UK CHAPTER NEWSLETTER
June 2021

Welcome to the June 2021 Newsletter

I trust you are all bearing up after nearly 18 months of lockdown restrictions. Not too long now and hopefully we will be living in a far more 'unrestricted' country, although no doubt many of you are already enjoying regular visits back to the gym or swimming pool and of course the restaurants, beer gardens and pubs. Long may it last.

UK Chapter AGM

The minutes of the UK Chapter AGM 2021 (virtual), which took place on Thursday 25 March 2021 using Zoom, are now available on the UK Chapter website AGM Minutes. Please take a moment to review this year's proceedings. Thank you.

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

Obituary – Peter Haynes RIP

Published at the request of Dstl:

It is with great sadness that we have to inform you that our colleague and friend, Peter Haynes, of the Dstl Platform Survivability Group, passed away on Wednesday 19 May 2021 after a year-long battle with illness. Peter had a long and distinguished career in defence, beginning at RAE as a graduate apprentice in the sixties. He fulfilled various roles in MOD and industry before returning to Dstl Farnborough in 2006.

Peter was passionate about the protection of our aircraft and crew and dedicated his later career to ensuring our helicopter fleets had the best protection possible. His reputation in the Electronic Warfare (EW) community extended well beyond the UK, as Peter was a keen advocate of collaboration with our international partners. He also provided valuable opportunities, advice and mentoring to developing scientists and engineers in this domain.

Peter loved his work and the camaraderie it brought, and despite his illness had always planned to return to work." He will be greatly missed in the EW world he cared so much about over so many years of dedicated service to the industry.

Letters to the Editor

A new section to the UK Chapter Newsletter, which was a welcome suggestion from one of our avid members, namely Andy Stove. Many thanks Andy, a great idea which hopefully other members will agree with.

'Letters to the Editor', so if you have a comment, a suggestion or observation to make, or indeed any feedback at all (hopefully positive) then please contact me direct at cahowe500@gmail.com when I will be only too pleased to consider your thoughts for future newsletters.
First letter to the Editor:

Dear editor,

Thanks very much for the April 2021 Newsletter. I was particularly interested in the article 'Why Are We Called 'Crows'?"

I am aware of another, rather vague, explanation of why we are called 'Crows': that it has something to do with 'CRO' as an abbreviation of 'Cathode Ray Oscilloscope.' I must say that I always found this rather unconvincing as it stands, as it could equally be applied to many other specialities within the field of electronics. Maybe that is why David didn't mention it in his article?

Nonetheless, I wonder whether any of our fellow-Crows knows of a more convincing version of this story?

yours faithfully

Andy Stove

Thanks Andy, good to hear from one of our UK Chapter members. So, if you have anything you wish to share with your UK Chapter colleagues, please let me know.

Technical Item of Interest

(The following item was very kindly provided by James Shephard, CRFS – Thank You)

Part 2: Strengths and Weaknesses AOA vs TDOA (Part 3 in next Newsletter)

In this article for AOC UK (part 2) we look at both TDOA (Time Difference on Arrival) and AOA (Angle of Arrival) geolocation techniques to determine their relative strengths and weaknesses. As previously mentioned, passive RF sensing is a well-established method of signal geolocation allowing you to build intelligence without giving yourself away, and therefore without altering target behavior. In the case of TDOA, the hardware's small size, ease of concealment, low data requirement and speed of deployment, means ground based counter-surveillance will find the technology hard to identify.

Approach

RF sensing is not limited to just geolocation of signals, but instead forms the origination point for a vast quantity of data which can be applied to many other simultaneous missions, from interference hunting through to signal capture, isolation and decode using best of breed toolsets. The key to success is frequency range and sensitivity to deliver the broadest possible capability and mission flexibility. This means focusing on the range of frequencies of interest (both today and tomorrow) and ensuring the lowest noise figure across that frequency range. To avoid the need for excessive data-backhaul, and eliminate any single point of failure, consider processing data locally, ideally on the device itself. In general, it is answers we want, not just data.

When we look at AOA, there are multiple ways to design the antenna array, and often more than one will be implemented:

- Spinning Antenna, which involves rotating a directional-antenna to measure signal amplitude
- Pseudo Doppler, which relies on a series of fixed omni-antennas rapidly switching
- Watson-Watt, mono/dipole antenna pairs configured to compare amplitude
- Correlative interferometry, is based on measuring phase between a number of pairs of antennas. It does this to resolve aliases caused by wavelength/2 being smaller than antenna separation. If the target signal frequency is known, regular interferometry can be used.
- Amplitude comparison, which employs a circular array of wide band directional antenna. Antenna can have linear or circular polarization.

A single antenna array example employing multiple DF methods

Each methodology has its own strengths and weaknesses which confuses the overall picture of AOA vs. TDOA, so we will focus on what is generally true.

Which approach is right, and when?

TDOA has several significant advantages, particularly when contrasted with AoA. It works particularly well for pulsed transmissions and can resolve multipath effects. The simpler antenna requirements (i.e., a single antenna, rather than an array) allow the system to be smaller, and therefore much easier to install and transport. It is also more robust against multi-path effects (as the direct route between emitter and receiver will be the shortest, so the first signal received will be the one required). TDOA works best for wider-modulation bandwidths with better signal correlation properties and therefore superior localization to a narrower area. Furthermore, a significant advantage of TDOA is that the processing gain of correlations allows successful geolocation of signals that are close to, or even below the receiver noise floor.

TDOA is not ideal for performing geolocation on very narrowband (<10 kHz bandwidth) signals (as obtainable accuracy is inversely proportional to bandwidth). Accuracy degrades as bandwidth falls, meaning there is no specific limit to bandwidth, only the geolocation accuracy deemed acceptable. It is not possible to perform TDOA geolocation with fewer than three receivers, or 3D TDOA with fewer than four receivers. An accurate synchronization method (usually GPS-based) is required in order to work out the time difference of arrival at the different receivers, and communications link with a high data rate is needed to allow comparison of the signals received using a cross-correlation function, to work out when the same signal is received at different receivers. This also means that performing multiple simultaneous geolocations can be problematic, as the data rate requirement scales accordingly (although this can be mitigated by performing data processing at the receiver location, rather than sending raw data).

Technique	Strengths	Weaknesses
AoA	• Conceptually simple	• Requires an (often very large) antenna array, which is bandwidth-limited

	• Can geolocate with just two measurements • Narrowband signals (e.g. rotating radar) • When moving can deliver cumulative LOB, limiting the effect of multipath	• Multipath effects can lead to spurious LOBs • Complicated calibration requirements • Short-pulsed signals
TDOA	• Simpler antenna requirements • Wideband, low-SNR signals and short-duration signals • Rejection of uncorrelated noise and interference • Mitigates multipath effects • Also suited to multi target, co-channel signals e.g. ADS-B	• Narrowband signals • Geolocation requires 3 (or 4) receivers • Requires communication links with higher data rates • Requires accurate time synchronization across receivers

In conclusion

Both TDOA and AOA are proven methods for the geolocation of RF. For many users of RF geolocation systems, the preference for AOA or TDOA may change on an hourly basis dependent upon the task at hand. There may even be multiple signals of interest which require geolocating simultaneously, where some would be best located with AOA and others more suited to TDOA.

Doubling infrastructure and operator man-hours to run two separate systems in parallel is obviously not a desirable solution. Deciding which system to use on a case-by-case basis would also be disruptive. An interesting option is taking the best of both, a hybrid approach. A hybrid approach uses hardware capable of performing AOA and TDOA with software then used to optimize the geolocation output by combining the AOA and TDOA data to deliver the best answer in that moment of time.

Method aside, passive RF sensing technologies deliver enormous capability to the modern military, whether keeping communications running, gathering intelligence, identifying targets of interest or geolocating specific emitters. The core consideration is the point of capture, the data originator, the receiver itself. Focusing on best of class here will always deliver the greatest capability and flexibility to your mission.

For more information on both TDOA and AOA, CRFS ran a series of webinars recently:

AOA Accuracy – Myths & Legends which demonstrates target geolocation in the real world on a live system

TDOA – A modern geolocation solution looking at both TDOA and hybrid approaches. Again, using live target prosecution in 2 and 3 dimensions

Understanding Multipath – A short animation to help visualize multipath in the real world, and the effect it has on AOA

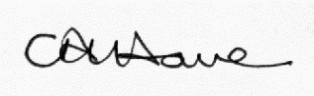
Future Events/Visits

AOC Region 1 Chapters' Virtual Presentations – After the first few extremely popular and successful running of these events by Norway, UK and the Italian Chapter, the next chapter to provide a brief and presentation will be the Swiss Crows Chapter. This virtual presentation will commence at 1800 on Wed 9 June 2021. To take part you simply need to register with the AOC Region 1 Director, Dr Sue Robertson @ sue@gpl.co.uk

DSEI Excel, London, 14 - 17 September 2021 https://www.dsei.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 looking for a big push 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, and have some festive fun.



Chris Howe MBE
AOC UK Chapter - President

Check 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)?