UK CHAPTER NEWSLETTER
August 2021

Welcome to the August 2021 Newsletter

Hello everyone, so we finally made it out of the dreadful COVID lockdown restrictions, well mostly anyway. For those that cannot resist the temptation of overseas holidays and travel, good luck with it and stay safe. Like many of us no doubt we will simply be happy with resuming a normal lifestyle, or should that be 'new normal', time will tell of course. However, the relaxations should allow the go ahead for the planned AOC Europe in Liverpool, 12-13 Oct this year, I hope to see some of you there perhaps.

Thought Provoking Paper - What's in a Name?

This short article is my personal thought on the ever-expanding liturgy of names and abbreviations in the general context of what was previously called Electronic Warfare. These are my personal thoughts and they do not represent Chapter or AOC HQ positions!!

If we look at the initial origin of communication transmission by word of mouth a few millennia ago and the associated intercept thereof, together with what may have been encouragement by various means for message carriers to reveal their sources, we may arrive at the use of flags to convey information. Obviously successful but subject to line of sight and visibility; I note the Admiralty Telegraph system from London to Portsmouth as just one example using the telegraph towers. All very manual and not a jot of electronics.

Then we may move to above-ground telegraphic lines or underwater cables as the electrical message carriers, with associated chances of intercept or denial by second and third parties. And then there was radio transmission by Marconi and others before the end of the 19th century. Those facilities all served a wide variety of users: political, military, commercial, etc., together with the early exploitation of that message traffic. One outstanding episode was the Zimmerman Telegrams that had been intercepted from international telegraphic traffic which passed through the Cable Termination Station in Cornwall. Those messages were copied to the Admiralty's Room 40 in London – leading to the US entry into WW1. Here was Signals Intelligence at the very highest level of international importance.

Curious and amusing was the decision in 1929 by President Hoover's new Secretary of State Henry L. Stimson who refused to continue funding the US 'Black Chamber', with the now-famous comment, "Gentlemen do not read other people's mail."

Clearly the arrival of electrical message carriers heralded the arrival of electrical interference to deny those messages. The message carriers were either electromagnetic

in freespace or along cables or lines of different types; the common feature was that they all could be detected, intercepted and exploited. For many decades we had been content to speak and think about Electronic Warfare in both offensive and defensive contexts, with the targets generally being communications or radar devices. The accepted terminology of detection, interception, exploitation and jamming mutually lived within the concept of Electronic Warfare. The Selex book 'Exploit and Deny' is an admirable presentation of the origin and history of Electronic Warfare and I commend the book to all Chapter members.

The portfolio of Signals is a close fellow-traveller with Electronic Warfare; the nature of Signals Intelligence may be seen as a natural bridge between Signals and Electronic Warfare. There are many lessons but there are just two that I will identify here and now:

1. The world of Signals Intelligence does not and never did contain the whole portfolio of information. Intelligence is a multi-faceted business and woe betide anyone who believe he or she has the single silver bullet.

2. Keep your own messages safe from unwanted access; the opposition will enjoy reading your information.

We should not overlook the aspects of propaganda, political and psychological warfare, as most graphically recorded from WW2 in the book 'Persuade or Perish' by Wallace Carroll. Today's language of disinformation and misinformation, coupled with social media of various types, illustrates the extent of global communication coverage using the web and internet. However, they may all be regarded as examples of signal messages and subject to the same principles including intercept, interference, denial and 'fake news'. I am not going into national or personal privacy and the associated national laws.

Cyberspace presents a challenge. It is part of the information environment and operates across digital networks to facilitate online communication, typically involving a large computer network(s) made up of many worldwide computer subnetworks that employ TCP/IP protocol to aid in communication and data exchange activities. Some people consider cyberspace to be just a notional environment in which communication occurs over computer networks. There may be no electromagnetic propagation as such but there is electronic interaction within the network(s). The question here is the extent to which that interaction may be subject to the same principles: intercept, interference, denial, etc, within the computer networks. Are we looking at the original concept of Electronic Warfare now conducted within those networks?

The term Electromagnetic Spectrum has become a widely recognised critical enabler in offensive and defensive roles. Do the boundaries of that spectrum include cyberspace?

An ever-increasing number of new names and functions have been created by different agencies which individually and collectively are confusing. Multi-Domain Operations is one recent candidate, but I ask, 'What is new?' when we have for decades lived and operated with visual, electrical, and optical devices – surely that presents a multi-domain operational environment.

It seems to me that there is a culture to create a new name, if only to suggest that it is something different or perhaps something new. The key thing in my opinion is that we must have a firm jointly agreed definition of names and their functions.

By John E G Stubbington
Treasurer, UK Chapter

EW Job Advertising on UK Chapter Website

https://www.ukaoc.org/ew-job-vacancies

As previously announced, the recent initiative to provide a low-cost EW Job Advertising section on the UK Chapter website has continued to be popular with UK EW Industry. Why not take a moment to see what your next challenging role in EW might be in 2021?

Any companies/organisations interested in taking advantage of this low-cost job advertising facility, simply contact the UK Chapter President Chris Howe MBE for more information cahowe500@gmail.com

Letters to the Editor

Launched last edition, a new section to the UK Chapter Newsletter, 'Letters to the Editor', does not seem to have found favour, but not to be put off I once again ask any UK Chapter member to send any feedback you may have. So, if you have a comment, a suggestion or observation to make, (hopefully positive) then please contact me direct at cahowe500@gmail.com when I will be only too pleased to respond and consider your thoughts for future newsletters.

On-Line Event

UK Chapter members may be interested in this free event; book online with IET Events:
Date: 8 September 2021 **Time:** 7pm BST

Aspidistra and the Broadcast Group of the Diplomatic Wireless Service including the wartime transmission of black propaganda

In this illustrated talk we will learn first about the transmission of black propaganda and associated activities during WWII. Also, such activities as trying to interfere with enemy rocket guidance systems. Then about the various Medium-Wave and Short-Wave transmitting stations of Broadcast Group with transmitter stations at Crowborough, Orfordness, Cyprus and the island of Masirah, a part of Oman. Please register to hear the story of Aspidistra and the Broadcast Group of the DWS with the engineering used to build and operate these stations.

Technical Item of Interest

3D TDOA - Extending TDOA geolocation into the Air Domain, and why you might want to

So, in parts 1 and 2 of this mini-series for AOC UK, we looked at TDOA and then at the key differences and benefits between TDOA and AOA. In this section, we will look at 3DTDOA, what are its uses and how accurate it can be. 3-dimensional TDOA has existed for many years and is often referred to as multilateration or MLAT. But as time moves on, capabilities inevitably improve, and the latest generation of hardware and software have without doubt moved this principle forward significantly.

Extending TDOA geometry into three dimensions necessarily alters the geolocation procedure seen previously. The set of points in 3D, that are a given difference, further from one receiver than another is not a curve but is instead a surface – the three-dimensional extension of a hyperbola is known as a hyperboloid. Adding a third receiver will define a second hyperboloid, which will overlap with the first one along a curve. That means that we need a fourth receiver, and the third hyperboloid that it defines if we are to determine a point location for the source. So, the point of intersection between these 3-dimensional hyperboloid surfaces is the position in space of the emission.

How might 3DTDOA be used?

Beyond the obvious applications for 3DTDOA as an augmentation for radar systems, or as a passive air defense platform, its useful to understand how this method of geolocation is applied to other problems.

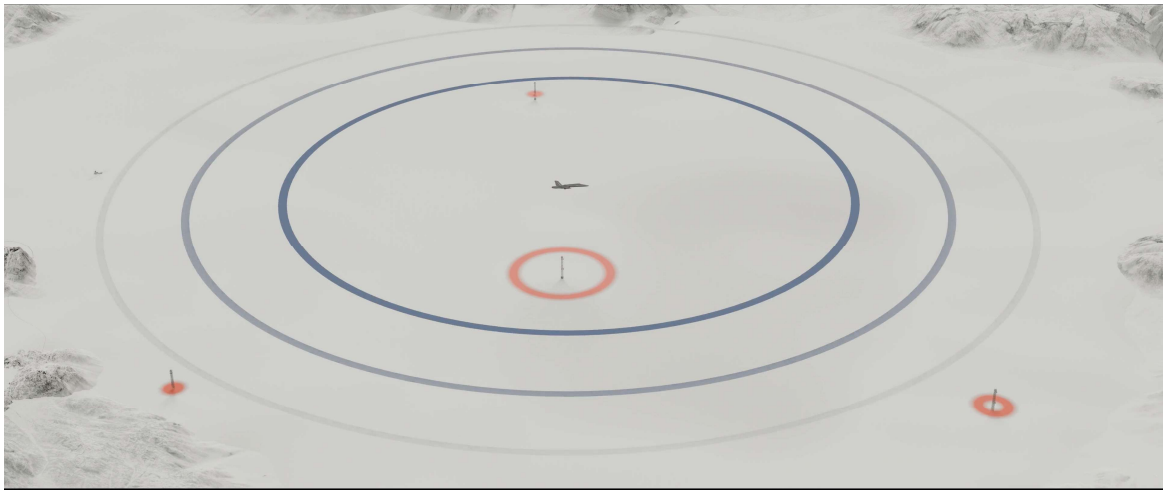
ADS-B Spoofing Detection

Automatic dependent surveillance-broadcast (ADS-B) is a surveillance technology recently introduced in the US (Next Generation Air Transportation System), Europe (Single European Sky ATM Research) and across the globe as a replacement for secondary surveillance radar, and possibly in future to replace primary radar, for air traffic monitoring and control. It requires planes to determine their current position using GPS, and then to broadcast the details of this position (ADS-B OUT). This information can then be used by air traffic control to coordinate the movement of planes through their airspace. Planes may also carry an onboard receiver (ADS-B IN), which allows them to receive the ADS-B OUT transmissions of other planes in the vicinity.

ADS-B is an attractive solution for air traffic control management for several reasons. Receiving stations can be built in almost any location, which means that ADS-B does not suffer from the problem of black spots in remote locations where building radar stations is unfeasible. Increased accuracy of location data (from more regular broadcasts of position) allows for smaller minimum aircraft separations, and therefore higher capacity. And as already described, it allows for plane-to-plane communication of position. However, it also has several potential drawbacks that need to be considered.

Because ADS-B is unencrypted, anybody receiving a transmission can determine the location of the plane sending that transmission. This possibility is used in a harmless (and indeed, useful) way by websites such as FlightAware, which plot (almost) live position updates of commercial aircraft. A more worrying possibility is that because ADS-B transmissions are unauthenticated, spoof ADS-B signals can be generated. By creating a signal that matches the required messaging protocol, details of a non-existent 'ghost' aircraft can be sent to either ATC ground stations or to other planes. This could cause major disruption if flights need to be diverted to avoid the ghost aircraft. Moreover, it is possible to create multiple ghost signals simultaneously, greatly increasing the possible disruption.

3D TDOA offers a means to mitigate the harm caused by ADS-B spoofing. By analyzing the signal time of arrival at TDOA stations, we can determine whether the signal originates from the location it purports to, based on the ADS-B encoded information. In cases where there is a disparity between the two location determination methods, air traffic controllers can be alerted, and investigation of the signal source can be carried out.



3DTDOA network showing time delay from aircraft RF pulse

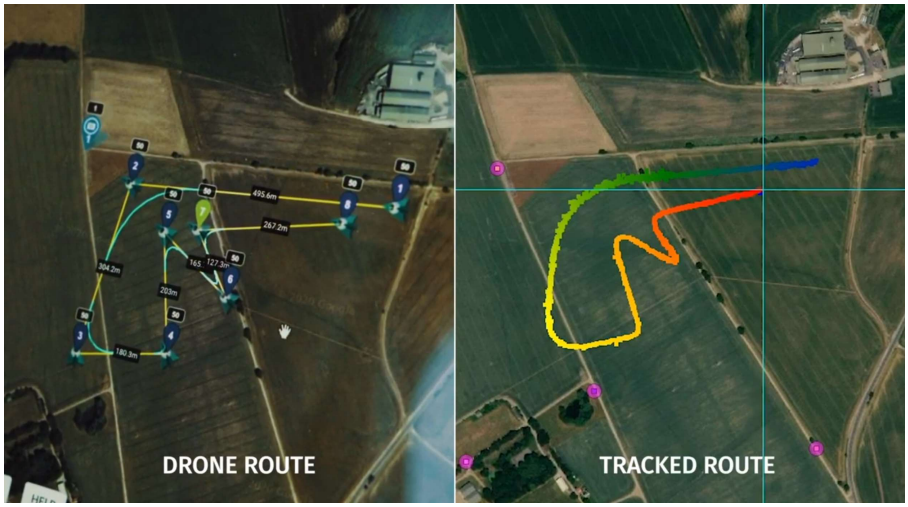
Search and Rescue with UAVs

Applications of 3D TDOA are not limited to situations with an airborne target and ground-based receivers. Consider the situation where a search and rescue team is trying to locate a person trapped by an avalanche in mountainous terrain. There are some existing locator

technologies (such as the RECCO radar-based system, which uses radar pulses that can be reflected by a passive reflector that can be carried), but they almost all require a prior awareness of danger, so that the necessary steps can be taken (such as ensuring that the person has a RECCO reflector in their clothing/on their person). Even in cases where someone is unprepared for the possibility of avalanche, though, it is highly likely that they will be carrying a mobile phone. This raises the possibility of using TDOA to locate them using RF signals from the phone. However, in the kind of terrain where avalanches are likely to occur, there are also likely to be significant physical obstacles to signal propagation at ground level. These obstacles can be avoided by mounting receivers on unmanned aerial vehicles (UAVs), which can be flown high enough to ensure their line-of-sight is not blocked. In this situation, with airborne receivers and a ground-based target, 3D TDOA is necessary, especially as small errors in the estimated position could lead to significant (and life-threatening) delays in the search and rescue operation.

Drone Detection and Geolocation

Of course, UAVs/drones are not always deployed in such a constructive manner. Recent incidents at airports around the world have demonstrated the need to be able to detect and locate drones that threaten the safety of air traffic, either through negligence or deliberate ill intent on the part of their operators. The economic impacts of these incidents can also be substantial, with the two-day closure of Gatwick estimated to have cost more than $64m.[1] Existing radar systems have some utility in tracking drones, but have several significant drawbacks, including problems differentiating drones from birds (which have a comparable radar cross-section).



Drone detection track example from CRFS field trials

3D TDOA geolocation of drones can be carried out by receiving RF communication sent from drones to their operators (normally at 2.4 or 5.8 GHz). This has the advantage of avoiding any confusion with birds, which are unlikely to be sending out any RF signals. The one drawback of using TDOA for drone location is that it depends on drones sending

[1] http://fortune.com/2019/01/22/gatwick-drone-closure-cost/

out signals, so it could potentially be bypassed by a drone with a pre-programmed flight path that does not need to communicate with its operator while in flight. However, there are very few scenarios where such pre-programming would be operationally useful.

How Accurate is it? Buffalo, New York Network

We set out to discover how accurate 3DTDOA systems can be. In Buffalo NY, CRFS erected a fixed monitoring network of RFeye Nodes. We used 4 of these devices to compare self-reported positions from aircraft ADS-B beacons to understand how precise 3DTDOA really is at a range of 100NM (165km) from the network. Over a period of 2-days, we captured more than 150,000 beacon pulses at this distance and geolocated latitude, longitude, and altitude for each. In our test results, we found accuracy at a distance of 100NM to be 90 meters (median) for Lat/Long, equivalent to a median bearing error of just 0.01° (or 0.02° (95%)). Bringing the sample into 100km (53NM), that accuracy improves to a median of 44 meters. These are all being measured well outside of the networks convex hull.

3DTDOA is obviously not limited to ADS-B emissions but can be used to track any received energy. That could be communication systems or datalinks between aircraft or the ground for example. As an air domain geolocation tool, 3DTDOA tracking is undetectable as the system is entirely passive, while both range and accuracy are unquestionable strengths. Perhaps the most important advantage though is operational cost, and that is why we see this system deployed as an augmentation to new and existing radar platforms.

If you would like to find out more about 3DTDOA, how it is used and deployed, there are several useful resources available:

Whitepaper: https://www.crfs.com/white-papers/3d-tdoa-white-paper/

Webinar Recording – How to covertly detect and geolocate airborne objects – https://www.crfs.com/videos/webinar-how-to-covertly-detect-and-geolocate-airborne-objects/

Tracking Multiple Targets with 3D TDOA - https://www.crfs.com/blog/tracking-multiple-targets-with-3d-tdoa/

Airdefense - https://www.crfs.com/airdefense/

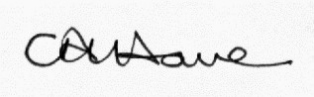
DroneDefense - https://www.crfs.com/drone-detection/

Future Events/Visits

AOC Region 1 Chapters' Virtual Presentations – Having completed four of these excellent virtual online presentations we take a summer break, but Sue Robertson will be arranging a further presentation in September 2021. To take part in future virtual events you simply need to register with the AOC Region 1 Director, Dr Sue Robertson @ sue@gpl.co.uk

AOC Europe 2021 - Liverpool 11-13 Oct 2021
Full details here: https://www.aoceurope.org/welcome

UK Chapter Christmas Awards Dinner – Friday 10 Dec 2021, RAF Club, London – see Flyer below. I am encouraging more members to attend this year; let us all try to get attendance up higher than in recent years! Please consider joining us; witness the award presentations, enjoy some fine dining, good company, and have some festive fun.



Chris Howe MBE
AOC UK Chapter - President

Keep Checking out the UK Chapter website at:

www.ukaoc.org

UK CHAPTER

CHRISTMAS AWARDS DINNER 2021

Royal Air Force Club, 128 Piccadilly, London W1J 7PY

Friday 10 December 2021

The AOC UK Chapter Board is pleased to confirm that the annual AOC UK Chapter Christmas Dinner will be held in the Royal Air Force Club, Piccadilly (Hyde Park end) on **Friday 10 December 2021**. All AOC members, their partners and guests will be most welcome at this very enjoyable festive occasion. Let us make this a grand occasion with as many as possible attending as we will also recognise the achievements of Chapter members and units.

The outline programme for the evening is:

1800: Pre-dinner drinks in the Victoria Bar.

1900: Christmas Dinner in the President's Room.

Carriages as required.

Dress: Gentlemen, Black Tie & Miniatures preferred; Ladies, as appropriate.

The Dinner will cost £50 per head, including wine and port at the table, this cost includes a substantial subsidy from Chapter funds. Members wishing to attend should complete the proforma below and send it by e-mail to Phil Davies (or simply send Phil the information via email), early notification is appreciated for planning purposes. The preferred method of payment is by bank transfer to the UK Chapter account. Payment details will be provided on submission of attendance details. All payments to be made no later than Friday 3 December. Having made a commitment to the RAF Club, we regret that payment for the dinner will still be due in the event of a late cancellation after Monday 6 Dec 2021.

To: Phil Davies E-mail: phildavie@aol.com Mobile: 07387 200554

I wish to attend the AOC UK Chapter Christmas Dinner on Friday 10 December 2021.

Name: AOC Membership No:

Guest(s):

Telephone: E-mail:

Any special dietary requirements (e.g. vegetarian)?