

David Hurst. [dth@shephard.co.uk](mailto:dth@shephard.co.uk)

**Head of Advertising Sales**

Mike Wild. [mw@shephard.co.uk](mailto:mw@shephard.co.uk)  
+44 1753 727007

**CEO**

Alexander Giles

**Chairman**

Nick Prest

**Subscriptions**

Annual rate £65  
Tel: +44 1858 438879, Fax: +44 1858 461739  
[shephardgroup@subscription.co.uk](mailto:shephardgroup@subscription.co.uk)  
[www.subscription.co.uk/shephard](http://www.subscription.co.uk/shephard)

*Unmanned Vehicles* is published six times per year – in February/March, April/May, June/July, August/September, October/November and December/January – by **The Shephard Press Ltd**, 268 Bath Road, Slough, Berks, SL1 4DX.

The 2011 US Institutional subscription price is £65. Air freight and mailing in the USA by agent named Air Business, c/o Priority Airfreight NY Ltd, 147-29 182nd Street, Jamaica, NY 11413. Periodical postage paid at Jamaica, NY 11413. US Postmaster: Send address changes to Air Business Ltd/Priority Airfreight NY Ltd, 147-29 182nd Street, Jamaica, NY 11413.

Subscription records are maintained at CDS Global, Tower House, Lathkill Street, Sovereign Park, Market Harborough, Leicestershire, LE16 9EF, UK.

Air Business Ltd is acting as mailing agent. Articles contained in this publication may not be reproduced in any form without the written permission of the publishers.

© **The Shephard Press Ltd, 2011.**  
ISSN 1351-3478

**DTP** Vivid Associates, Sutton, Surrey, UK

**Print** Williams Press, Maidenhead, Berks, UK

Member of



**The Shephard Press Ltd**,  
268 Bath Road, Slough,  
Berkshire, SL1 4DX  
Tel: +44 1753 727001  
Fax: +44 1753 727002

**www.UVonline.com**

**3 Editorial Comment**

Unmanned strike aircraft are a generation away from being able to fly the kind of missions currently undertaken over Libya, argues Darren Lake.

**News analysis****4 DARPA picks Northrop Grumman for unmanned CAS study**

A review of some of the latest developments from around the unmanned systems industry.

**7 Shifting sands**

Andrew White finds evidence at IDEX that the Middle East is waking up to the potential of unmanned systems.

**12 Bang for the buck**

North America Editor Scott R Gourley takes a look at how the US military is aiming to increase the weaponisation of its UAVs over the next few years.

**16 The art of deception**

Unmanned platforms offer a novel means of taking naval electronic warfare offboard, Richard Scott discovers.

**22 Land of the giants**

Andrew White reports on the build-up to an imminent wave of operational debuts for large UGVs.

**27 Threat neutralisation**

Tom Withington discusses how UUV technologies have become essential to the MCM work of the world's navies.

**30 All-seeing eyes**

Peter Donaldson looks at some of the latest developments in wide-area and lightweight EO/IR technology.

**36 Breaking with tradition**

To date, UAVs have been used in Central and Latin America mainly as discreet surveillance platforms. Against that background, José Higuera looks at how Colombia is leading the way in the acquisition of weaponised systems in the region.

**40 Interview**

Tom Withington talks to Bo Redeborn of Eurocontrol about the future of unmanned flight in European airspace.

**Front cover:** A US Navy mine neutralisation vehicle is readied for operation. (Photo: US DoD)

**Subscriptions**

Shephard's aerospace & defence publishing portfolio incorporates six titles; *Defence Helicopter*, *Digital Battlespace*, *Land Warfare International*, *Military Logistics International*, *RotorHub* and *Unmanned Vehicles*.

Published bi-monthly, each have become respected and renowned for covering global issues within their respective industry sector.

For more information, including editorial content in the current issues visit: [shephard.co.uk/magazines](http://shephard.co.uk/magazines).

Subscribe today via: [www.subscription.co.uk/shephard](http://www.subscription.co.uk/shephard) or +44 (0)1858 438879





SolarEagle



A160T



Integrator

## FLYING UNMANNED SYSTEMS TO NEW CAPABILITIES.

Boeing is bringing next-generation capability to unmanned systems. From small tactical to high-altitude systems, Boeing is maximizing the performance envelope for remotely-piloted vehicles with greater payload flexibility, secure networked systems, autonomous operations and an open architecture design for built-in growth potential. At every altitude, Boeing is taking unmanned systems to new heights.

Phantom Ray



ScanEagle





## Copping the flak

As it became more and more likely that Western forces would become embroiled in yet another conflict in the Muslim world, various commentators started to discuss the range of options for action against Libya. Among the tactics frequently mentioned was the use of unmanned aerial strikes against targets in the country, with the often added detail that such operations removed pilots from harm's way.

However, following the adoption of Resolution 1973 by the UN Security Council on 17 March, which called for the creation of a no-fly zone over Libya and allowed for further measures to protect civilians, it was not UAVs that were sent in to do the business. In fact, the first aircraft in operation were French Rafale fighters, closely followed by manned jets from the UK's RAF and the USAF.

Of course, most of the West's unmanned assets are tied up on current operations in Afghanistan and Iraq, but no information has yet been released about whether any UAVs have taken part in the Libyan operation or whether they will be positioned to become involved. But there is a crucial difference that means the current generation of UAS may not be as usefully employed in this instance as in the other ongoing conflicts.

Crucially, unlike Afghanistan and Iraq – or indeed Pakistan and Yemen – the Libyan theatre of operations does not offer a completely benign air environment. Until the initial manned strikes, Libya possessed a relatively sophisticated air defence network that included some of the more modern generation of Russian surface-to-air missile and radar systems.

Even after damage was inflicted upon this network, military planners acknowledge that it continues to pose a danger to

operations. Much of the fixed missile and radar infrastructure was destroyed in the first attacks, but nightly news images show the skies above Tripoli and elsewhere laced with tracer fire from anti-aircraft guns that the US military has acknowledged are too numerous to destroy.

In order to avoid that threat, the manned aircraft conducting operations are able to fly high and fast, and manoeuvre to avoid danger. However, the current generation of unmanned strike platforms is not designed for this type of flying. Shaped by the requirements of southwest Asia, they have been bred for endurance and time over target – to provide surveillance as well as strike. A slow-moving Reaper would be good target practice for any air defence commander.

Although these workhorses of the UAS world are unlikely to be replaced completely in the future, a new generation of faster, sleeker thoroughbreds is in development, meaning that in the next couple of decades, it may not be manned fighters that go in first and pilots truly will not have to be placed in harm's way.

There are a number of efforts under way internationally to produce true unmanned strike platforms with the speed, agility and stealth of manned fighters. Military planners recognise that the advanced, integrated air defence networks of potential future adversaries will be a tougher nut to crack, and that if UAS are to have a place in that type of environment, they must have all the same characteristics that the next generation of manned fighters will possess.

Until then, commentators need to think before they speak about the dawning of a new age in air combat operations where pilots no longer have to risk their lives.

**Darren Lake, Editor**

### RESPONSE

*Unmanned Vehicles'* editorial team is always happy to receive comments on its articles and to hear readers' views on the issues raised in the magazine. Contact details can be found on p1.

### IN THE NEXT ISSUE

- European market
- Military UAVs

- UAV engines
- Data links



The A-10 Thunderbolt II is a strong contender for DARPA's Next Generation CAS programme. (Photo: US DoD)

# DARPA picks Northrop Grumman for unmanned CAS study

Northrop Grumman is being lined up to progress with US DoD plans to develop an unmanned close air support (CAS) capability, according to industry sources.

*Unmanned Vehicles* was informed that the company is in talks with the Defense Advanced Research Projects Agency (DARPA) for its Next Generation CAS programme, following an RfI in January 2010. Sources said other competitors for the programme included Lockheed Martin.

A spokesman for Northrop Grumman said that he was 'not able to comment on much right now', but would be able to reveal details at a later date. However, the company did refer to the programme as 'Persistent CAS' (PCAS) – designed to 'allow the joint tactical air controller (JTAC) the ability to rapidly engage multiple, moving targets within his area of responsibility'.

Sources said the programme could entail the 'unmanning' of the Fairchild A-10

Thunderbolt II or 'Warthog', which is currently used for CAS operations in Afghanistan. Other options, according to DARPA, could also include QF-4 and QF-16 aircraft.

The agency also refused to comment on the status of the programme, but confirmed that a contract had yet to be awarded. The original RfI was released by its Tactical Technology Office and requested 'potential alternatives to the UAS component of a Next Generation CAS system'. A flight test demonstration is expected in 2012-2013.

As well as a platform, the requirement also calls for C2 components to 'more effectively conduct CAS using small/smart munitions, emerging state-of-the art networks and JTAC equipment to allow digital acquisition, tracking and target prosecution in CAS'.

Other parameters include a 900-2,250kg payload, range and endurance comparable to existing armed UAS, the capability to allow flight after data link loss, open architecture

and the ability to integrate airborne networking and next-generation munitions.

Finally, the UAS must provide sufficient speed, manoeuvrability and C2 to 'process CAS requests and get the aircraft and weapon into a firing position in a timely manner'. There are no specific speed and manoeuvre requirements, but the closer to high subsonic speeds ( $M=0.65+$ ) and several-g manoeuvring the better, sources added.

The Northrop Grumman spokesman said: 'PCAS will be a "system-of-systems" approach, demonstrating the ability to digitally task a CAS platform from the ground. The system will be designed to reduce collateral damage and potential fratricide to friendly forces. Enabling technologies are manned/unmanned airborne platforms, next-generation graphical user interfaces, data links, digital guidance and control and advanced targeting and visualisation tools.'

**By Andrew White, London**

## UK adds Scout UGVs for 'low-level' ISTAR

The UK MoD has procured a number of ReconRobotics' Recon Scout XT UGVs ahead of an evaluation programme in Afghanistan.

According to company officials, the UK's Operational Training Advisory Group (OPTAG) has taken delivery of four systems for 'compound clearance operations'. Industry sources added that the procurement formed part of the MoD's Valkyrie programme, which is designed to increase the effectiveness of the army's ISTAR capabilities at 'low levels'.

Recon Scout XT, which weighs a total of 600g, features a day camera or IR payload, and can be thrown over compound walls or driven into rooms for reconnaissance before troops enter a position. They are accompanied by extending poles, allowing

the camera to be handheld over a wall or obstruction. The UGVs can then relay video feed up to 30m indoors or 90m outdoors, according to the company.

ReconRobotics told *Unmanned Vehicles* that two of the UGVs have been delivered to British forces beginning preparations to deploy on Operation *Herrick 14*. The remaining two will stay at OPTAG locations in the UK, including the mock Afghan village at STANTA, for training purposes.

It is understood that the MoD is considering a 'large buy' of Recon Scout XTs for ongoing operations in Afghanistan, where compound clearance has become routine for conventional units. Currently with OPTAG's Surveillance and Reconnaissance Wing for appraisal,

the exact size of any future procurement is as yet unknown.

Meanwhile, in the US, DARPA has launched its Maximum Mobility and Manipulation (M3) programme. Announced on 17 March, the programme was created as a result of what the agency considers to be the 'poor' capability of unmanned assets currently in service.

Focusing primarily on UGVs, the programme 'seeks to create and demonstrate significant scientific and engineering advances in robot mobility and manipulation', according to a statement released by the agency.

Multiple contracts have been awarded to companies including Boston Dynamics, HRL, iRobot, Raytheon, Tekrona and Vecna Technologies.

**By Andrew White, London**

General Atomics Aeronautical Systems has unveiled artist's impressions of its latest Predator UAV variant – the XP. Designed as an export model for the wider international market and especially the Middle East, the XP is based on the USAF's original RQ-1 Predator, designed for persistent ISR while carrying up to 200kg in payload at altitudes up to 25,000ft.

International customers can expect it to be fitted with Lynx synthetic aperture radar and EO/IR payloads, as well as satellite and line-of-sight communications, according to General Atomics strategic director Christopher Ames. Having been licensed for sale to Middle Eastern countries for three years, the company said it was still 'in discussions' with various countries, including the UAE (see p8 for more details).



## Australian airshow witnesses UAV flight debut

Lockheed Martin's (LM) Stalker became the first UAV to fly at the Australian International Airshow in Avalon on 2 March, coinciding with plans to make it available to the open market.

The small UAV, which has been in service for six years with special forces in the US, conducted its flight alongside Avalon airport's runway, which was used by a variety of aircraft during the event, including F-22s, F/A-18s and a B-1. UAVs at the show that did not fly include Insitu's ScanEagle and the IAI Heron.

The flight coincided with LM's decision to make Stalker available to the wider market, outside the special forces community, and was observed by several undisclosed potential customers, according to Thomas Koonce, programme manager for special projects at LM Advanced Development Programs.

Describing why the company had made the decision to unveil the Stalker system to a larger audience, he told *Unmanned Vehicles*: 'There is a perception that LM was not doing anything in UAVs.'

The company has supplied the UK armed forces with 'hundreds' of Desert Hawk III airframes, and is also engaged in a cargo airlift requirement for the USMC with an unmanned version of the Kaman K-Max helicopter.

It is understood that there is interest in Stalker from the UK and Finland, as well as Australia which, UV was informed, has potential requirements for special forces use, as well as under Joint Project 129 Phase 4, which includes a hand-launched UAV for the Australian Defence Force.

Hand or bungee-launched, Stalker is capable of operating at altitudes up to 900m and can carry payloads up to 1.4kg. Koonce added that LM was also looking to double its endurance to eight hours by utilising ruggedised fuel cell technology.

Originally designed as a squad-level surveillance system for special forces, Stalker has also been upgraded with ShotSpotter's acoustic gunfire detection system, which is capable of recognising and geo-locating small-calibre and mortar rounds as well as RPGs. The airframe is also now available in a maritime configuration, so it can be recovered directly from water instead of a skyhook or net.

Existing payloads include day and EO/IR cameras or a laser illuminator, and the UAV can also be tasked for target or convoy tracking. Koonce added that a major benefit of the system was its 'inaudibility' at altitudes over 120m. Stalker is also capable of dropping a 1.4kg payload to provide forward-deployed troops with supplies such as batteries.

**By Andrew White, Melbourne**

## On the web

**NURC upgrades to latest SeeTrack software**  
23 March 2011

**Themis completes successful pilot operation for civilian customer**  
22 March 2011

**NASA Global Hawk takes the Earth's temperature over the Pacific**  
22 March 2011

**Nostromo Defensa, Innocon sign MoU for collaboration in South America**  
22 March 2011

**RE2 announces new family of manipulators for UGVs**  
22 March 2011

**DARPA explores future unmanned technologies**  
21 March 2011

**TiaLinx announces launch of Phoenix40-A mini-UAV**  
21 March 2011

**Northrop Grumman, USN complete new flights of X-47B UCAS**  
17 March 2011

**Northrop Grumman ships first BAMS UAS fuselage**  
16 March 2011

**Muscular ten-pack powers new ROV into top spot**  
16 March 2011

Visit  
**www.UVonline.com**  
for the full stories and latest news.

Be in the spotlight  
at

# UDT Europe UV Europe Paris Air Show

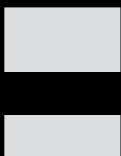
Get the best exposure with a stand-out advert in the  
May/June show issue of *UV*, or the dedicated news feeds from Shephard's  
top-quality team of show-based journalists

## Print advert opportunities

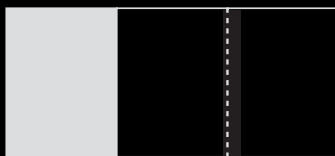
Cover wraps



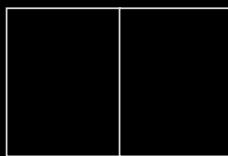
Bellybands



Gatefolds



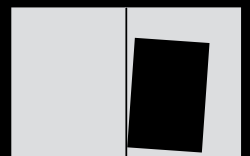
Company/product profiles



Tip-ons



Inserts



## Two-week online event package

The week before and the week during from just \$1,500



To make an informed decision contact:

Mike Wild on +44 (0)1753 727007  
or email [mw@shephard.co.uk](mailto:mw@shephard.co.uk)



**SHEPHARD** 30 YEARS

[shephard.co.uk/advertising](http://shephard.co.uk/advertising)

# Shifting sands

**W**ith a vast array of unmanned assets operating in the Middle East and southwest Asia under the control of coalition forces in recent years, local developers, it seems, have now recognised the market potential of these systems and have recently undertaken substantial strides to remedy what might be described as a technology shortfall.

At IDEX in Abu Dhabi in February, for example, a multitude of deals and agreements were signed to cement cooperation between Middle Eastern investment houses and specialist Western companies – a trend that is set to only increase, according to industry sources.

**Andrew White** finds evidence at IDEX that the Middle Eastern states are waking up to the potential of unmanned systems.

## REGIONAL RODEO

Illustrating the region's aspirations in the unmanned sector, the UAE's Higher Colleges of Technology recently announced the first 'Unmanned Systems Rodeo' in the Middle East, which will be supported by Northrop Grumman and Abu Dhabi Autonomous Systems Investments (ADASI), the latter being involved with Schiebel and its S-100 Camcopter locally.

Due to be held in Abu Dhabi on 4-5 May, the event is designed to encourage the

design, build and testing of 'remote-controlled unmanned aircraft' with Northrop specifically on call to assist with aerodynamics and airframe construction. According to Homaid Al Shemmari, chairman of ADASI, such a move will assist in ensuring the 'growing market need for autonomous systems... through the development of national capabilities in the UAE'.

Referring to the establishment of what he called the 'pillars' of a local autonomous



A General Atomics partnership with IGG is designed to offer the Predator XP to the Middle East market for the first time. (Photo: USAF)

## REGIONAL FOCUS

systems industry, Al Shemmari continued: 'The strategic partnerships that are being formed will ensure the long-term growth and success of this industrial sector in Abu Dhabi, which will inevitably lead to the diversification of the local economy and the creation of highly skilled jobs. We are confident that not only will the UAE benefit from the development of this new industrial sector, but the region as a whole.'

However, according to Rockwell Collins International & Service Solutions VP Greg Churchill, the unmanned market in the Middle East still remains a 'challenging' opportunity.

'We believe the [UAVs] are coming. There is tremendous utility and countries are looking how to interoperate them in commercial airspace. There is a [required] cultural and procedural roll-out of UAVs, but I'm not sure if the UAE or the region, as a whole, has thought that far ahead,' he told *Unmanned Vehicles*.

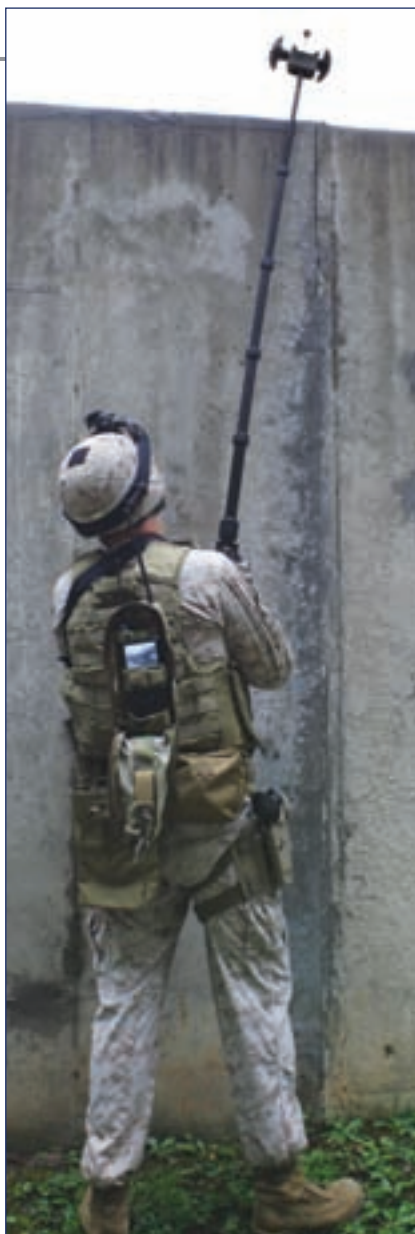
### FORGING LINKS

Currently, the strategy is to encourage an early transition by forging link-ups with international companies and, finally, certain firms are now establishing a presence in the Middle East. Rockwell Collins has just opened up an office in Abu Dhabi for precisely this reason and, elsewhere, General Atomics Aeronautical Systems (GA-ASI) signed an MoU with International Golden Group (IGG) as part of the UAE's desire to generate a 'premier ISR capability'.

Signed on 16 February and officially completed at IDEX a day later, the MoU will allow GA-ASI to market its Predator XP UAV primarily to the UAE armed forces.

'GA-ASI's establishment of a working relationship with IGG represents a strategic commitment by both companies to help the UAE strengthen its national security and protect critical infrastructure,' said Neal Blue, chairman and CEO of General Atomics.

According to the company's strategic development director Christopher Ames, the agreement will initially focus on the



**Saudi Arabian special forces are preparing to take delivery of the Recon Scout XT UGV, designed for MOUT missions.**

(Photo: ReconRobotics International)

provision of surveillance variants of the UAV, as opposed to the weaponised platforms currently in service with the USAF and others.

The XP model could be fitted with GA-ASI's Lynx synthetic aperture radar, EO/IR payloads and satellite and line of sight communications, Ames told *UV*. Similar to the USAF's original RQ-1 Predator, the XP is designed for 'persistent ISR' and is capable of carrying up to 200kg in payload at altitudes up to 25,000ft.

Ames added that IGG would be involved in programme management and logistical solutions for the Predator XP. GA-ASI has

been working with IGG for a number of years now, as part of an agreement to sell its Griffin Eye manned ISR solution to the UAE. However, Ames would not comment on the progression of the MoU to cover other company products.

### ROTARY SURVEILLANCE

Elsewhere, IDEX was used to announce news that Schiebel had delivered two S-100 Camcopter systems to Jordan's King Abdullah II Design and Development Bureau (KADDB) at the turn of the year. Unable to comment on contract details, Schiebel managing director Neil Hunter told *UV* that a single S-100 system would normally comprise two airframes plus a single GCS and antenna.

According to KADDB, the VTOL UAV will form a 'key' part of the Jordanian Armed Forces Reconnaissance Squadron, with operations likely to include ISTAR mission sets. The airframes are also the first S-100s to be fitted with L-3 Wescam's MX-10 EO/IR payload, with Schiebel also providing in-country support.

'KADDB said they would procure a couple of [Camcopter] systems before utilising and assessing them. We would be hopeful to achieve more sales,' Hunter said. Referring to the Middle East market in general, he continued: 'There is interest in this market and they have money. There's a lot of opportunity... and they tend to procure a bit more quickly than standard Western militaries.'

Elsewhere, he confirmed that all 60 S-100 aircraft ordered had been delivered to the UAE as part of ADASI's Al Sabr programme, designed to provide the UAE armed forces with an ISR capability based on a VTOL UAV.

Included in the requirement is capacity for 'capability building... for the production of aviation standard components,' and Hunter told *UV* that there was potential for an S-100 hub in the Middle East as a supply logistics centre. 'This is likely to turn into a JV agreement which we've talked about,' he continued.

# THREAT COUNTERED

## Lynx Multi-mode Radar

Detecting and defeating Improvised Explosive Devices (IEDs) is one of today's most urgent Intelligence, Surveillance, and Reconnaissance (ISR) requirements. General Atomics Aeronautical Systems' Lynx Multi-mode Radar locates disturbances that point to potential IED threats and provides early threat warning to ground forces.

Currently flying combat missions on both manned and unmanned aircraft, Lynx's Synthetic Aperture Radar (SAR) capability provides photographic-quality images through all weather, in daylight or total darkness, detecting time-sensitive targets and changes on the ground.

Lynx's broad-area Ground Moving Target Indicator (GMTI) scanning capability detects threats in real-time, automatically cross-cuing to the aircraft's optical payload for target identification. Ground forces depend on the Lynx Multi-mode Radar to counter the threat.



Airborne Radar Antenna



Threat Device



Radar Image



Elsewhere, Bahrain is understood to be seeking an aerostat/UAV surveillance solution for national security missions. Sources told *UV* that CyberTech Middle East, a JV between CyberTech Systems and Software and investment company GoldCoastway, was planning to offer up S3Tel's FalconEye aerostat and a tactical UAV based on Schiebel's S-100 airframe.

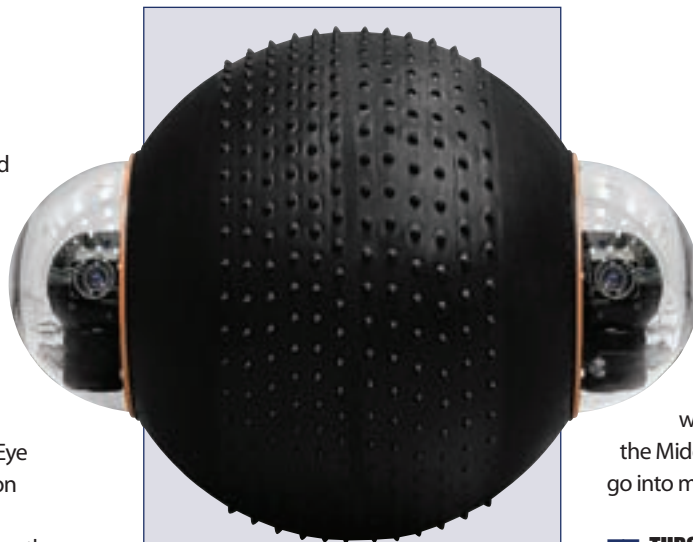
Jobs have also been advertised on the Internet for a UAV pilot, as well as a flight director, winch operator and flight engineer for aerostat operations. However, Hunter confirmed that Schiebel had had a 'relationship' with CyberTech in the past, although this had gone quiet in the past year.

#### BROAD SELECTION

Meanwhile, KADDB chairman and CEO Shadi Ramzi Majali told *UV* that Jordan was looking to increase its capability in the unmanned arena as the development agency considers a wider cross-section of ground and aerial vehicles. 'We are heavily interested in this area for UGVs,' he said. When questioned on whether he would action any future domestic development of UAVs, he would only admit that KADDB was looking into this area.

'We are testing and playing around with some of these [unmanned] gadgets but they are not fully developed yet in that field, and we are considering joint ventures,' he continued.

Meanwhile, referring to KADDB's development of its 'UGV' and 'Small UGV' programmes, Majali said: 'We have an excellent product there, but now we are trying to bring it down in size and [make it] better in quality.' Developed from start to finish by KADDB, the platform has been designed to carry a variety of weaponry and robotics such as the RPG-32 Hashim anti-tank projectile, for example, which was on show at IDEX.



One of the more visually striking UGVs, Rotundus is being developed under a UAE JV with a Western company. (Photo: Rotundus)

'The use of tele-operated ground vehicles is becoming an established tool for many civil and military applications. The military has and will continue to use a number of ground vehicles to provide mobility, counter-mobility, reconnaissance and survivability support to formations whilst providing protection to their own crews,' a KADDB official said, outlining the UGV's ability to carry a payload of up to 70kg. He said the platform had been driven remotely at distances of up to 1km. The six-wheel vehicle includes day and night surveillance payloads, obstacle detection, skid steering and communication nodes.

On the ground front, Emirates Arab Investments (EAI) displayed the Rotundus UGV at IDEX. Developed in conjunction with Sweden's FMV defence agency and Saab, the UGV forms part of Sweden's Robotic Collaboration Programme.

Dubbed a 'mobile sensor platform', Rotundus is designed to search and secure perimeters at speeds up to 10km/h. Described by an EAI operator as 'very silent', Rotundus carries two cameras and features GPS navigation. He added that it could also be equipped with CBRNE sensors.

Controlled via a game console control joystick, Rotundus can operate for between eight and 16 hours, running on a lithium-ion rechargeable battery. A standard payload

comprises two pan-tilt-zoom cameras for '360° field of vision'.

Measuring 60cm in height and 80cm in width, Rotundus has also been proven to operate in temperatures between -30 and 40°C. A source close to

EAI said discussions were under way with undisclosed customers in the Middle East, although he was unable to go into more detail.

#### THROWAWAY CAPABILITY

Elsewhere, Saudi Arabian special forces are understood to be preparing to take delivery of 37 Recon Scout XT UGVs, manufactured by ReconRobotics International. However, sources told *UV* that the Saudi Arabian government had yet to issue a purchase order for the systems, which are currently in use with US forces in Afghanistan.

Recon Scout XT, which weighs a total of 600g, comprises a day camera or IR payload and can be thrown over compound walls or driven into rooms for reconnaissance of an area before troops enter a position. They are accompanied by extending poles, allowing the camera to be handheld over a wall or obstruction. The UGVs can then relay video feed up to 30m indoors or 90m outdoors, according to the company.

However, it appears that in order for the Middle East to continue its journey into the unmanned sector, it must embrace international companies already established in this field. Speaking to *UV* at IDEX, Lockheed Martin Missiles and Fire Control director of international business development Morri Leland echoed this view, describing how the UAE, for one, was exploring 'potential participation' in unmanned solutions – especially ground and air vehicles.

'UAE companies approached Lockheed Martin to proceed with this before IDEX and possible options could include the Squad Mission Support System [UGV], Common Controller, Desert Hawk III [UAV] or Stalker [UAV],' he explained. **uv**

# One robot, unlimited possibilities...

iRobot® **510 PackBot®**:  
the multi-mission robot

510 PackBot performs bomb disposal, surveillance/ reconnaissance and other dangerous missions while keeping warfighters and first responders out of harm's way. Modular, adaptable and expandable, 510 PackBot is quickly reconfigured based on the mission and operator's preferences.

More than 3,500 PackBot robots delivered worldwide.

Get more information about PackBot;  
e-mail [packbotsales@irobot.com](mailto:packbotsales@irobot.com)  
or visit [www.irobot.com/uv](http://www.irobot.com/uv)



# iRobot®



# Bang for the buck

North America Editor **Scott R Gourley** takes a look at how the US military is looking to increase the weaponisation of its UAVs over the next few years.

**A**s noted in the US Army Roadmap for UAS 2010-2035, the proliferation of unmanned capabilities over the past decade has been characterised by the 'introduction of available or rapidly developed UAS to meet the immediate needs of the soldiers engaged in OIF/OEF. Moving away from that 'relatively disjointed, limited and stovepiped UAS effort', the roadmap notes that subsequent science and technology efforts have focused on 'improving endurance/range, precision engagements, weaponisation and the delivery of flexible multi-mission-capable mission packages.'

## SMALLER AND SMALLER

In the area of weaponisation, one trend that has emerged from those efforts involves the application of armed capabilities to smaller and smaller unmanned airframes.

Part of this trend is an evolutionary expansion, with an example being the USMC's interest in exploring weaponisation of platforms like the RQ-7 Shadow. Evidence of revolutionary progress can be found in a

recent broad agency announcement from the Air Force Research Laboratory calling for proposals to perform 'flight vehicles integration research' for a range of technologies surrounding micro air vehicles (MAVs). Areas of identified interest included 'miniature weapon design and dispensing technologies', with possible applications ranging from 'rapid-response weapon concepts for use on time-critical targets' to 'unmanned combat air vehicle weapon integration/dispensing and MAV munitions.'

Another trend involves industry exploration – both under contract and through internal R&D – of new weapons options for UAS.

Representative examples of recent programmes range from Northrop Grumman's Viper Strike to the roll-controlled fixed canard (RCFC) guidance system that General Dynamics Ordnance and Tactical Systems demonstrated in 2008 to guide 81mm air-dropped mortars onto a stationary ground target after release from an aircraft. This application of RCFC

technology was sponsored by the US Army's Armament Research, Development and Engineering Center, with the potential application of providing tactical UAV operators with a low-cost, lightweight weaponisation candidate for rapid fielding.

## MULTI-PURPOSE ROMEO

Miniaturisation aside, most initial UAS weaponisation activities focused on the Hellfire missile and, in fact, helped to drive some of the ongoing activities surrounding that weapon system.

'Most of the activity on improving Hellfire has been driven out of the UAS requirements,' explained a spokesperson for Lockheed Martin Missiles and Fire Control. 'And one of the biggest improvements has been in creating what I call the "Romeo" variant of that missile.'

Reflecting global security advice, they offered their update on condition of not tying a specific individual to the Hellfire programme.

'Hellfire currently has lots of different warheads that it can be employed with,' they observed. 'And what the army has done over



**Mechanics load an AGM-114 Hellfire onto an MQ-1B Predator at Ali Air Base, Iraq (left), while Raytheon technicians preflight a Cobra UAV armed with a Griffon munition (above). (Photos: US DoD/Raytheon)**

the last couple of years with us is taken some JCM [Joint Common Missile] technology that we demonstrated a few years ago and funded us to productionise that and create a single multi-purpose warhead for the Romeo version of Hellfire.

'That new warhead provides a lethality solution against a broad range of targets. We've demonstrated that at the component level. We've done some system flight testing with that configuration. And we're going to be moving that into production very shortly. [With Romeo], essentially whatever target they find with the UAS system they will be able to decisively engage.' The spokesperson offered 'within a year' as a rough timeframe for the Romeo warheads to reach warfighters' hands.

The Romeo variant also features trajectory improvements that allow engagement of

every target that the platform can identify. By way of comparison, with some earlier versions of Hellfire, operators were required to bring the aircraft around to bear on the target. Later developments of the missile, including Romeo, significantly shorten the sensor-to-shooter timeline by allowing engagements in 360° around the platform.

The spokesperson noted that the capability had been 'prototyped' in the recently introduced P+ variant but was now being 'mainstreamed' in the Romeo version.

#### ■ IMPROVED LAUNCHER

'We are also working on an improvement to the launcher system for the UAS platforms,' they said. 'Our model is to work very closely with the UAS prime OEMs. And one of the things that is at a premium on UAS platforms is weight. So we have been working on an army programme to modernise the launch system. That is in the process of qualification, and starting in about a year we will be delivering some lighter-weight launchers that will get installed on UAS. It will allow them to remain on station longer, and do their mission with a little more flexibility.'

'A couple of years ago, when they first put Hellfire on UAS platforms, users loved the reliability and the precision capability,' the spokesperson said. 'But almost immediately they made a list of things that they wanted to improve. And we've been working on those improvements ever since.'

'We've referred to our DAGR [Direct Attack Guided Rocket] missile as "Hellfire junior",' they continued. 'It's basically the brains of Hellfire in a 2.75in package. We think that

the big advantage that DAGR brings to UAS platforms is in loadout, since we can put four DAGRs wherever you can put one Hellfire. The interface is transparent, since the DAGR canister "looks" just like a Hellfire to the platform.'

'We are just getting DAGR into production,' they added. 'We've got one contract and we are just getting ready to get another – hopefully within days – and we are looking forward to basically going around and helping the UAS community by providing them more "shots on the wing" with a similar precision and interface.' The most common warhead used on DAGR is a 4.5kg blast fragmenting design.

'From a lethality point of view, one of the things that we think discriminates our guided rocket solution from others is the incorporation of the same kind of smart fusing we have in Hellfire into DAGR. We've done some live firings and demonstrated its ability to essentially penetrate a soft target and then detonate. And for a lot of the targets the UAS is going after, that's the kind of lethality effects they're looking for.'

Looking to the future, the Lockheed Martin spokesperson highlighted the Joint Air to Ground Missile (JAGM), emphasising that 'the great thing about JAGM, just like DAGR, is that it is the follow-on to Hellfire, and as such anywhere that Hellfire is integrated platform-wise, JAGM will follow. It essentially has the same lethality solution that is in Romeo – multi-target, multi-purpose smart fusing lethality. It also brings two additional capabilities to the UAS community. First, with twice the range, a single UAS platform will be able to engage four times the footprint on the ground, making every aircraft that much more effective in terms of the missions they have to work. Also, JAGM has an adverse weather capability.'

#### ■ INTEGRATION EXPERIENCE

Raytheon Missile Systems representatives also pointed to an impressive portfolio of existing and emerging systems encompassed within UAS weaponisation planning. ➤

*'Whatever target they find with the UAS, they will be able to decisively engage.'*



DAGR (or 'Hellfire Junior') allows UAS to carry a greater number of 'shots on the wing'. (Images: Lockheed Martin)

*'We're not naive enough to think that there aren't special needs for UAS.'*

'We've been doing weapons integration for over 60 years,' observed Cody Tretschok, Raytheon capture manager for advanced UAS weapons in the advanced missiles and unmanned systems directorate. 'We've done everything from Phoenix and Maverick missiles to the Tomahawks and AMRAAMs and Paveways. So we think we're particularly skilled in this area. We are the largest manufacturer of guided weapon systems. And we think all that helps a lot in the unmanned systems world.'

'We're not naive enough to think that there aren't special needs for unmanned systems,' he quickly asserted. 'But we've got some experience there as well.'

Some of the company's experience involves the UAS integration of its Griffin munition, a 15kg missile with a 6kg warhead that falls under the Special Operations Precision Guided Munition (SOPGM) family of weapons. One of few recent public disclosures indicated that Raytheon was pursuing rapid fielding efforts to place Griffin on 'UAV, scout helicopter and ground launch applications.'

Turning to the company's Small Tactical Munition (STM), Tretschok described it as 'something we have been working hard on. It is specifically developed for the smaller UAS systems – the Shadow 200 class. The reason is that you really didn't have anything small enough to fit on that class of UAS. So what we did with STM was to pack the capabilities of a full-sized missile inside a very small lightweight weapon that is currently about two feet long and 13½lbs – although right now we're working on an even smaller version.'

'But you don't have to sacrifice capabilities. It still gives you extreme precision – we have a dual-mode guidance system where you have GPS, inertial navigation and a semi-active laser seeker – giving you tremendous precision and capability to hit the target. You can't miss the target when you're this small.'

'It also gives you a tremendous capability on the bigger UAS platforms,' he added. 'Because now you can have a more flexible loadout. Current systems can sometimes only carry two weapons because of payload limitations. But if you go to something like an STM you can possibly replace two weapons with 12-16 STMs, or whatever combination is necessary depending on your target set.'

#### MISSILE ON THE TABLE

Following successful flight tests in July 2010, the company applied lessons learned to increase ease of production and reduce cost. 2011 plans call for follow-up flight testing.

'We realise that there is a need for this kind of weapon and we want to be ready when they demand it,' Tretschok said. 'UAS weaponisation is growing, and we see that so we are trying to proactively meet the warfighter's needs.'

**JAGM will be fitted to the US Army's Grey Eagle fleet.** (Photo: Raytheon)



'We've been trying to think ahead to what the customer may want and fill in the gaps that may be necessary,' echoed Don Newman, programme director for the UAS weapons portfolio and deputy director for Raytheon's unmanned systems product area. 'But [the customer] is not spending any R&D dollars to make this happen. So, in our case, Raytheon built STM on our own nickel and then presented it to them as ready to go.'

'That seems to be the paradigm in acquisition these days,' he said. 'I call it LAMOTT – Lay A Missile On The Table. You walk in and say, "here it is".'

'It's really a new paradigm,' Tretschok agreed. 'Everyone is trying to adjust to it and it's one of the reasons that we are out front now in the development of STM.'

Turning to the future, he observed: 'Another weapon system that is going to replace one of the most commonly used UAS weapons [Hellfire] is the JAGM. We've had tremendous success with that. We're six for six in testing. And basically it's waiting to go on the [MQ-1C] Grey Eagle amongst other platforms. It's tremendously capable, with a tri-mode seeker system that gives you unbelievable flexibility. We're pretty much "good to go" on that guy and we're just waiting for the RFP to come out. And that's going to be a powerful UAS weapon when it's out.'

Asked about the correlation between the company's approach and the different DoD UAS roadmaps released over the past decade, Newman concluded: 'The biggest emphasis these days is on open architecture. That's a big deal. As Raytheon, we're mission systems integrators. We provide mission systems for all the platforms while remaining platform-agnostic. Those are open-architecture mission systems. And the weaponisation part is also open architecture.' **uv**

# SETTING STANDARDS

AROUND THE WORLD

Pushing technology beyond limits, Insitu sets the standard among unmanned aircraft systems in its class, providing cost-effective situational awareness, interoperability, flexibility, and the most advanced ISR capabilities in the world.

Cutting edge solutions and the agility to support any land or maritime mission—from military operations to counter-piracy, environmental research to disaster preparedness and response.

See the proof at [www.insitu.com](http://www.insitu.com).

 **INSITU**

Unmanned platforms offer a novel means of taking naval electronic warfare offboard, **Richard Scott** discovers.

The Protector USV runs a demonstration in Singapore. Rafael has recently developed a compact EA module for this platform. (Photo: author)



# The art of deception

Ever since October 1967, when Egyptian missile boats disabled and sank the Israeli destroyer *Eilat* using P-15 Termit rounds, navies worldwide have sought to invest in ways and means to protect high-value surface platforms. Soft-kill mechanisms are acknowledged as a vital part of a ship's self-defence armoury, providing a means to disrupt targeting and deceive missile seekers.

Electronic attack (EA), the component of soft kill specifically aimed at countering radio frequency (RF) threats, embraces a variety of technologies and techniques that can broadly be separated into two categories: expendable decoys that are launched offboard to deploy payloads (chaff, corner reflectors, active jammers) intended to distract or confuse active RF seekers; and high-power shipboard jammers that generate noise and deception modulations designed to deny information, create false targets and/or break seeker lock.

## SOFT-KILL LIMITATIONS

However, each of these approaches has limitations. Offboard decoys are, by their nature, of relatively short duration and so require frequent re-seeding. They may also require the launch platform to perform complex evasive manoeuvres in order to be effective.

Nor is onboard EA without its drawbacks. Shipboard jammers have often been viewed with circumspection by naval officers because of the potential for counter-targeting, and the vulnerability of active jamming to home-on-jam. Jammers may also cause interference with own-ship sensors and hard-kill systems.

So there remains an inherent attraction in some measure of physical separation. It is for these reasons that several navies, defence research laboratories and contractors have in recent years explored the potential offered by unmanned platforms to naval electronic warfare (EW). Indeed, it was during the Iran-Iraq 'tanker war' of 1984-88 that what was then Marconi Defence Systems devised the concept of TOAD (Towed Offboard Active Decoy), a compact, low-cost EW package that could be installed in a small hull and towed behind a high-value commercial vessel to detect and jam threat missiles.

The goal of physical separation was also a driver for Australia's Defence Science and Technology Organisation (DSTO) when it began work in the 1970s to devise a decoy capable of seducing sea-skimming anti-ship missiles. Its answer, novel for the time, was to use a small, hovering solid-propellant rocket to move an electronic repeater away from the ship in order to capture the inbound missile's seeker tracking circuits.

This concept, originally conceived under Project Winnin, provided the basis for what

was in effect an expendable, short-endurance UAV that would fly away from the ship under the control of an autopilot pre-programmed at launch. DSTO scientists saw a number of merits in this approach, notably quick reaction, no blind arcs, no restriction on ship manoeuvre and the ability to function effectively regardless of wind conditions.

Project Winnin eventually led to the Mk 234 Nulka active missile decoy system, developed by what was AWA Defence Industries – now subsumed into BAE Systems Australia – under a cooperative programme with the US. Nulka entered service in 2001, and over 1,000 rounds have now been delivered to the Australian, Canadian and US navies.

## RESEARCH ROUTES

A different route was taken by the US Naval Research Laboratory (NRL) during the 1990s. Under the sponsorship of the Office of Naval Research (ONR), the NRL pursued advanced technology demonstration (ATD) programmes such as the Flying Radar Target (FLYRT) and the Eager preferential acquisition decoy.

FLYRT, a folding-wing distraction decoy designed for deployment from the existing Mk 36 Decoy Launching System, was successfully demonstrated in 1993. Launched by a small rocket boost motor, the FLYRT vehicle deployed fold-out flight surfaces and then transitioned to powered flight using an electrically driven propeller.

The Eager ATD subsequently demonstrated the application of an electrically powered long-endurance manoeuvrable UAV to

*'Each of these approaches has its limitations, so there remains an inherent attraction to some measure of physical separation.'*

# AAI: TAKING UNMANNED INNOVATION TO THE SEA.



## LEVERAGING UNMANNED SYSTEMS COMMAND AND CONTROL EXPERTISE

AAI is a proven unmanned systems designer and integrator. Our unmanned command and control technologies are put to the test every day by the U.S. Marine Corps and Army through the Shadow® Tactical Unmanned Aircraft System program.

Today, AAI is taking that success to the sea by uniting our mature common command and control architecture with unmanned surface vessels (USVs). Our multi-payload, mission-flexible USV design is capable of hosting a variety of payloads to provide force protection and projection for naval operations.

To learn more, call 800-655-2616 or e-mail [RSC\\_AAIReg@aai.textron.com](mailto:RSC_AAIReg@aai.textron.com).

the ship defence role. Carrying a 10kW electronic payload and powered by an electric motor driving a 3m diameter rotor, Eager would be tied to its host ship by an umbilical tether (at least 230m long) containing a fibre-optic link for payload and control signals. A successful at-sea demonstration was undertaken in September 1997.

Other NRL studies examined UAVs and micro air vehicles – systems adopting ultra-low-Reynolds-number aerodynamics could provide a capability to fly in consort with a task group at ship-like speeds for long periods.

Perhaps most intriguing was a concept briefly publicised by the ONR in 1999. Known as Area Protection by Offboard Countermeasures Network, it conceptualised a host of RF and IR countermeasures devices being remotely deployed around the

perimeter of a battle group. In effect, these would establish a 'safe haven', being networked and nested to provide co-ordinated and deconflicted area-wide protection for the maritime force.

It was postulated that these enduring offboard countermeasures could include tethered decoys like Eager, and free-flying UAVs orbiting around the group to deploy RF devices such as electronic repeaters, corner reflectors and/or chaff according to precise time and positioning criteria. Alternatively, UAVs might be used to lay and then re-seed IR clouds.

Information released by the ONR in 1999 indicated a four-year programme of requirements analysis, experimentation, prototype build and at-sea demonstration. However, the initiative subsequently vanished

**Nulka is in effect an electronic repeater mounted on an expendable short-endurance UAV.** (Photo: Australian DoD)

from public view, and it remains unclear whether it was simply cancelled or taken into a more classified realm.

### **SURFACE SOLUTION**

More recently, the use of USVs as a means of deception, jamming and warning of EA has generated significant interest on the basis that they can provide a persistent and effective capability with significant range, endurance and the capacity for large

# Inertial

## 3DM-GX3<sup>®</sup>-35

- Miniature, lightweight AHRS with onboard GPS
- Provides independent, time correlated measurements
- Unprecedented user control with new API
- Fully calibrated and temperature compensated over operational range of -40°C to +65°C

# Sensors






**Energy Harvesting**

Meeting the need for powering wireless nodes for the long-term, EH-Link™ operates indefinitely from a wide range of ambient energy sources.

**Displacement Sensors**

Amongst the world's smallest linear displacement sensors, our DVRTs are ideally suited for tightly spaced sensing arrays.

**Wireless Sensors & Systems**

Extended range, synchronized sensing systems for structural health monitoring and industrial test & measurement applications.

**Little Sensors. Big Ideas.®**



Call 800.449.3878 or visit us online at [www.microstrain.com](http://www.microstrain.com)



payloads and power generation. Indeed, the US Navy (USN) 2007 Unmanned Surface Vehicle Master Plan suggests that it could be possible 'for a USV to generate false targets for deception in support of anti-ship missile defence [ASMD], initiate a denial of service, or instigate spoofing, local area network jamming and other disruptive missions' – for example, a USV could be equipped with a false target generator and used in a counter-targeting or military deception role.

Looking specifically at the Littoral Combat Ship (LCS) programme, the document goes on to suggest that the USV offers a number of advantages: the electronic payload is reusable (unlike those associated with active decoys), which brings economic advantages; a USV used in an ASMD role can be employed as an automated remote platform to augment the host LCS in a hostile environment, allowing the ship to perform its primary mission; and the USV can provide an extended jamming capability.

The size and power of the jammer relative to the capabilities of the USV will determine overall mission capabilities and limitations. Offering one example, the USV Master Plan postulates that a high-power jammer mounted on a large USV could be

used in an expeditionary role to provide electronic screening, masking or deception prior to a beachhead being penetrated by special operations forces.

Alternatively, smaller jammers with directional high-gain antennas could be used in a relatively covert manner near hostile shores, airfields or chokepoints. Roles here could include communications jamming or deception and GPS jamming.

#### MODULAR EW

It is against this background that the Tactical Electronic Warfare Division (TEWD) of the NRL has undertaken research, development and demonstration of a modular and easily portable shipborne EW suite that has grown out of an earlier effort to demonstrate EA functionality from a USV. ➤

# FUEL LEVEL SENSORS

## Ultra-Lightweight Fuel Level Monitoring for Unmanned Systems

- Accurate Measurement of Avgas, Petroleum & Heavy Fuel
- Lightweight - from Only 25g
- Low Power Consumption
- Solid-State - no Moving Parts
- Custom Designed - from 30mm to 1.5m Long
- Mission Proven on Unmanned Systems Worldwide

Find more information at [www.gillsensors.co.uk/uav](http://www.gillsensors.co.uk/uav)





To demonstrate the utility of USVs for surface ship EA protection, the NRL integrated an EW package on board the HS-USSV. Here, the platform is prepared for payload testing. (Photo: author)

According to the NRL, the use of USVs and UAVs is a 'promising avenue for delivering advanced EW capabilities to defend surface ships'. In this vein, the TEWD instigated the development of payload technologies providing 'low-cost, sophisticated EA capabilities that can be rapidly transitioned to unmanned vehicles that utilise open-architecture standards' such as the Joint Architecture for Unmanned Systems.

Sponsored by the ONR, this initial research effort set out to engineer an EA payload capability, designed for both counter-targeting and seeker deception, suitable for installation on USVs such as those planned for use with the LCS. The reasoning is that, used singly, such unmanned craft could provide a long-duration point defence countermeasures system. Deployed multiply, they could confer an area defence EA capability over larger sectors.

#### ■ INTEGRATED PAYLOAD

To demonstrate the utility of USVs for surface ship protection, the NRL teamed with Naval Sea Systems Command's Carderock Division to integrate an EW payload on board the High Speed Unmanned Sea Surface Vehicle (HS-USSV), a remote-controlled 11m hydrofoil. The HS-USSV design was considered well suited as it provides a stable jamming platform, and can maintain mission performance in high

sea states and at speeds commensurate with larger USN surface combatants.

The compact, lightweight EW payload adopted a wideband digital radio frequency memory (DRFM) EA system previously developed under the ONR's Advanced Multifunction Radio Frequency Concept programme. In addition to the standard 'menu' of jamming techniques, this system offers the capability to generate high-resolution false targets with realistic amplitude and Doppler modulations, engage multiple threats simultaneously and generate sophisticated multi-component waveforms that combine false targets with various types of obscuration jamming.

High transmit power is achieved through use of high-gain antennas and high-power microwave power modules originally developed for tactical aircraft. A novel, low-cost electronic support (ES) receiver and direction finding system, integrated with the DRFM-based EA suite, was also developed for the HS-USSV.

An initial EA experiment with this platform was conducted in August 2006 and focused on the anti-ship missile decoy mission. Using a shore-based missile simulator to track the ship target, the experiment examined the set of effective station positions that would prevent the radar threat seeker from successfully

tracking the target vessel. According to the NRL, the experiment revealed that an unmanned surface platform performing EA could deny radar tracking of the target vessel using generic jamming waveforms. Subsequent testing examined performance in the counter-surveillance role.

#### ■ PROTECTOR MODULE

It will come as no surprise that Israel is also exploring the use of unmanned vehicles in the naval EW arena. In this regard, Rafael has applied experience from its C Pearl-DV ES system and Digital Shark EA subsystem to develop a lightweight, compact EW module suitable for both offboard decoys and unmanned vehicles.

This miniaturised payload includes a wideband digital receiver, a low-power digital techniques generator and a solid-state active array transmitter offering high effective radiated power. The EA subsystem transmits complex responses in order to counter RF threat seekers adopting monopulse and lock-on receive-only homing techniques.

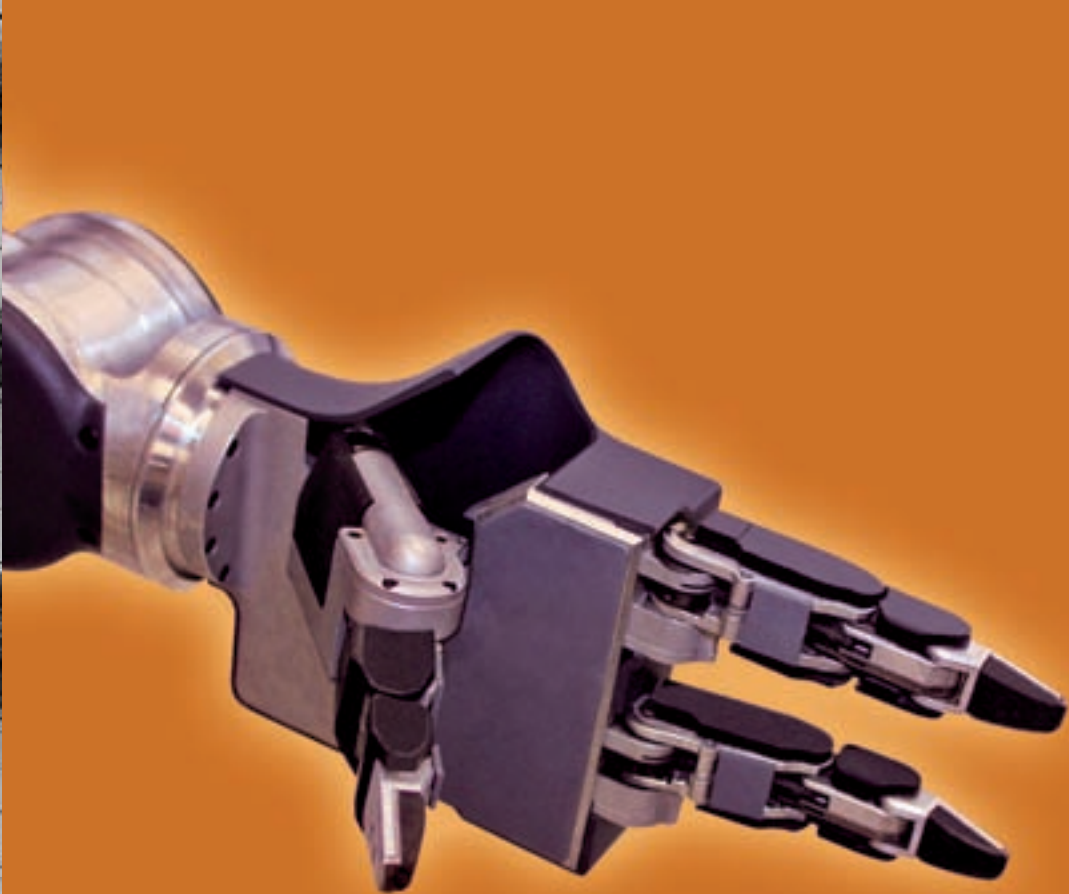
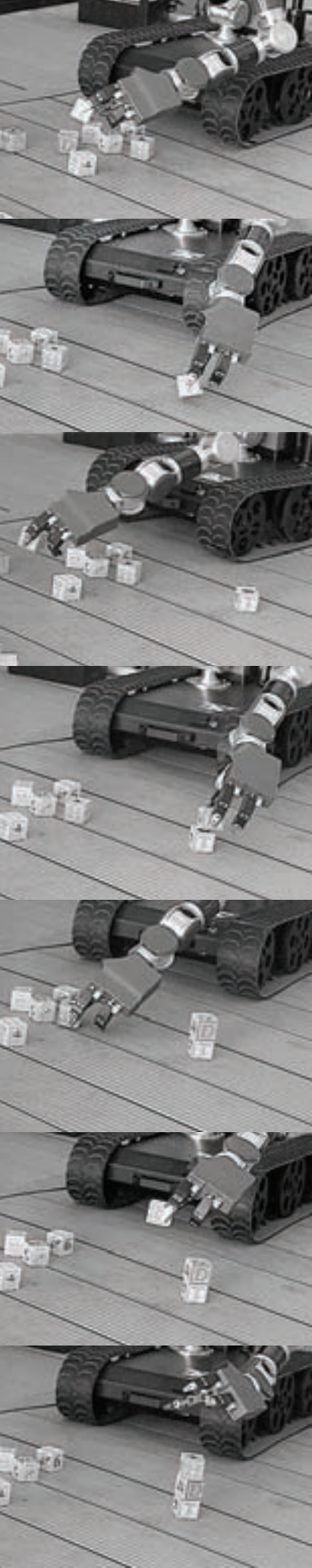
The initial application for this EW payload was the C-GEM active decoy, a rocket-powered expendable round intended to seduce threat missile homing heads in the terminal stages of an attack. However, Rafael has also eyed the potential for this same generic EW module to equip unmanned vehicles, starting with its own Protector USV.

Now in its fourth generation, Protector was originally conceived to carry an anti-terror/force protection module. However, the manufacturer has latterly looked to engineer a more modular system architecture design capable of receiving a range of alternative mission payloads, including as an EA subsystem.

More recently, the company has worked with Schiebel to engineer the integration of its ECM payload on board the latter's Camcopter S-100 VTOL UAV. This development is believed to have been initiated in response to specific customer interest in a UAV capable of providing persistent offboard EA protection. **uv**



This model of Schiebel's Camcopter S-100 shows the compact antenna array associated with Rafael's EA payload. (Photo: author)



## IT'S ONLY SCIENCE FICTION UNTIL YOU MAKE IT FACT.

It started as a mission to create a prosthetic limb to replace those lost to IEDs and other hazards found in the field. Today, it offers a way to prevent those injuries from occurring in the first place.

The MK-1 Robotic Arm was pioneered by HDT to provide a light-weight, high-strength arm with unmatched dexterity. These attributes make it ideal for disarming explosives while its human operators remain out of harm's way. It represents the most-advanced robotic arm in existence, and is a sterling example of the innovation HDT's engineers bring to its shelters, ECUs, Power Systems and other industry-leading products.



[hdtglobal.com](http://hdtglobal.com)

# Land of the giants

**Andrew White** reports on the build-up to an imminent wave of operational debuts for large UGVs.

**T**heir smaller relations have built up strong reputations in Afghanistan and Iraq over the past few years and, finally, it appears that larger UGV platforms are set to enter frontline service as they bid for similar recognition.

The UK and US are leading the charge for systems designed for load carriage – especially pertinent for operations in southwest Asia – while Israel has already deployed a number of large UGV platforms for ISR duties, including border protection.

The UK is stepping up plans to deploy an unmanned version of the much-maligned Land Rover Snatch to Afghanistan at a 'later

date' for surveillance duties and force protection. According to sources close to the UK MoD, the Treasury released initial funding for the design and development of a technology demonstrator (TD) last year.

It is understood that the MoD has also been considering G-Nius's AvantGuard as well as Lockheed Martin's Squad Mission Support System (SMSS) for 'route proving and force protection'. Additionally, it is understood that such a capability, in whatever form, could be used as part of the new Talisman counter-IED system which was deployed to Afghanistan with British forces in April 2010.

## SNATCH SOLUTION

Sources told *Unmanned Vehicles* that a larger unmanned capability could be deployed alongside each Talisman team, which already comprises: two Buffalo 'Rummage' systems and four Mastiff 'Protected Eyes' mine-protected vehicles; two micro air vehicles; two High Mobility Engineer Excavators; and two Talon small UGVs. Such a solution would provide a suitable role for several thousand Land Rover Snatches, which have been sidelined from service in Afghanistan after stinging criticism by troops regarding protection levels.

It is envisaged that such a capability would be able to carry a 'variety of sensors' (although the MoD refused to specify further due to operational security constraints), while the vehicle could easily be converted back to a manned platform for use within bases such as Camp Bastion in Helmand Province.

The TD can be operated from a cover vehicle, with sources telling *UV* that an operating system like this would allow the Land Rover to be deployed at ranges of up to 500m from the control station. This, they added, would be subject to limitations on the communications links used. 'The concept of operations needs to be thought through. The TD could be used as a "sacrificial lamb"; but if you lose it at head of convoy, you lose your eyes at the front', one insider stated.

The remote control position, which can be located on a fixed base or in a follow-up



The SMSS is being readied for operational deployment in Afghanistan later this year.  
(Photo: Lockheed Martin)



Oshkosh's Terramax technology, seen here on an FMTV, can be fitted to almost any ground vehicle.  
(Image: Oshkosh)

vehicle, has all the controls and instruments which the driver would see when sitting in the actual Land Rover. The operator also has a screen which provides him with a real-time image of the view from the driver's position.

It is understood that Exponent, which has developed its own series of UGVs as well as undertaking sensor integration, is working on the TD with the MoD, but the company refused to comment on the programme.

### SQUAD SUPPORT

Meanwhile, Lockheed Martin is currently working up plans with the US Army to deploy its SMSS to an 'overseas' location this calendar year. According to Lockheed Martin Missiles and Fire Control's director of international business development, Morri Leland, 'several' systems will be deployed. An internal development by the company, SMSS was originally designed for squad operations and as a 'key enabler' for US Special Operations Command, light infantry and the USMC.

'We are evaluating [SMSS] for Afghanistan deployment to lighten the load, along with wider uses including reconnaissance, surveillance and targeting,' Leland told *UV*, explaining how the UGV could operate with a gyrocam on a mast.

Similarly, the UK MoD has a requirement for 'reducing the burden' and, according to Leland, representatives have observed a

demonstration in the US. However, a specific trial for the MoD has yet to occur, he added.

Based on a Land Tamer chassis, the vehicle now has voice control and follow-on features, and is capable of obstacle avoidance when given a predetermined waypoint to travel to. It is also capable of following a soldier at a specified distance, using laser detection and ranging (LADAR) technology, Leland explained.



The Common Controller is designed to operate UAVs and UGVs alike.  
(Photo: Lockheed Martin)

'The LADAR will take a map of the soldier and follow him and can also track the same guy if he crosses paths with another operator,' he said, describing the latest part of Lockheed Martin's development plan – voice command. Leland said that an SMSS can be loaded up and verbally commanded to 'RTB' or return to base. Referring to weaponising the platform, he

said no tests had yet been scheduled for armaments.

'The US Army has approved the SMSS to work closely around soldiers through four safety releases received during user testing. The vehicle recently demonstrated new capabilities unique to the Block 1, including voice control, which allows hands-free operation,' a company spokesperson told *UV*.

### TRIAL CONTENDERS

Also looking to get involved in UK and US deployments is BAE Systems with its Multi-Operated All-Terrain Vehicle (MOATV). A spokesman for the company told *UV* that the system, based on a Supacat chassis of which a TD has already been shown to the MoD, could be 'in service very quickly'.

Also in the running is Boeing with its Assisted Carriage System (ACS), using a John Deere chassis. After completing troop trials earlier in the year with the British Army on Salisbury Plain, the UGV was fitted with two LIDARs, two cameras for tele-operation, a pan-tilt-zoom camera and a thermal imaging system. Designed to carry a 600kg payload, ACS was also fitted with a MESHnet wi-fi system.

Elsewhere, Lockheed Martin is still developing its Multifunction Utility/Logistics and Equipment (MULE) vehicle. Originating under the US Army's cancelled Future Combat Systems (FCS) programme, MULE is designed for company-sized missions and above.

Leland said the system was still in its TD phase as part of the US Army's Brigade Combat Team Modernization effort. The 2.5t vehicle was originally designed to include a transport variant as well as an armed platform, the Armed Robotic Vehicle-Assault Light, although Leland told *UV* that the weapons mix for the latter had yet to be determined. However, he said it could include 'guns and light weapons as well as DAGR and Javelin' rockets. Additionally, Lockheed Martin was also looking at a demonstrator payload which might include a gyrocam.

The 6x6 vehicle, which uses the Common Mobility Platform chassis, includes

independent articulated suspension and in-hub motors designed to power each individual wheel. Capable of climbing a 1m step, Lockheed Martin said the system was also capable of covering rough terrain including rocks and 'urban rubble', as well as water up to 0.5m in depth.

Also originally developed for FCS, Lockheed Martin, Boeing and SAIC's Common Controller remains on course for production, although Leland was quick to assert that it would not be deployed along with the SMSS in Afghanistan later this year.

The Common Controller, according to Lockheed Martin, has demonstrated command over ground, air and sensor platforms in US military trials. The ruggedised Spiral 2 design is 4.5kg lighter and features a custom, sunlight-readable display with a physical keyboard.

### ■ PURE G-NIUS

Meanwhile in Israel, G-Nius Unmanned Ground Systems, Elbit Systems' joint venture with IAI, is developing a 'next-generation' UGV for the Israel Defense Forces (IDF), the company has announced.

Following on from its Guardium and Guardium LS platforms, which are currently fielded in undisclosed numbers with the IDF, the Nahshon or Guardium Mk III will be developed in collaboration with the Israeli MoD's Administration for the Development of Weapons and the Technological Industry (Mafat). The programme is due to be completed by 2011, G-Nius officials stated.

According to company CEO Yoav Hirsh, the UGV will offer 'improved autonomous movement and operational performance' and 'intensified navigation capabilities' including various 'advanced control solutions'. Other parameters include an increased payload capability, improved situational awareness and autonomy, and independent decision-making.

'These advanced capabilities will also allow the vehicle to provide combat support, along with the Guardium which operates mainly on security missions', said Hirsh, describing how the IDF decision to develop a next-



**The much-maligned Land Rover Snatch is being re-roled as an unmanned system.**

(Photo: UK MoD)

generation UGV only proved the capability's 'major contribution to security missions in the modern combat arena'. However, he would not comment on the weaponisation of Guardium or Nahshon.

'There are a lot of lessons learned [from the development of Guardium], and some purposes needed changes', he told *UV*. 'This includes an increased payload and more power – generally it is more complicated. It is designed to operate better in difficult terrain.'

Hirsh said Nahshon would be ready for evaluation by the third quarter of 2011, but would not comment on details. However, he stated that a combination of Guardium, Guardium LS and Nahshon would 'cover most requirements in the international markets' for larger UGVs. More specifically, he described these as being: logistics capabilities for low-level units and convoy security; border control and homeland security; and base patrol in Afghanistan, for example. He also said such a platform would have a use in humanitarian missions, such as those currently being undertaken in Japan following March's earthquakes and tsunami.

### ■ TRUCKS UNLIMITED

Looking at larger systems still, Oshkosh's Terramax technology is designed to be fitted to any vehicle. First introduced in 2003, it was designed to address the 'litany of daily challenges military forces face, including long and demanding missions over varying terrain in hostile environments and unconventional threats like IEDs'.

Designed to have a reduced unmanned signature for 'minimal visual impact', Oshkosh has to date fitted its system to 4x4 and 6x6 Medium Tactical Vehicle Replacements (MTVR), Palletized Load Systems and Family of Medium Tactical Vehicles Load Handling Systems. But company officials told *UV* that the main developmental focus now was



**MULE extends UGV capabilities beyond load-carrying.** (Image: Lockheed Martin)

to identify how best to use the technology and integrate it into current standard operating procedures.

Selected through the Joint Ground Robotics Enterprise for the Cargo UGV project, Oshkosh is working alongside the USMC Warfighting Laboratory and the Naval Surface Warfare Center to integrate a 6x6 MTVR for 'test logistics missions in operations and representative environments'.

'We are doing just that by: evaluating the placement of unmanned vehicles within a manned convoy; testing the effectiveness of lead-follower convoys; helping to determine the right mix of manned and unmanned vehicles in a convoy; and other implications for real-world tactical missions', John Beck, chief engineer of unmanned systems advanced project engineering at Oshkosh, told *UV*. 'MTVR will be tested and evaluated by the USMC to assess the ability to assimilate an unmanned MTVR into a manned convoy conducting supply distribution in a tactical environment. It will be completed in phases.' No timeline for this was revealed.

Internally funded and developed in conjunction with the Defense Advanced Research Projects Agency and Robotics Technology Consortium, Terramax UGVs have achieved 'thousands' of miles since 2003, displaying average speeds of around 30km/h, *UV* was informed. Another developmental priority is the Terramax Operator Control Unit, which is designed to allow a novice user to be trained to 'drive' the system in three days or less, Beck said.

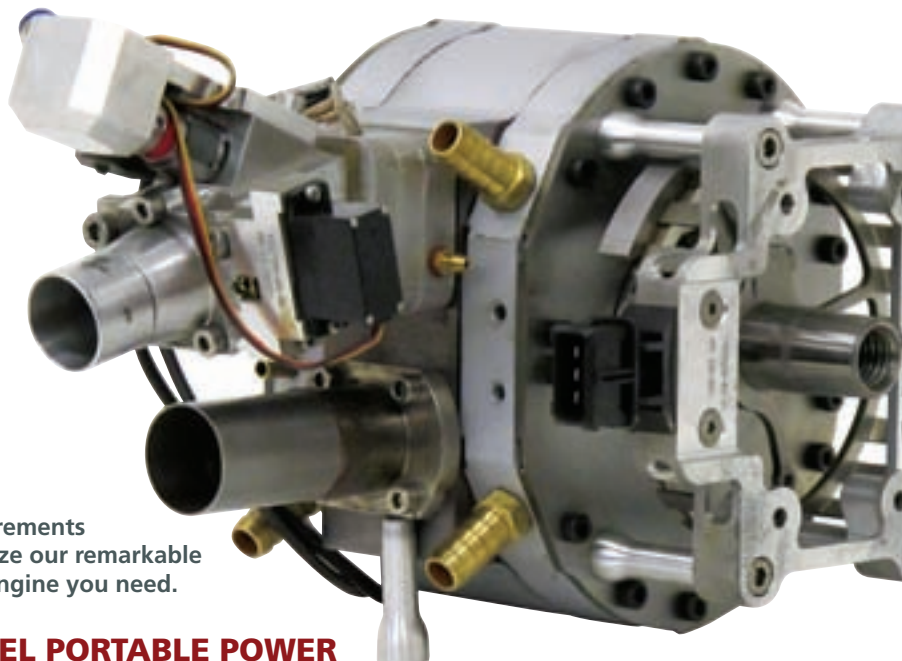
In conclusion, it appears that widespread deployment of large UGVs could be imminent and, as Oshkosh and Lockheed Martin both confirmed, the operational feedback and subsequent developmental steps taken in response will determine how such systems are utilised in the future. *uv*

# A HEAVY FUEL ENGINE THAT WORKS

At Cubewano we build heavy fuel engines. Not rendered models, drawings or one off prototypes, but real working, lightweight engines that run on almost any fuel available. All engines are available in air cooled or liquid cooled that can be customised to your platform.

Our patented technology pushes conventional notions

- Exceptional power density yet small in size
- Switchable between heavy fuel and gasoline
- Cold starting on heavy fuel (without any extra equipment)
- Almost no vibration
- Separate closed oil system
- Bi-directional fly-by-wire engine control
- Automatic altitude and climate compensation.
- Starter generators available on all models.



Engines are developed with field requirements in mind and can be made to order. Utilize our remarkable design and test services to create the engine you need.

## COMING SOON – HEAVY FUEL PORTABLE POWER GENERATION.



## MAINTAIN BATTERY POWER ON THE FIELD.

One man portable power generation is just around the corner. Cubewano are currently developing a new range of portable generators starting with a 1kw heavy fuel unit, expected to weigh less than 25lbs. Orders are now being taken for integration programs.

Contact us to solve your heavy fuel power requirements with either a COTS or custom propulsion system today.



The World's Most Advanced Small Engines



# IMDEX Asia 2011

18 - 20 May 2011 • Changi Exhibition Centre • Singapore



## The New Era of Maritime Defence has sailed in at IMDEX Asia 2011!

Capitalise on the wave of opportunities with IMDEX Asia, Asia Pacific's only dedicated international maritime defence show, the event to exchange insights, network and make buying decisions that really count. The one event created to meet industry needs for the Asia Pacific market, primed to be the second largest source of naval spending in the world.

See what lies ahead of you in the new era of Maritime Defence that unfolds at IMDEX Asia 2011.

### More Reasons why you should attend IMDEX Asia 2011

As one of the top maritime defence shows in the world, IMDEX Asia 2009 attracted:

- 7,600 visitors from 55 countries
- 130 exhibitors from 24 countries
- 45 VIP delegations from 35 countries
- 17 Chiefs of Navy and Coast Guard Directors-General
- 20 Warships from 14 countries

**Pre-register now and stand to win exciting prizes!**  
[www.imdexasia.com/preregistration](http://www.imdexasia.com/preregistration)

For more information on IMDEX Asia 2011, visit [www.imdexasia.com](http://www.imdexasia.com), call +65 6542 8660 or email: [enquiries@imdexasia.com](mailto:enquiries@imdexasia.com)

Organised by:

**experia**  
events that influence

Supported by:



Endorsed by:



Held in:





The Daurade is a multipurpose experimental AUV which has been designed to gather hydrographic data. It can dive to 300m and has a maximum speed of 8kt. (Photo: author)

# Threat neutralisation

**Tom Withington** reports how UUV technologies have become essential to the MCM work of the world's navies.

The importance of the AUV and ROV to the mine clearance mission can hardly be overstated. Not only are such vehicles essential for navies around the world, but NATO, in particular, has to deal with a mine menace on its doorstep. This is one of the reasons why a number of European companies are involved in the development and sale of specialised UUVs – the First and Second World Wars have left the seas around the continent littered with naval mines.

In 2009, NATO published a report entitled 'Sea Mine Countermeasures: Exploring Neutralization Options', which stated that around 80,000 mines may still inhabit the North Sea, Baltic and English Channel alone. On top of this is a realisation that the naval mine represents an attractive 'asymmetric' weapon for a potentially hostile nation.

The upgrade of the French Navy's mine countermeasures (MCM) force took an important step forward on 21 February, following news that the service would acquire Alister 100 UUVs from French marine robotics specialists ECA, to be delivered from 2012. The Alister 100 can operate at depths of up to 100m, although the capability to operate at up to 1,000m is available as an option.

This vehicle provides up to 15 hours' endurance when operating at its nominal speed of 3kt, relative to the water speed. In

terms of payload, the UUV comes equipped with side-scan sonar, video cameras, obstacle avoidance sonar, a multi-beam echo sounder and a conductivity, temperature and density probe. Radio, acoustic, wi-fi and Ethernet communications links connect the Alister 100 to its human operator.

## STABLE OF PRODUCTS

The UUV is one of several MCM and underwater inspection products in the ECA stable. It is joined by its Alister AUV sibling, which has a maximum operating depth of 300m, and an endurance of up to 20 hours, depending on the vehicle's sensor suite. Naval operators requiring tethered ROVs have a range of ECA products to choose from, including: the H300 Mk II which can operate at a depth of 300m; the H1000 light work class ROV, also operating at depths of 300m (with an optional extension to 1,000m); and the Roving Bat hybrid ROV/crawler.

Furthermore, specific ROVs designed to assist the MCM mission are provided by ECA in the form of the K-Ster family, which can operate in deep or shallow water. K-Ster includes a tiltable warhead which can be positioned near a mine in such a way as to achieve the best destructive effect.

Meanwhile, the company's Olistar subsea mine hunter is available in two different versions. The FDS (Forward Detection Sonar) can be used for: mine hunting ahead of a fleet; detecting and classifying moored and buried mines; and survey and navigation. The MIDS (Mine Identification and Disposal System) variant can be employed to classify and destroy moored and buried mines, and for general water inspection. Finally, the company's PAP Mk 5 subsea mine identification and destruction system can operate at 300m depth and position a 120kg explosive charge near a mine, or cut the mine's mooring chains to force it to the surface where it can be made safe.

## FUTURE SYSTEM

UUVs play a key part in ensuring that the MCM capabilities of NATO's navies remain sharp. To this end, ECA is involved in the French Navy's SLAMF (Système de lutte anti-mine futur/Future Anti-Mine Warfare System), which will perform a major modernisation ➤

*'Around 80,000 mines may still inhabit the North Sea, Baltic and English Channel alone.'*



The BAE Systems Archerfish has been designed as a one-shot mine neutralisation system. The company is currently under contract to provide this AUV to the US Navy. (Photo: BAE Systems)

of the service's MCM capabilities. Along with fielding a new UUV to perform mine clearance, these craft will be operated from a larger unmanned 'mother ship' which will take the place of the traditional manned mine clearance vessel.

Essentially, this aims to keep the human as far away from the dangers presented by mine-infested waters as possible. The mother ship will be networked to its UUVs via communications and data links, and will locate a minefield using organic sonar before despatching UUVs to take a closer look and destroy individual mine threats.

SLAMF will be deployed from around 2020 as a replacement for the navy's existing

Éridan-class minesweepers. As regards contractors, ECA is joined by French shipbuilder DCNS, which is developing the mother ship, and Thales which is providing the necessary sonar and communications equipment. Along with France, Belgium, Germany, the Netherlands and the UK may yet be invited by the DGA procurement agency to contribute to the SLAMF initiative.

#### ■ PLATFORM PROLIFERATION

Away from France, unmanned MCM platforms are also available from Germany's Atlas Elektronik. The company's SeaCat includes 'SwapHead' technology allowing for the rapid exchange of payload sections on the ROV, which can be operated with or without a fibre-optic tether. Other Atlas Elektronik products include the SeaOtter which, according to Sven-Christian Hesse, head of UUV programmes at the company, 'offers the capability to achieve 8kt, and has an endurance of 24 hours at 4kt'. He added that the firm's SeaFox vehicle 'is designed as a one-shot mine disposal system'. Other Atlas Elektronik armed mine disposal products include the SeaWolf UUV for use against buried and semi-buried naval mines.

Meanwhile, the SeaOtter family includes sub-variants such as the Mk II, which has a modular design enabling it to perform mine detection and clearance, plus seabed mapping and hydrographical survey, along

with ISR collection. An AUV version of the SeaOtter Mk II is also available in the form of the Mk IID.

Atlas Elektronik's mine-hunting products are joined by those of Norway's Kongsberg. The company's MineSniper Mk II vehicle has been acquired by the Spanish Navy to destroy naval mines using a 72mm charge, plus an optional larger warhead which can be deployed against insensitive munitions.

*'These craft will be operated from a larger unmanned mother ship.'*

In addition to the MineSniper Mk II, navies can opt for Kongsberg's HUGIN AUV product line which offers three variants (HUGIN 1000, 3000 and 4500) which have maximum operating depths of 3,000-4,500m, and can support a number of payloads for MCM, ISR, hydrography and anti-submarine warfare. The HUGIN range is supported by Kongsberg's REMUS (Remote Environmental Measuring Unit) AUVs which include the REMUS 100, 600 and 6000 models – the numerical designation reflects their maximum operating depths in metres.

NO EXPORT RESTRICTIONS NOR ITAR

DST CONTROL

Direct drive for highest bandwidth  
Multiple choice of sensors, EO & IR  
Built-in video tracker feature  
Integrated geo-location & geo-tracker  
Light-weight 1-2 kg, dia. 135-205 mm

info@dst.se OTUS GYRO STABILIZED MICRO GIMBALS www.dst.se



**Saab's Double Eagle SAROV can operate either with or without a tether at depths of 500m and speeds of 8kt. (Photo: author)**

Scandinavia is also home to Saab, manufacturer of the AUV-62MR UUV, which can operate at depths of around 500m and travel at speeds of up to 20kt to support the MCM mission. The craft's payload includes a dual flank array and high-resolution gap-filler sonar, although its modular design also enables the AUV-62MR to be used for hydrography work. The Swedish Navy is one operator of the vehicle.

Other Saab MCM products include the Double Eagle SAROV, which can be operated with or without a tether and is in service with the Royal Danish Navy. The Double Eagle SAROV is capable of speeds of 8kt, and can operate at depths of 500m, although an optional extension to 3,000m is available.

#### ONE-SHOT SPECIAL

Finally, BAE Systems is also involved in the AUV sector. The firm has fielded its Archerfish, which is designed as a one-shot mine neutralisation device. Archerfish can be launched from either a boat or a helicopter, and is guided using a fibre-optic link. Like the ECA K-Ster, Archerfish includes a tiltable warhead to ensure the most efficient destruction of a mine.

According to a BAE Systems spokesperson, the company has 'invested private funding in the development of Archerfish', and is 'currently under contract to the US DoD to deliver the low-rate initial production of Archerfish to meet the Common Neutralizer requirement for the Airborne Mine Neutralization System

programme'. This involves procuring a suite of MCM systems to equip the US Navy's 230-odd Sikorsky MH-60S Knighthawk multi-mission helicopters.

In addition to Archerfish, BAE Systems is developing the Talisman UUV product line which includes the Talisman-L and Talisman-M, the latter being optimised for the MCM mission. The Talisman-L accommodates the M's mission system on a craft which can be operated, transported and handled by two people.

As far as forthcoming trends in UUV technology are concerned, Hesse predicted: 'AUVs will increase their level of autonomy to perform in-mission re-planning rather than pure collision avoidance, and navigation accuracy will be further enhanced. Another key element will be the capability of underwater docking to allow AUVs to stay for longer periods in a certain area, and to perform regular inspection surveys.' Moreover, new AUVs are on the horizon. For example, Thales, ECA and French inertial navigation specialists IXSEA are developing the Asemar, which will perform mine clearance work, along with general underwater surveillance. **UV**



**Thales is involved with the development of the Asemar AUV, which is equipped with a side-scan synthetic aperture array sonar, and is designed for MCM work and hydrography. (Photo: author)**



## Piccolo Autopilots

THE choice of UAV developers

World class feature set

Ease of integration

Open development environment

Reliable, proven solution

Over 3,000 units delivered



[www.cloudcaptech.com](http://www.cloudcaptech.com)



Acturus UAV's T-20 flown with Piccolo Autopilot

**Cloud Cap**  
TECHNOLOGY

**GOODRICH**

Contact us: +1 541 387 2120  
email: [sales.cct@goodrich.com](mailto:sales.cct@goodrich.com)

ARGUS-IS provides more than 65 steerable 'windows' across a super-wide field of view. (Image: BAE Systems)

**Peter Donaldson** looks at some of the latest developments in wide-area and lightweight EO/IR technology.

# All-seeing eyes

Advances in IR detector technology are paving the way for a new generation of EO sensors that enable unmanned wide-area, persistent surveillance systems at the high end and pack high-resolution, multi-spectral imaging capabilities into smaller and lighter packages for small vehicles. Dual- or multi-colour sensors have a multiplying effect on the data volume, compounded by the use of multiple cameras in the latest panoramic vision systems. All these trends threaten to overwhelm analysts already neck-deep in data, but the quality of the feed from these new sensors could be the key to the conundrum.

One important driver of progress in this area has been investment by industry and governments in mercury cadmium telluride (HgCdTe) technology. In recent years, sustained R&D efforts have overcome problems that previously made full exploitation of this semiconductor's fundamental capabilities impractical, and had diverted attention to alternative technologies such as indium antimonide (InSb) in advanced thermal imagers. HgCdTe's unique selling point is its sensitivity to radiation in all three atmospheric transmission windows for IR, namely the longwave (8-14µm), midwave (3-5µm) and shortwave (1.5-2.4µm) bands.

Two-colour IR detectors can now be manufactured economically using HgCdTe, and the material's broadband sensitivity

makes cameras that can image in all three wavebands, perhaps simultaneously, an intriguing possibility. What's more, the shortwave IR (SWIR) band has great potential for unmanned vehicle applications that are now beginning to be realised. Today, most SWIR cameras are based on indium gallium arsenide (InGaAs) detectors, but they could face challenges from HgCdTe detectors in multi-spectral applications.

## PERSISTENT PANORAMA

This comes at a time in which multi-sensor, high-resolution and high-definition payloads are beginning to enable applications such as artificially intelligent wide-area persistent surveillance from unmanned platforms. As recent troubles with the USAF's Gorgon Stare project illustrate, this is a complex and difficult area, but one on which the US military is strongly focused.

There are several programmes aimed at developing and fielding such capabilities,

including the US Army's Airborne Wide Area Persistent Surveillance System (AWAPSS), which collects simultaneous IR and visible images of an 8km diameter circle in which it detects and tracks moving vehicles. DARPA's Autonomous Real-time Ground Ubiquitous Surveillance (ARGUS) project has a similar brief and is earmarked for deployment on a variety of UAV platforms.

The ARGUS-IS daylight imaging system, for which BAE Systems developed the processor, demonstrated the ability to provide more than 65 independently steerable video 'windows' across the field of view (FoV). ARGUS-IS can either provide continuous imagery of a fixed area on the ground, says DARPA, or be designated to automatically keep a specified target, such as a person or a vehicle, in the window. The system was successfully tested last October aboard a US Army UH-60 Black Hawk helicopter.

Last September, BAE Systems announced that it had received an additional \$49.9 million contract for the IR night-time version known as ARGUS-IR. The company's Nashua, New Hampshire-based Electronic Solutions sector is responsible for the design, development, manufacture and testing of the airborne processing subsystem (APS) and the subsequent integration of a high-resolution IR sensor over the course of the 32-month, 'A'-phase project.

Following the successful development of the daytime version of ARGUS, the new

*'New payloads are beginning to enable applications such as artificially intelligent wide-area persistent surveillance.'*



# FLIR's Tau 640



Actual size

## The Route to the Future

Introducing the new FLIR Tau 640 - the world's first commercially available 640 x 480 resolution, 17-micron thermal imager. Smaller than many lower resolution cameras, the Tau 640 is the high-resolution thermal imaging camera core of the future that you can have today.

**The best just got better ... again.**



The world leader in thermal imaging

For more information, call 877.773.3547  
or visit [www.flir.com](http://www.flir.com).

APS establishes appreciably expanded capability, and will be designed for use with a number of platforms', commented John Antoniadis, ARGUS programme manager and director of ISR technology for BAE Systems.

The US joint military community wants to use such capabilities as force multipliers, so something less manpower-intensive than hordes of human operators is needed to interpret the video streams. 'A truly transformative capability requires visual intelligence, enabling these platforms to detect operationally significant activity and report on that activity so warfighters can focus on important events in a timely manner', according to DARPA.

#### ■ GOOD DATA

In January this year, DARPA announced a programme aimed at making the best use of imagery collected by systems such as ARGUS. Known as Mind's Eye, the effort seeks to develop a visual intelligence capability for unmanned systems such as UGVs that could deploy persistent stare capabilities on scout missions.

Artificial intelligence (AI) software needs good information on which to base its decisions, just as humans do, and high-resolution images in several wavebands manipulated by fusion engines look set to provide the computer with the quality of data it needs to track vehicles and people over large areas for long periods of time.

Improved information quality from the latest sensors is a key part of the solution to the problem of the sheer quantity of data

spewed out by ISR systems, a point made very clearly by DARPA director Regina Dugan in her testimony to the House Armed Services Committee a year ago. In response to what she described as 'near constant complaints that we are drowning in data', DARPA produced an assessment that calculated data volume as a function of sensor resolution and area coverage, then compared the volumes required for different tasks.

Detecting strategic bombers, for example, needs a resolution of about  $10\text{m}^2$ , and over an area the size of Washington's National Airport, this produces a data volume equivalent to about a second of Milstar satcom traffic, she said. Detecting dismounts, however, requires a resolution of about  $10\text{cm}^2$ , which over an area the size of Baghdad would produce a volume of data equivalent to 121 seconds of total US internet traffic at 2009 levels.

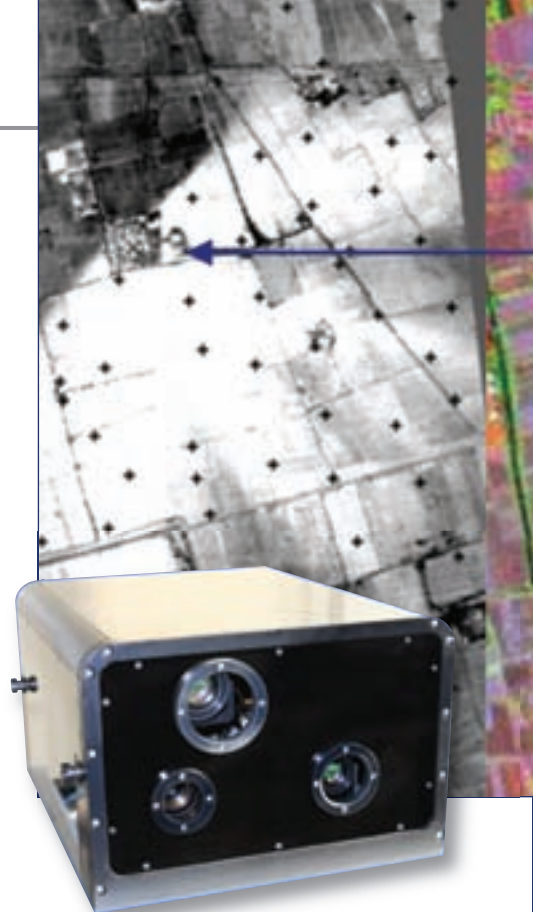
#### ■ UPWARD PRESSURE

The trend towards higher resolutions and wider FoVs can only drive data volumes upwards exponentially. 'We cannot solve this exponential problem with a linear growth in analysts', Dugan said. 'Our need is diverging from our capability. Specifically, if we examine the implications of [US Central Command] requirements alone and a modest deployment of the new high-definition ARGUS-IS described earlier, the number of analysts required increases roughly 15-fold.'

Dugan argued that this problem contains the seeds of its own solution: 'Better sensors are not only creating more data, but better data. More and better data leads to better automation. Better automation enables

better analysis.' She used the tenfold increase in video frame rate over earlier systems provided by ARGUS-IS to illustrate her point.

**The label 'GIVE' refers to a significant action detected by AI software of the kind sought by DARPA's Mind's Eye effort.**  
(Image: DARPA)



'Ten times the frame rate means ten times more data, but it also means that an automated system tracking a dismount or vehicle gets ten times as many looks at the target as it moves. Increasing the frame rate makes the automated tracking both more accurate and less likely to lose the track. More data leads to better automation and, ultimately, to less of a load on an analyst.

'Such tracking algorithms, in concert with more accurate image analysis enabled by high resolution, can be trained to identify and flag "video verbs" such as "digging", "downloading" and "walking", allowing more and more analysis of existing and new ISR data volumes to be turned over to untiring 24/7 automated analysis systems, not humans.'

#### ■ THE RISE OF HgCdTe

If the latest sensors can help to solve the data deluge problem that they create, then HgCdTe detector technology is at the heart of the matter. This is because of the multi-band (including SWIR) sensitivity that is fundamental to the material, and recent improvements to fabrication processes that have reduced costs and increased performance.

The UK arm of Selex Galileo, with its Albion detectors grown using the





A multi-sensor hyperspectral camera, SIM.GA can reveal information that remains hidden from conventional optics lacking spectrometer capabilities.

(Images: Selex Galileo)

metalorganic vapour phase epitaxy (MOVPE) process, is a major force in the resurgence of HgCdTe technology. The process enables fine layers of the alloy to be deposited from vapour onto a gallium arsenide substrate. It is sensitive and flexible enough to allow a layer of material sensitive to one IR waveband to be placed on top of another layer sensitive to a different waveband.

Selex Galileo has produced two-colour detectors (SWIR/MWIR, dual MWIR and MWIR/LWIR) using this technique, and integrated them into cameras. There is nothing fundamental that would prevent the fabrication of a three-colour (SWIR/MWIR/LWIR) detector, sources say.

The MOVPE process enables the creation of very small, fine-pitch detector elements, meaning that more of them can be squeezed

onto a chip of a given size, or arrays with a given number of pixels such as 1024x768 can be made physically smaller. There are limits to this progression, however, as the practical pixel pitch is limited by the wavelength of IR light it is intended to detect. Selex Galileo, for example, has demonstrated a midwave camera with 16µm pitch detectors and longwave cameras running detectors with 24µm pitch for that reason. Also, making detectors physically smaller can mean that the associated camera optics have to get bigger for a given FoV, so there is a balance to be struck.

Other leading EO houses, including Raytheon, Teledyne, FLIR Systems, Sofradir, AIM and SCD are investing in HgCdTe technology. FLIR Systems, which pioneered the rival quantum well IR

**Situational awareness. Anytime, any weather.**

Airborne EO/IR payloads deliver huge value to surveillance operations, but sometimes you need a sensor that delivers more than meets the eye. Which is why our PicoSAR X-band Active Electronically Scanned Array (AESAs) synthetic aperture radar (SAR), is the perfect accompaniment to imaging sensors across a range of manned, unmanned, fixed wing and rotary wing platforms. Characterised by compact size, low weight and low power consumption, PicoSAR provides a true, all-weather ground mapping and ground surveillance capability that transforms battlefield ISTAR.

Scanning new horizons. Tomorrow's technology is here today.

[www.selexgalileo.com](http://www.selexgalileo.com)

 **FINMECCANICA** Right there with you.

 **SELEX GALILEO**  
A Finmeccanica Company

photodetector (QWIP) technology, has joined forces with France's Sofradir to develop two-colour detectors.

DRS Technologies emphasises the resolution benefits of small pixels in the 12µm pitch of its new high-performance HgCdTe detector technology. The company's High Operating Temperature IR (HOT-IR) technology 'delivers superior performance at temperatures well above 110K', says the company, which also claims big savings in the size, weight and power requirements of cryogenic cooling systems. Compared with other technologies that must be cooled down to 77K, says DRS, HOT-IR needs about a third of the power required by comparable InSb devices.

### THE THIRD WAVE

The increasing importance of SWIR, in unmanned vehicle payloads particularly, is likely to produce a battle between improving HgCdTe detectors and the InGaAs sensors that currently dominate this waveband. However, InGaAs detectors have a major advantage in that they do not require cooling to achieve high performance. Therefore, the competition from HgCdTe in SWIR may be stronger



The GS410 stabilised multi-sensor gimbal provides FLIR, TV, laser pointer and rangefinder, all integrated with automated video tracking. (Photo: DRS)

in big multi-sensor and multi-colour systems than in small single-waveband cameras.

SWIR is particularly attractive for small UAVs and UGVs because it provides high-resolution day and night imaging in small, lightweight cameras and is particularly sensitive to the laser targeting wavelengths that are now almost ubiquitous on the battlefield. Both Goodrich ISR Systems and FLIR Systems, for example, offer lightweight SWIR cameras for small UAVs. IAI Elta uses SWIR cameras in its EL/O-5230 family of gunshot detectors, while Elbit's Elop division integrates SWIR elements in its hyperspectral imaging systems.

SWIR is different from other IR wavebands because it is not thermal. MWIR and LWIR radiate from objects including landscapes, vegetation, buildings, vehicles and people, enabling thermal imagers to create



The SLXhawk sensor incorporates MOVPE technology. (Image: Selex Galileo)

detailed pictures from tiny differences in temperature. However, the main source of SWIR in the environment is the sky thanks to the airglow phenomenon, which is caused by photon-emitting chemical reactions high in the atmosphere.

Although these reactions are driven by solar radiation, the resulting SWIR-band light diffuses through the atmosphere and is available day and night, reflecting off the scene. Because human vision evolved to work with reflected light, SWIR images look very natural and, because airglow is not thermal, SWIR is not subject to contrast-killing thermal crossover.

Because of its short wavelengths, SWIR is capable of generating very high-resolution imagery and so, like other advanced sensors, is both part of the data deluge problem and a contributor to its solution. **uv**



World leader in Miniature UAV Autopilots



The choice of over 650 clients in 60 countries

[www.micropilot.com](http://www.micropilot.com)

## MP2128<sup>3X</sup> The New Standard in Reliability



- World's Most Advanced UAV Autopilot
- Three Complete Autopilots
- Advanced Voting Logic
- Carrier Phase GPS
- Helicopter and Fixed Wing
- Available Now!

pt: 1 204 344.5558

Introductory price: \$18,000 USD

e: [info@micropilot.com](mailto:info@micropilot.com)



**IT'S TRUE, SIZE AND EXPERIENCE DO MATTER.**



MX-20HD

MX-15HDi

MX-15Di

MX-10



There's a reason why WESCAM's imaging and targeting systems are flying on the finest UAV's in service today. Building on 40 design experience, MX-Series turrets continue to evolve in the areas of Magnification, Resolution and Stabilization. As a result, each MX-Series turret continues to outperform its major competitor in every performance area. The reduction of system LRU's has simplified cabling and have created lighter integration weights – two factors that directly relate to the ease of integration that End users and Primes alike are excited about. With varying sizes, weights, and clearance levels, WESCAM has a flight proven solution for all classes of UAVs - from a Predator to a Schiebel and every type in between.

To learn more, visit [www.wescam.com](http://www.wescam.com)

# Breaking with tradition

To date, UAVs have been used in Central and Latin America as discreet surveillance platforms, mainly in support of counter-drug and similar activities. Against that background, **José Higuera** looks at how Colombia is leading the way in the acquisition of weaponised systems in the region.



Already in use with the Colombian Air Force, the Brazilian and Chilean navies are also considering procurement of the Insitu ScanEagle. (Photo: US DoD)

**M**exican UAV operations received some bad publicity in December 2010, when an Aeronautics Orbiter airframe malfunctioned and crashed in El Paso, Texas. Subsequently, the aircraft was salvaged by US Customs and Border Protection officers alerted by a local resident. No one was hurt and no property damaged, as the Orbiter's emergency parachute was successfully deployed after the machine stalled.

Following this incident, local sources told *Unmanned Vehicles* that plans were afoot to increase both the numbers of systems already on inventory, as well as to procure other, more capable aircraft. In the meantime, however, the US has started to support operations in Mexican territory by deploying unarmed Global Hawk UAVs on high-altitude surveillance patrols, under an agreement reached between both governments.

The Mexican authorities also continue to make extensive use of UAVs for surveillance in support of law enforcement agencies in the fight against drug trafficking and arms smuggling across its common border with the US. The Federal Police flies a number of Orbiter systems in combination with Aeronautics Skystar 300 aerostats, while the Mexican Air Force operates Elbit Hermes 450 and Skylark I airframes.

## ■ INVITATION ONLY

After a request by the government of Belize, US Special Operations Command deployed a Boeing A160T Hummingbird rotary-wing UAV to that country to test the Defense Advanced Research Projects Agency's Forester foliage-penetration radar on counter-drugs operations. Based at Cayo, the A160T is undertaking test patrols over the rainforest in a mountainous area of western Belize near the border with Guatemala. According to local sources, many of the trial sorties have been arranged to provide support to the regular operations of the local police, taking advantage of Forester's capabilities to detect movements under the trees.



A joint development between Brazil's three services, VANT is still under evaluation. (Photo: Brazilian MoD)

Even though the Belize government is unable to afford the equipment on test, there is a growing interest in the possibility of acquiring a cheaper UAV for border surveillance. The same has happened in Honduras, where the US is operating an RQ-4 Global Hawk in support of counter-drug operations by the local military and law enforcement agencies. The machine is based at US facilities in Palmerola.

In February, the government of Panama decided to order four UAVs from an undisclosed US manufacturer, at a cost of \$16 million, to combat drug trafficking and other illegal activities. The decision to proceed with procurement of this type of machine was made after a successful pilot programme in the second half of 2010, when a UAV was operated for three months from the National Naval Air Service base at Tocumen airport under US government sponsorship.

More recently, while paying an official visit to El Salvador, US President Barack Obama promised to extend the Mérida Initiative, aimed at providing financial and equipment

support to Mexico and Central America in the fight against drug trafficking, pledging to give \$200 million to Central American countries. Some of that funding could go to finance the acquisition of UAVs, sources suggested.

#### **CROSSING BORDERS**

In Brazil, the three IAI Heron UAVs ordered late in 2009 are operational with the Federal Police, being used for surveillance in the border areas with Paraguay and Bolivia, a common transit point for drug traffickers. Follow-on orders are envisaged until a fleet of 12-14 machines is in service by 2014. Brazil's plans for the Heron include fitting it with a synthetic aperture radar capable of penetrating foliage.

Under an inter-governmental agreement reached in February, the Brazilian Herons will start also operating over the Bolivian side of the border, providing surveillance and imagery in support of bi-national counter-drugs operations. A demonstration took place in Bolivian territory during the visit of a Brazilian delegation led by Justice Minister

José Eduardo Cardozo in March, and joint operations are set to start in August this year.

Plans for the procurement of an initial batch of Skylark 1 mini-UAVs for urban police use announced early in 2010 in preparation for security measures related to the FIFA World Cup and Olympic Games, which Brazil will host in 2014 and 2016 respectively, have not materialised yet. However, local sources said those efforts had only been delayed and would progress further during 2011. In addition, sources told *UV* that Ecuador's army was awaiting delivery of six Skylark 1s in May.

In 2005, the three Brazilian military services started the joint development of a tactical UAV (TUAV) for experimental purposes. Designated only as 'VANT' (a Portuguese term for UAV), the platform reached operational status in 2008 and was extensively tested during that year and 2009. Performance with an autonomous flight control system and field trials using a tactical suite of cameras were assessed as adequate. However, the future of the aircraft beyond the evaluation phase is now uncertain, as each ►



The Brazilian Air Force has finally acquired Elbit's Hermes 450, with follow-on orders a distinct possibility. (Photo: Elbit)

service has different operational requirements and is studying options in the international market. Some sources told *UV* that the army had not decided to put the VANT in production with the Technological Centre of the Armed Forces (CTEx).

After leasing two Elbit Hermes 450s during 2010, for joint operations and assessment with the navy, the Brazilian Air Force cemented its first order in January last year. According to local sources, the contract covers the acquisition of the previously leased vehicles and associated GCS plus an additional pair of aircraft and a second GCS, with plans for follow-on orders under consideration. The UAVs are being acquired through Elbit's local subsidiary AEL Sistemas, which will carry out assembly and provide post-sale support.

Without losing sight of the Hermes 450, Brazilian Navy interest is leaning towards Insitu's ScanEagle for shore-based and ship-borne operation. If acquired, ScanEagle would be assembled by Santos Lab, incorporating a number of locally manufactured components. Santos Lab also developed and produced the light, man-portable Carcará UAV for the navy's marine infantry, which is using it operationally on peacekeeping duties in Haiti.

#### ARMED FUTURE

Elsewhere, the Colombian military started gaining experience with UAVs in 2006, when the US based a number of systems in the country to provide surveillance in support of operations against drug traffickers. Between eight and ten ScanEagles were ordered in 2008 for the air force, for continuing surveillance in support of counter-drug work as well as in the fight against FARC guerrillas. Plans to add a more capable UAV were also initiated discreetly in 2008, involving consultations with a number of manufacturers and gathering information on all options available on the market.

A call for bids followed in April 2009, with both the Heron and Hermes 450 shortlisted during the last quarter of that year, leading to a series of test flights with both platforms. Preferences in the air force were divided, with those favouring a UAV also capable of flying higher and carrying weapons leaning towards the Heron. An award of a \$28 million contract to Elbit for a number of Hermes 450 was due to be signed and announced in March 2010. However, local newspapers ran stories citing unnamed sources who claimed that key decision-makers had been bribed. The government immediately suspended the programme, putting the contract on hold

before launching an investigation. The procurement is still suspended but, as the requirement for more capable UAVs is pressing, it is expected to be restarted later this year.

In Argentina, Córdoba-based Nostromo Defensa was awarded a contract early in March for a first batch of three Yará light UAVs, in order to equip a UAV school being established by the air force for training of operators across the armed forces and law enforcement agencies. Deliveries are scheduled to take place in April and May. As well as being a national product, the Yará was selected because of its characteristics and performance. Robustly built and sturdy, it is able to withstand very hard landings, which makes it ideal for initial training of operators without previous experience. The US DoD also operates a number of Yará for similar training purposes.

The three Argentine military services continue with their own UAV development programmes, including the air force's PAE, the navy's Guardian and the army's Lipán. The latter reached active status with the Lipán III version – in service with Combat Intelligence Battalion 601 based in Campo de Mayo near Buenos Aires – and the more advanced and capable Lipán IV is set to become operational soon. According local sources, the recently created Ministry of Security has plans to procure a proven UAV for surveillance on counter-drug operations by the Gendarmería Nacional, the police service tasked with patrolling Argentina's borders.

#### CHILEAN EXPERIMENTS

Elsewhere, the Chilean Army is conducting a field test programme in the north of the country using two Skylark I mini-UAVs which it received in August 2010. Options are also being studied for the procurement of TUAV and MALE machines, and the acquisition of a single type of TUAV for both army and air force use is expected to be decided upon soon. In 2010, the Chilean Navy concluded a long test and experience-building programme with the experimental

Mantarraya UAV designed and built by local company RMS. The manufacturer is now using the design to develop a target drone for naval use.

Naval interest is now centred on the Insitu ScanEagle, which since late 2010 has been tested by the service for shore-based and ship-borne use, with a decision on procurement expected to be taken during 2011. RMS is now working on final development of the light, man-portable Gaviota TUAV, to meet a requirement of the Chilean Navy's marine Infantry.

Idetec UAV, another local firm based in Santiago, which has had success in the civilian and private security market with its Sirol and Stardust I/II UAVs, is now working on the design and construction of a prototype



**Argentina's Lipán III has achieved 'active status', with Lipán IV set to become operational soon. (Photo: via author)**

intended for operation at sea. The machine, which will have a payload of 10kg with sealed, waterproof compartments for sensitive

components and equipment and a high degree of buoyancy, is intended both for support of fishery operations and naval use.

Finally, the Peruvian Army acquired a light, man-portable Micro-Falcon UAV system towards the end of 2010 from Israel's Innocon, with a package including a Controp optronics suite comprising both daylight and night cameras, a GCS and a Naviaton flight computer. Weighing 6kg and with an endurance of two hours, the machine will be used for 'over the hill' observation in support of military and police operations against Shining Path guerrilla groups. Follow-on orders may be made during 2011, after assessing field performance of the single machine acquired. **uv**



world leading laser measurement technology



Modules range up to 4,650 feet with 2" accuracy with up to 1000 readings per second




Laser Altimeter

**Precise Height Control means:**

- Safer Landings
- Less Damage to Equipment
- Reduced Maintenance Costs
- Reduced Pilot Stress
- Precision Approaches

## LANDING SAFE WITH MDL'S LASER ALTIMETER

Call MDL TODAY on +44 (0)1904 791 139 or email [sales@mdl.co.uk](mailto:sales@mdl.co.uk) • Web: [www.mdl.co.uk](http://www.mdl.co.uk)

# Access for all

**Tom Withington** talks to **Bo Redeborn** of Eurocontrol about the future of unmanned flight in European airspace.

**U**AVs will be treated in the same manner as manned aircraft in Europe's airspace by the end of this decade, according to Bo Redeborn, Eurocontrol's principle director of air traffic management (ATM).

Headquartered in Brussels, Europe's air navigation safety body Eurocontrol is developing a regulatory framework for the operation of UAVs in non-segregated airspace. Moreover, the organisation is working with international partners to fulfil this aim by providing technical assistance and advisory support.

'We've been involved with UAVs since 2004,' explained Redeborn. During this time, the organisation has chaired Working Group 73, an initiative of the European Organisation for Civil Aviation Equipment (EUROCAE), focusing on UAV flight alongside conventional aircraft. 'We have provided Working Group 73 with several studies and simulations,' he stated, adding that Eurocontrol also 'chaired the International Civil Aviation Organisation [ICAO] study group until 2010, and continues to support ICAO UAV airspace integration efforts.'

## CROSS-COLLABORATION

These have consisted of 'preliminary safety case work, human factors studies and spectrum assessment', including various studies 'on the possible use of traffic collision avoidance systems [TCAS]; to facilitate UAV operations in non-segregated airspace.

Eurocontrol has three dedicated staff members who are working on this problem. Alongside working with ICAO, these individuals provide technical support to the European Defence Agency and NATO. Beyond the continent, Redeborn said that his

organisation had a 'memorandum of understanding with the Federal Aviation Administration [FAA] in the US, where we address the interoperability of UAVs between America and Europe. Essentially, we are providing technical assistance within Europe and without.'

As far as UAVs are concerned, Redeborn said: 'It is reasonable to have global rules, standards and recommended practices in terms of how UAVs can be integrated into non-segregated airspace.' Underpinning Eurocontrol's approach of devising procedures and frameworks, which member nations can then implement to ensure that UAVs fly safely in their national airspace, is the belief that 'all of the airspace should be made available to all users, manned and unmanned, at all times.' The fact that Eurocontrol is reaching out to other stakeholders such as the FAA is an indication of its belief that global regulations and standards for UAV flight in national airspace should be closely harmonised.

Redeborn cited the example of the Northrop Grumman RQ-4 Global Hawk, which already transits through several nations from the US to its operational orbits above the Middle East and southwest Asia. He also expected an increased use of airspace by UAVs over the next decade, particularly as aircraft are removed from theatres of operation such as Afghanistan, or moved to new operational areas if, and when, future crises develop.

One major issue here that Eurocontrol is heavily involved with is spectrum management. Redeborn described how Eurocontrol does not 'do any technical development in terms of designing and building hardware, but there is some



technical work in terms of spectrum, frequency allocation and frequency planning in which we're involved.'

This is a major issue for the organisation, as UAV C2 systems require their own part of the electromagnetic spectrum, which can accommodate the radio and data links between the GCS and the aircraft itself. Redeborn noted that, presently 'no portion of the spectrum is allocated for UAVs, but this is on the agenda for the 2012 World Radio Conference.'

## SLOW MOVER

Along with providing technical assistance to individual nations and other stakeholders, Redeborn added that his organisation maintained links with companies developing sense and avoid equipment. To this end, he described how Eurocontrol was 'working with industry to provide assistance and avoid duplication of effort' as this technology develops.

Ultimately, Redeborn believes that routine, normal operation of UAVs in non-segregated airspace is close, and will be achieved by the end of the decade. However, he maintained his belief that, in aviation, 'things do not move very fast in terms of changing the way that we operate. Perhaps the UAV world should have started earlier in addressing ATM and spectrum issues, but we are making progress and I am optimistic.' **uv**

# When their terrain changes **VERSATILITY** is key.

WASP  
UAS: **RAVEN**  
PUMA<sup>AE</sup>

Around an embankment, beyond the horizon, or over the sea, continue to gather critical data undetected without putting your troops or civilians in harm's way. Each AeroVironment UAS is uniquely designed to maximize results without compromising the mission. Be prepared for any situation with our family of UAS ready for your deployment today.



**WASP**

RANGE - 5 km  
ENDURANCE - 45 minutes  
WEIGHT - 0.95 lbs (430 g)



**RAVEN**

RANGE - 10 km  
ENDURANCE - 60-90 minutes  
WEIGHT - 4.2 lbs (1.9 kg)



**PUMA<sup>AE</sup>**

RANGE - 15 km  
ENDURANCE - 2 hours  
WEIGHT - 13 lbs (5.9 kg)

# Setting the Standard in *Medium Range, Long Endurance UAS Missions*



## **IAI-MALAT's HERON Family of multi-payload UAS - your most reliable multi-mission team mate in the sky**



Maritime HERON



Ground Control  
Station

Backed by over 800,000 operational UAS flight hours, the HERON Family of UAS features:

- Mission Payload - 250 kg
- Operation Ceiling >30,000 ft
- Endurance >40 hours
- LOS and SATCOM Communication



SEE US AT  
**LAAD 2011**

- Israel Pavilion,  
Hall 4, Stand H-30
- Israel HLS Pavilion,  
Hall 3, Stand Q-66



**LET'S  
PARTNER  
FOR SUCCESS**