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WELCOME

The proliferation and commercial promise shown by Remotely Piloted Aircraft Systems (RPAS) has made their successful integration with manned aircraft a high profile issue for ANSPs, regulators and manufacturers around the world.

In this issue of NET*ALERT*, Mike Lissone, EUROCONTROL's RPAS ATM Integration Programme Manager, explains the main challenges facing ATM and some of the work that is taking place to address those challenges.

Looking specifically at safety nets, EUROCONTROL's Stanislaw Drozdowski considers the questions that need to be answered for RPAS. We also look at the subject of RPAS and 'collision avoidance' in its broadest sense – how does an RPAS pilot undertake 'see and avoid' when the RPA is beyond visual range, and what solutions are there to stop the smallest RPAS causing disruption and damage to aviation and wider society?

RPAS - expert interview

Mike Lissone

Mike Lissone is the RPAS ATM Integration Programme Manager for EUROCONTROL and has worked on the subject for over 15 years. Mike provides policy support to the European Commission regarding technical RPAS integration issues, and was seconded to the SESAR JU for the development of the RPAS definition phase. He is the Secretary General for the Joint Authorities for Rulemaking on Unmanned Systems (JARUS) and is actively involved in the ICAO RPAS Panel and other international initiatives.

With a rapidly growing RPAS market, what are the challenges facing ATM, what are we doing about them and who is doing what? Mike Lissone explains.

Q What is your view of the current status of the RPAS market and how do you think it is set to evolve in the future?

The RPAS market in Europe is developing very fast. There are approximately 3,000 commercial companies involved, and the market for smaller RPAS (around 25kg and less) in particular is growing very fast.

Aside from the military and police, RPAS are already being used for aircraft inspections, meteorological observations and bird control at airports, photography, surveying, infrastructure inspection and agriculture.

The rapid growth in RPAS is expected to continue. For me there are parallels to the mobile phone and tablet markets, with the potential for RPAS to be applied to numerous commercial and everyday tasks. For example, why climb up a ladder to check for a leak on a roof when you could use an RPAS with a camera?

Q Does the rapid growth of the RPAS market present challenges to the ATM industry?

Yes, the rapid growth of RPAS is already presenting challenges to the industry.

RPAS and manned aircraft operations need to be safely integrated. To do so a number of principles need to be met, such as RPAS being as safe as, or safer than, current manned operations, no significant changes to the ATM system to accommodate them, and not significantly impacting current airspace users. RPAS behaviour in operations will also have to be transparent to manned aviation, in particular Air Traffic Control (ATC), as ATC will not be able to handle many different types of RPAS contingency procedures effectively.

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National regulations need to be harmonised. RPAS below an operating mass of 150kg are regulated by National Aviation Authorities (NAAs) and those above are regulated by EASA. Less than half of European states currently have RPAS regulations, and those in place are not harmonised, meaning that an RPAS permitted to operate or undertake a particular activity in one State cannot automatically do so in another.

There is also a learning curve for the ATM and RPAS sectors to work together. For example, the innovative nature of the RPAS industry means we are already seeing a keenness to put RPAS applications into use more quickly, and not necessarily taking the same steps that we would traditionally take in the ATM industry.

Q In today's airspace, can RPAS and manned aircraft operate together?

Our mantra has been integration not accommodation. Today, we are able to accommodate any RPAS by increasing the horizontal and vertical separation criteria. Doing this for a single RPAS has minimal impact on the Network. However, when there are many more RPAS wanting to be accommodated, applying enlarged separation criteria will have a negative impact on the Network as other aircraft will be denied access.

Q What are some of the key challenges in integrating RPAS and manned aircraft?

Most RPAS operations are presently taking place below 500 feet. This means safely integrating RPAS with other airspace users like military aircraft, helicopters, general aviation, other recreational users and aircraft operating around airports. Two of the key challenges are enabling the RPAS pilot to detect hazards, including other aircraft, and making RPAS detectable to other airspace users.

Today, the foundation for operations in uncontrolled airspace is based upon 'see and avoid'. Therefore, to safely integrate RPAS in this environment, the pilot of an RPAS operating beyond visual line of sight will need a capability analogous to the human's means of detecting hazards like other aircraft, obstacles, terrain and severe weather conditions by sight. At the same time, the 2012 EASA scoping Improvements to 'See and Avoid' for General Aviation (SISA) study identified that 'see and avoid' has its limitations. The technology required for RPAS to undertake 'see and avoid' has been called 'detect and avoid' (this is the subject of our third article).

A second big issue under investigation is how to make RPAS detectable to other airspace users. In particular, the smaller ones operating below 500 feet are not detectable by other aircraft and should always give way to manned aircraft. Several technical solutions are being investigated, one of which is equipping RPAS with a Mode S or ADS-B transponder. This would certainly make them more detectable by other airspace users capable of detecting these transponders, but does the European CNS infrastructure have the capacity for this? Already several States have a limited tracking capability and increasing the number of transponders to track RPAS could push this to the limit and subsequently negatively impact the network.

Q What work is currently taking place to manage the ATM aspects of RPAS?

Various institutions and bodies are involved in the planning for RPAS integration, working on topics such as harmonising regulations, developing standards, undertaking research and maintaining the European integration roadmap. See text box.

Q What can ANSPs do today to enhance safety and minimise risk in relation to RPAS?

From the workshops held with States, I'd say that the majority of European ANSPs need to catch up on RPAS.

Work by institutions and industry bodies to manage the ATM aspects of RPAS

- **ICAO:** a Manual on Remotely Piloted Aircraft Systems (Doc 10019) was recently published and SARPs are under development. The first SARPs release is envisaged for 2018 but is not expected to include collision avoidance. ICAO has also released a web-based RPAS iKit providing access to material produced by ICAO, international and national organisations (http://cfapp.icao.int/tools/ikit/rpasikit/story.html).
- **European Commission:** a roadmap for the integration of civil RPAS into the European Aviation System has been published. The recent European Commission Declaration on drones can be accessed at www.ec.europa.eu/transport/modes/air/news/2015-03-06-drones_en.htm.
- **JARUS:** the Joint Authorities for Rulemaking on Unmanned Systems is a worldwide group of experts from the National Aviation Authorities and regional aviation safety organizations. Its purpose is to recommend a single set of technical, safety and operational requirements for the certification and safe integration of UAS into airspace and at aerodromes, and provide guidance material aiming to facilitate each authority to write their own requirements.
- **EASA:** is responsible for regulating RPAS when used for civil applications and with an operating mass of 150kg or more, and also chairs JARUS. EASA recently published a 'Concept of Operations for Drones' that proposes regulating RPAS in three categories – 'open', 'specific' and 'certified'. These categories take into account factors such as purpose/complexity of use, operating height, if the RPAS is being operated Beyond Visual Line of Sight (BVLOS) etc.
- **EUROCONTROL:** has responsibility for the ATM part of RPAS integration across Europe. As part of this EUROCONTROL is supporting its Member States on how to integrate RPAS operations.
- **SESAR:** is addressing the R&D requirements related to RPAS integration into the European civil aviation system. This currently includes 9 demonstration projects.
- **EUROCAE:** working groups 73 (large RPAS) and 93 (light RPAS operations) are working on industry standards.
- **National regulators:** A number of national regulators have developed RPAS regulations. For example, the UK CAA has published CAP 722 Unmanned Aircraft System Operations in UK Airspace – Guidance.

ANSPs need to have a close look at how RPAS operations below 500 feet impact their FIR. General aviation and other airspace users below 500 feet need to have sufficient information to plan a safe flight. However, it is of course impossible to provide ATC at that altitude and airspace classification will also have an impact. Several States are already working with a web based application that RPAS operators can use to file for flight approval. Once approval is acquired, the RPAS operator is provided with the necessary data (e.g. weather, NOTAMs etc), and the manned aircraft community is given information about the intended RPAS operation.

There are new opportunities for ANPSs to contribute to the development of RPAS-specific products such as more detailed weather forecasting and RPAS NOTAMs. NASA is developing a SWIM type traffic management system using the 4G network, where all RPAS communicate with each other. Russia has already developed an airborne network based on ADS-B, where all RPAS are used as information nodes and communicate with each other and other manned aircraft. It also provides 'detect and avoid' as all aircraft are equipped.

UAS/UAV/RPAS

UAS is the ICAO term for the family of Unmanned Aircraft Systems and it encompasses **Remotely Piloted Aircraft Systems (RPAS)**. RPAS consists of a set of configurable elements including a remotely-piloted aircraft (RPA), its associated remote pilot station(s), the required command and control links and any other system elements as may be required, at any point during flight operation;

Autonomous UAS is a possible future category. These are automatically programmed to fly a predefined flight path but without a pilot in charge, even remotely. Note that the term Unmanned Aerial Vehicle (UAV) has been replaced by UAS and is now therefore obsolete according to ICAO (Cir 328).

ESA User/Stakeholder Workshop on RPAS
21st May 2015 at the ESA ESTEC Centre, in Noordwijk (The Netherlands)

Key objectives of the workshop: To present the preliminary findings of the 2nd element of the joint ESA-EDA RPAS demonstration initiative (DeSIRE2) and to inform attendees on other EDA and ESA RPAS related activities.

Who should attend: Participation is particularly encouraged from ESA and EDA (participating) Member States, users, service providers, technology providers and policy makers who are willing to get informed and involved in the RPAS domain.

Registration and logistics: The event will be free of charge. Registration is now open.

RPAS and safety nets
– a race against time?

Introduction

If RPAS are to be integrated with manned aircraft operations, what will happen when there is loss of separation involving an RPAS? Are existing ATM safety nets compatible with RPAS? Will RPAS carry collision avoidance systems and will this be ACAS? EUROCONTROL safety nets expert Stanislaw Drozdowski provides an overview of the current situation and the questions that need answering – quickly!

RPAS and ground-based safety nets

To be fully supported by ground-based safety nets such as Short Term Conflict Alert (STCA), RPAS will have to be detectable by surveillance equipment and carry a transponder. The SESAR RPAS Demonstration projects considered the carriage of transponders on RPAS to be essential and indeed, the fitting of transponders is assumed within the European Commission's RPAS integration roadmap for all classifications of airspace. At the same time, RPAS tend to be smaller than typical manned aircraft and they are often made of composite material rather than metal. This may restrict the carriage of transponders and impede the ability of primary radars to detect them. So the fitting of transponders may not be straightforward.

The influence of RPAS performance on existing ground-based safety nets algorithms is also an interesting question. RPAS performance characteristics vary greatly and are generally significantly different from commercial airliners. Ground-based safety nets warning times and associated trajectory prediction algorithms may have to be adapted to take into account such flight characteristics. This is something EUROCONTROL and SESAR have begun analysing using fast-time simulation methodology.

Will a controller be able to communicate with an RPAS pilot in the same way as a manned aircraft pilot? Operating remotely either using ground based radio transmitters or satellite communication has the potential

RPAS and safety nets – a race against time?

continued

to increase the communication latency over manned flights. While the pilot of a manned aircraft will execute ATC instructions as soon as received, some delays might be introduced by the communication link forcing the RPA pilot to respond less promptly. Potential latency issues aside, it is expected that there will be little difference in the ability of pilots to follow ATC instructions whether they are on-board the aircraft or operating remotely. This is supported by the initial findings from the SESAR RPAS Demonstration projects, where integration trials found little impact in the cruise phase of flight, but found potential implications during approach phases of flight where latency issues had more of an impact. The ASTREA programme in the UK found that when using satellite communications, latency issues meant RPAS operations were only feasible in low ATC workload situations.

Airborne safety nets

Will RPAS need to carry a collision avoidance system? Everything from the ICAO RPAS Manual to material produced by States certainly points to the need for RPAS flying in non-segregated airspace to carry a collision avoidance system. This is backed up by recent experience. Lack of ACAS capability was seen as a significant obstacle to the certification of the Euro Hawk, which was eventually cancelled.

Will the collision avoidance system carried by RPAS be ACAS? The European Commission Implementing Rule mandating the carriage of ACAS II version 7.1 on turbine-powered aircraft with a maximum certificated take-off mass exceeding 5,700 kg does not apply to unmanned aircraft. Similarly, examination of the ICAO ACAS Manual suggests there is no basis for interpreting the ICAO requirement to fit ACAS to manned aircraft above this weight as a requirement to do so for RPAS.

Could an RPAS carry ACAS? Payload restrictions or technical limitations aside, ACAS was not designed for installation on RPAS. Nevertheless, safety analysis of ACAS on Global Hawk using airspace encounter models found that, although Global Hawks flight characteristics and communication latency reduced the effectiveness of TCAS, it still provided a significant safety improvement over a Mode S transponder alone.

If not ACAS, what type of collision avoidance system will be carried? There are no specific RPAS collision avoidance systems available on the market at present. A variant of ACAS X, ACAS X_u is envisaged for unmanned aircraft systems and some proof-of-concept trials have already taken place. Collision avoidance could also be an element of 'detect and avoid' systems (see next article). Whichever route is chosen, these systems will need to be interoperable with current ACAS/TCAS, particularly as the performance and flight characteristics of RPAS may mean they do not conform to existing profiles communicated as part of an ACAS Resolution Advisory. When the Mid Air Collision Avoidance System (MIDCAS) program analysed how their 'detect and avoid' solution interacted with TCAS during simulations and flight trials they found that the trials enabled a more compatible design to be implemented.

There are still more questions: Should the collision avoidance system carried by an RPAS operate autonomously? If not, the communications relay to the remote pilot needs to be robust and enable the remote pilot to react in sufficient time. But what if the communication link is lost between the aircraft and remote pilot? Should the RPA be regarded as being faulty, or should it be allowed to autonomously undertake collision avoidance? Will any proposed RPAS collision avoidance solution be financially viable?

We are looking to regulatory authorities to provide some of the answers, but the rate of growth of RPAS means time is of the essence.

Although regulatory frameworks for RPAS have been established in some countries, the overarching regulations and standards are still being developed by national and international bodies such as ICAO, JARUS (on behalf of EASA) and EUROCAE. It is currently expected that the ICAO RPAS SARPs planned for release in 2018 will not include collision avoidance.

Conclusion

Collision avoidance systems for RPAS, and compatibility with existing ATM safety nets, are clear requirements and potential barriers to the integration of civil and military RPAS into non-segregated airspace. The challenges are wide-ranging, including interoperability with existing airborne and ground based safety nets, the physical ability of RPAS to carry and power collision avoidance systems, the wide ranging performance characteristics of different RPAS and if/how RPAS should undertake autonomous collision avoidance if communication is lost with the remote pilot. In addition to collision avoidance, we are also seeing a need for systems to provide the remote pilot with a 'detect and avoid' capability for operations beyond the line of sight.

With so many potential uses for RPAS, we are faced with a race against time to have suitable collision avoidance systems in place when these applications reach maturity.

EUROCONTROL collision avoidance platform

Early trials assessing the impact of RPAS on collision avoidance systems used fast-time simulations in order analyse a number of potential scenarios. However, EUROCONTROL recognised that there were some limitations with the simulations and so analysis from the end of 2015 will be performed on the new EUROCONTROL Collision Avoidance Fast-Time Evaluation (CAFÉ) platform.

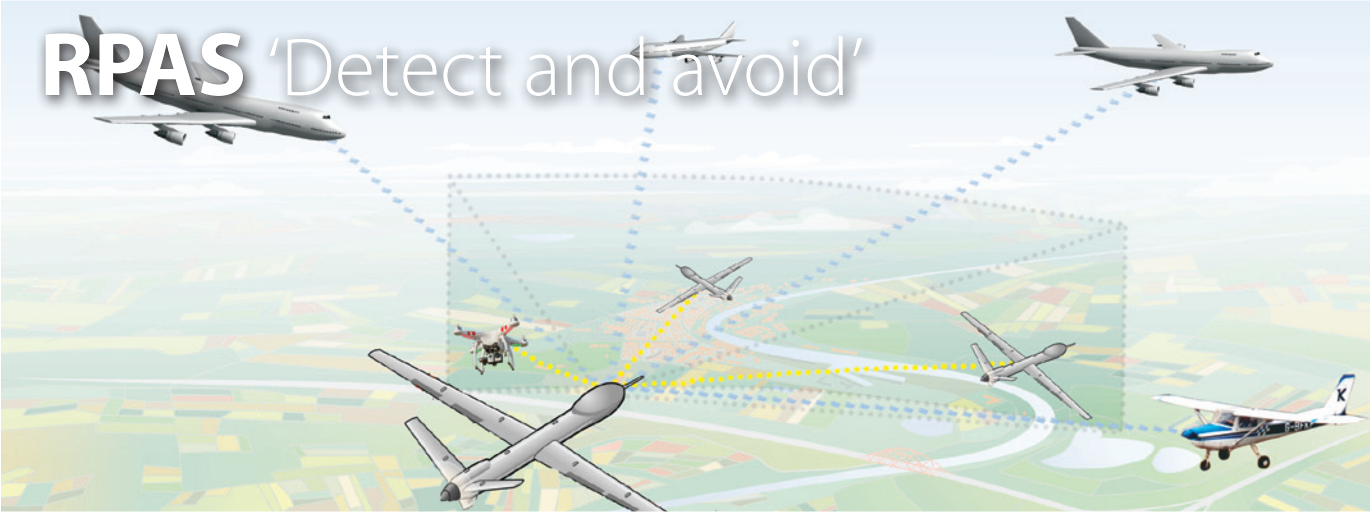
The platform is a software simulation package that can be tailored to exercise and test various collision avoidance concepts. The model will be adapted to both airborne and ground-based applications.

A number of applications are envisaged, including:

- ACAS X
- ACAS compatibility study
- RPAS collision avoidance

The platform will reuse some previously developed components, such as the EUROCONTROL Interactive Collision Avoidance Simulator (InCAS). The platform should become operational later in 2015.

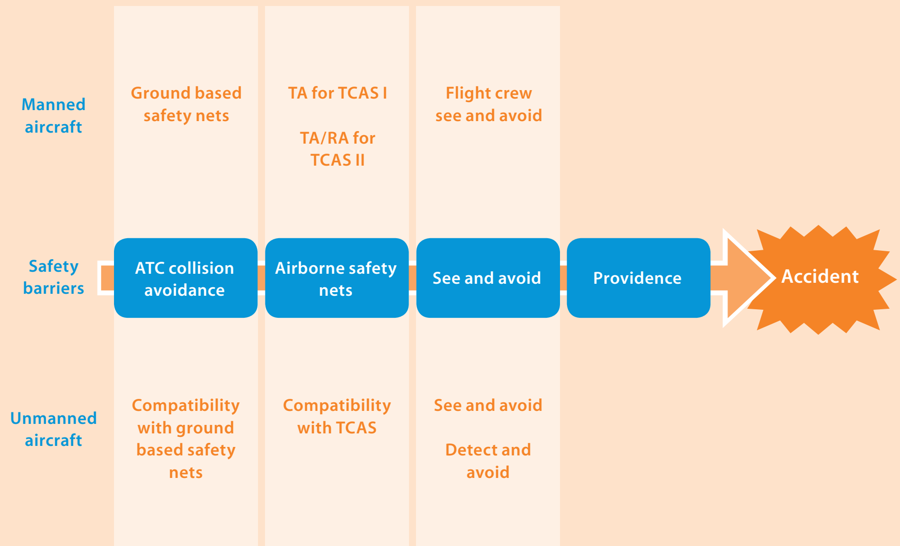
RPAS 'Detect and avoid'



In controlled airspace, safe separation will be provided by RPAS operators complying with Air Traffic Control (ATC) procedures and instructions. In uncontrolled airspace RPAS operators will need to be capable of applying the "rules of the air" based on his/her situational awareness. How will the RPAS pilot do this if the RPA is operating beyond the visual line of sight?

'Detect and avoid' and the ATM barrier model simplified

DAA systems are intended to provide traffic avoidance for the 'see and avoid' part of the barrier model, as opposed to collision avoidance. However, while airborne safety nets and 'see and avoid' are two distinct barriers in the model, and there may be separate systems providing each capability on RPAS, it could be argued that both rely on technology and are powered by the RPAS, and therefore the barriers become less distinct.



'See and avoid'

ICAO Annex 2 lays out 'The Rules of the Air', which states that:

"An aircraft shall not be operated in such proximity to other aircraft as to create a collision hazard".

An RPAS pilot operating within line of sight of an RPA can typically achieve this without the requirement for sensors on the aircraft using the principle of 'see and avoid' (SAA). However, those RPAS pilots operating beyond visual line of sight must have an alternative means to implement the Rules of the Air in all classifications of airspace – referred to as 'detect and avoid' (DAA).

'Detect and avoid'

RPAS must be capable of detecting both cooperative and non-cooperative targets and taking action to manoeuvre appropriately. To do this a 'detect and avoid' system is needed that is able to achieve an equivalent or better level of safety as SAA in manned aircraft. This must be achieved in all flight conditions, day and night.

As with airborne collision avoidance systems on RPAS, one of the challenges for the developers of DAA systems has been a lack of regulatory standards and requirements. Also, the extent to which the RPAS should be capable of autonomous 'detect and avoid' in the event that communication is lost with the pilot needs to be considered - in uncontrolled airspace pilots decide what is required to achieve an acceptable safe distance from other airspace users. If an RPAS is to have a degree of autonomy, guidelines on acceptable safe distances may be necessary.

'Detect and avoid' for cooperative targets

The detection of cooperative targets with Mode S transponders and/or ADS-B is relatively straightforward, provided the RPAS has the payload and power requirements required. The challenge here is to develop appropriate detection avoidance algorithms.

The ASTREA programme has completed a number of trials using ADS-B as the cooperative sensor. The sensor proved highly reliable and typically detected threats earlier than 6 minutes from the closest point of approach and provided sufficient time to implement the rules of the air.

A Mode S interrogator plus ADS-B receiver (linked to a DAA processor) is being trialled as part of the ATM Innovative RPAS Integration for Coastguard Applications (AIRICA) – see next page. The DAA system enables automatic evasive action (by implementing the rules of the air) should the pilot not take appropriate action.

RPAS – 'Detect and avoid'

continued

AIRICA - SESAR looks at RPAS 'Detect and avoid'

In 2013 the SESAR Joint Undertaking selected 9 civil RPAS Demonstration Projects for co-financing. These projects aim to deliver concrete results, ideally achieved through flight trials, to demonstrate potential solutions to integrate RPAS into non-segregated airspace.

One of these projects, AIRICA ('ATM Innovative RPAS Integration for Coastguard Applications') is being developed in conjunction with the Netherlands Coastguards, NLR, Schiebel and Commando Lucht Strijdkrachten. It aims to demonstrate the use of RPAS for coastguard activities in non-segregated airspace over the North Sea.

Background – envisaged RPAS coastguard operations

Today, coastguard services are carried out by aircraft that are manned with on-board operators. However, RPAS technology has now reached a level of maturity where it could provide real added value to coastguard operations, notably through quicker deployment, greater autonomy, and the use of smaller Remotely Piloted Aircraft (RPA). For these reasons, several government services have expressed interest in RPAS applications.

The mission

The envisaged coastguard operations will take place Beyond Visual Line Of Sight (BVLOS) - following take-off from an airport, the RPA will fly towards the targeted area over the North Sea, perform its mission, and fly back to the same airport. For such an operation, the RPA will undertake (low-level) flights in different airspace environments meaning it will need to be equipped with appropriate sensors and on-board 'detect and avoid' (DAA) capabilities

Flight trials

Flight trials will use an unmanned CAMCOPTER S-100 helicopter. A payload camera, attached underneath the aircraft, will provide the surveillance capability. To test the on-board safety features, manned aircraft simulating intruder traffic will be flown in the vicinity of the RPA. While remaining at a safe distance, these encounters are expected to trigger the DAA system and cause the RPA to react. The RPA will remain under ATC control for the entirety of the flight trials.

The technology

AIRICA is expected to trial a DAA system based on active Mode S interrogation. An ADS-B transponder on board the test RPA will be used to detect and locate other aircraft. The signals will be processed on-board the RPA, but will also be sent to the Remote Pilot Station where the remote pilot will have to approve the proposed evasive action before it can be carried out by the RPA.

The project is also expected to test the feasibility of a Simultaneous Non-Interfering concept to integrate RPAS operations with other airport traffic and assess a system that provides controllers with detailed live information about the RPA's waypoint route navigation.

Further reading

- Demonstrating SESAR - Civil RPAS Integration: www.sesarju.eu/innovation-solution/demonstrating-sesar/rpas
- AIRICA: www.airica.eu

AIRICA ATM Innovative RPAS Integration for Coastguard Applications — SESAR

'Detect and avoid' for non-cooperative targets

One of the greatest challenges is the detection of non-cooperative targets such as light aircraft, gliders, and microlights that may not be equipped with a transponder.
Due to the challenges involved in detecting a range of non-cooperative targets a multi-sensor approach tends to be favoured. The types of sensors being used today include:

- Millimetre-wave radar
- Electro-optic/infrared cameras
- Light Detection and Ranging (LIDAR)
- Acoustic sensors

Ground-based DAA systems using electronic sensors, such as those being developed by NASA, provide information for manoeuvre decision tasks especially in Terminal Manoeuvring Area (TMA) operations.

The ASTREA programme has developed high resolution electro-optical sensors that are capable of detecting intruders against complex clutter backgrounds and determining whether they pose a threat. Future work will focus on improving the accuracy with which the system can predict the time until collision.

Another system called Vigil-X from Selex-EX aims to provide pilots of both manned and unmanned aircraft with enhanced situational awareness by using infrared and visible electro-optical sensors. The sensors are capable of detecting other aircraft in all weather conditions and in zero light conditions bringing a considerable enhancement over current SAA.

Moving forward

There is currently no 'off the shelf' package that seems to answer all the needs for 'detect and avoid'. However, there are some promising developments afoot and the certification of such systems is expected to come sooner than the 2024 date in the EUROCONTROL roadmap for integration. Interestingly, looking back at the steps aviation has taken to harmonise technology, these systems are being developed by individual manufacturers. Could we be storing up a problem of interoperability in the future? Only time will tell.

Small RPAS – a unique challenge

Small RPAS weighing less than 25kg are undergoing rapid growth, with industry research experts Frost and Sullivan estimating over 200,000 drones were sold each month in 2014. Although no more than the weight of a small child, this size of small RPAS could still cause damage to a manned aircraft or non-aviation infrastructure. At the same time they are hard to detect and too small to carry transponders or ACAS-like collision avoidance systems. Our final article looks at the problems associated with small RPAS, and the range of solutions proposed to prevent damage and disruption to aviation and wider society.

A unique challenge

In July 2014, an A320 came within 20 feet of an 'unidentified model helicopter' believed to be a small RPAS whilst on final approach at London Heathrow airport. More recently, Dubai airport was closed for nearly an hour because of recreational RPAS being used in the vicinity of the airport. Finally, the FAA registers approximately 50 incidents involving RPAS on a monthly basis; most recently one crashed in the grounds of the White House.

Is regulation on its own enough?

For RPAS less than 150kg, a number of national CAAs have regulations on their use. These cover the need for airworthiness approval, registration, operating permissions and pilot qualifications. Even for the smallest of RPAS there are stated rules on how high and close to people or structures the RPAS can be flown.

However, there are a range of small RPAS users and not all of them are from an aviation background. For example:

- **Military and governmental non-military** users, such as the Police, are not necessarily from aviation backgrounds, but they do generally have a good awareness of other airspace users and undertake comprehensive training in their use.

- **Commercial** users range from experienced aviation professionals through to those with the minimum knowledge required to obtain the required permits from regulatory authorities. This group is likely to be conscious of the liabilities associated with operating RPAS and the limitations of where they can operate.

- **Recreational** users who have purchased small and relatively inexpensive RPAS from retailers, which do not require specific training. If they are aviation enthusiasts, they are more likely to have an understanding of the rules. Other members of the general public however might have very limited awareness of the rules governing the use of RPAS.

Raising awareness

One way of addressing the wide range in awareness levels and in types of users has been for regulators/ANSPs to join forces with industry groups on specific awareness campaigns. Examples include:

- The FAA in the United States which is partnering with the Know Before You Fly campaign, formed by three RPAS organisations to promote the dos and don'ts of flying RPAS amongst recreational, business and public entity users. *www.knowbeforeyoufly.org*

- Similar initiatives are taking place at a more local level, such as NATS and ARPAS-UK (the small RPAS industry association) in the United Kingdom. *www.arpas.uk*

- The ANSP in New Zealand has launched a website which helps people to discover where they can fly and what they need to know. *www.airshare.co.nz*

Some manufacturers are also playing their part in raising awareness by providing information in packaging and at the point of sale, when the RPAS is purchased.

Technologies

Various technology solutions are being pursued to avoid RPAS both flying into objects and entering areas they shouldn't. The variety of RPAS applications means that many are aimed at avoiding fixed objects such as power lines, rather than being aviation specific. So while not 'safety nets' in the traditional aviation sense, we provide some examples below to show what is out there.

Stopping small RPAS flying where they shouldn't

A number of systems have been developed that either prevent small RPAS from entering pre-defined areas or limit their ability to manoeuvre outside them. One small RPAS manufacturer uses a GPS database of

Small RPAS – a unique challenge

continued

restricted areas such as airports and sensitive areas and can provide warnings if operating close to an area or even prevent the RPAS from getting airborne inside a restricted area. The system also prevents operators from entering waypoints or routes which require flight in/through restricted areas. Other systems work differently by using pre-determined GPS coordinates and height restrictions to ensure the RPAS remains inside the desired area.

For those RPAS not equipped with GPS technology alternative methods are needed to detect possible infringements around aerodromes. Traditional surveillance sensors at airports are unlikely to provide good rates of detection. One potential solution being considered is using higher resolution radars with enhanced processing techniques to achieve higher rates of detection.

One of the more extreme solutions developed by the military in the US and China prevents access to restricted zones by using electro-optical sensors to detect the RPAS and then a powerful laser to shoot them down!

Avoiding collisions

Collision avoidance systems are not just the preserve of large RPAS and innovative solutions more suited to small, lightweight aircraft are continually being introduced. Solutions include using a range of sensors to generate an aggregated map of the surrounding environment. This helps prevent the remote pilot from colliding with both fixed and moving objects and provides automated avoidance if required.

Summary

The rapid growth in the small RPAS market combined with a diverse user group brings a unique challenge for the aviation industry. Education is crucial in raising the awareness of users about where they can fly and what they need to know. There is also technology to stop small RPAS colliding with objects and flying where they shouldn't, but technology alone is not enough.

RPAS applications span many different industries including agriculture and viticulture (main picture), traffic monitoring, search and rescue, construction site visits, telecoms and energy equipment inspections.

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ENSURING THE EFFECTIVENESS OF SAFETY NETS