



UK CHAPTER NEWSLETTER

April 2021

Welcome to the April 2021 Newsletter

We are all without doubt looking forward to the end of the COVID Lockdown restrictions. Many challenges were, and continue to be, presented to us but hopefully we are all dealing with them in our own way. It is certainly hoped that once I take to writing the next newsletter for June, we will all be facing a much brighter future beyond COVID where we can once again take up our normal lives. A visit to the pub or a holiday perhaps!

UK Chapter AGM

The UK Chapter (virtual) AGM 2021 took place on Thursday 25 March using Zoom; however, for those unable to participate, the AGM minutes are now available on the website so you can catch up on the issues presented and discussed. Thank you to all those that did log in for the meeting, your support and interest is very much appreciated.

Tributes to John Clifford OBE, Immediate Past President, UK Chapter

As a tribute to John, the AOC awards committee and other HQ staff, have established a new prestigious award in memory of John and all that he stood for in the ever-challenging world of Electronic Warfare. This new award for 2021 will be ranked amongst the highest accolades the AOC can present.

Titled: 'John M Clifford Award for the Advancement of the Electromagnetic Domain'. The award criteria are very comprehensive and exact which will require supporting evidence for many qualities, such as – Advocacy, Leadership, Management and the general promotion and advancement of EW. Do we have a UK Chapter candidate for this award?

The following tribute was also made to John Clifford OBE at the end of an AOC virtual presentation by Air Chief Marshal Sir Stuart William Peach, GBE, KCB, DL, Chairman of the NATO Military Committee. Most deserving recognition from the highest levels indeed. BZ John Clifford, OBE. Video below.

<https://vimeo.com/521611495/ebb72c0674>

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. Three UK companies (EWST ULTRA UK, DRAKEN EUROPE & ESROE) now have EW positions advertised on the UK Chapter jobs page, with a fourth due shortly. 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

Looking for EW Employment?

A new initiative! - The UK Chapter Board would like to assist members currently looking for employment in the world of Electronic Warfare. So, if you are on the lookout for your next challenging role in Electronic Warfare, the UK Board are offering to facilitate a window to your availability by placing any relevant details you wish to share with the EW Community in the UK Chapter Newsletter. Perhaps just a short introductory paragraph about yourself plus relevant contact details. However, should you wish to remain anonymous, but contactable via the UK Chapter President or Board member, name and contact details can be omitted. Subsequently, any potential employer can talk to you direct and in total confidence or via a Board Member in the first instance. This assistance would of course be free of charge to any of our members! So, update your CV and get it out there.

Technical Item of Interest

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

Part 1: Introduction to TDOA & how it works (Parts 2 & 3 in future Newsletters)

Principles of Operation

In the first part of this article for AOC UK, we are looking at TDOA (Time Difference of Arrival) to understand how it works, and what makes it a truly modern approach to signal geolocation. In the next issue, part 2 will look at some of the strengths and weaknesses of both TDOA and AOA (Angle of Arrival) when applied to different signal types. Understanding both approaches is critical to the missions we face in the real world to ensure we can generate reliable, accurate information against which decisions can be made.

Introduction

The concept of using radio frequency (RF) waves to locate objects is one that will be familiar to anyone acquainted with radar. Radar systems send short pulses of radiation out in a known direction, and then wait for any return signal that has bounced off an object in that direction. Measuring the time difference between the sent and received signals allows the distance to the object to be calculated. Radar is an example of an active geolocation technique because it requires a signal to be generated by the user if objects are to be located. If the object that we wish to locate generates its own RF signal, then we can use passive geolocation techniques that rely on detecting the RF signal being produced. These techniques use a network of spatially separated receivers to pinpoint the location of RF transmissions.

Passive techniques have a number of significant advantages when compared to active techniques like radar. Passive systems do not require an RF signal to be generated, so they do not interfere with other uses of the spectrum in the surrounding area. This also means that their use cannot be detected, allowing the user to “see without being seen.” Their effectiveness does not depend on the radar cross-section of the object being located, allowing for the detection of even very small RF emitters. In addition to locating the target, analysis of the nature of the RF signal received can allow identification and classification of its source. The infrastructure required is also usually significantly smaller and less expensive, making a much wider range of deployment scenarios possible.

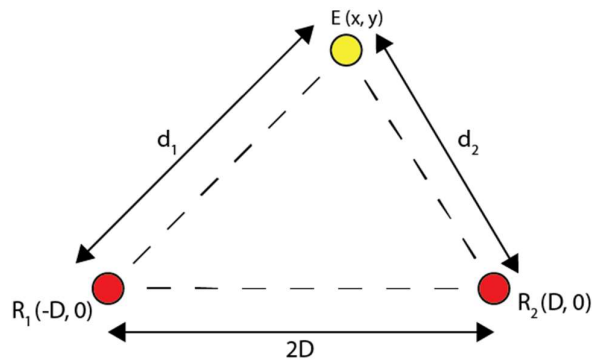
How does it work?

TDOA uses the time difference between receipt of signals at spatially separated receivers to determine the location of the source. The signals received at each of the two receivers are compared using a cross-correlation function to work out the time difference of receipt of the signals. If we take two receivers, R_1 and R_2 , and a signal arriving at R_1 a time T later than at R_2 , we can say that the source is a distance δ_1 further from R_1 than R_2 , where:

$$\delta_1 = cT$$

(Assuming that the RF signal travels at the speed of light.)

So, what can we say about the location of the source based on this information? If we have two receivers separated by a distance $2D$, and an emitter at an arbitrary point (x, y) , then we will have a scenario as in **Error! Reference source not found.** below.



Distances from two receivers to an arbitrary point

The distances d_1 and d_2 , from R_1 and R_2 to the emitter are

$$d_1 = \sqrt{(x + D)^2 + y^2}$$

$$d_2 = \sqrt{(x - D)^2 + y^2}$$

If we know that the emitter is δ_1 further from R_1 than R_2 , then we have

$$d_1 - d_2 = \delta_1$$

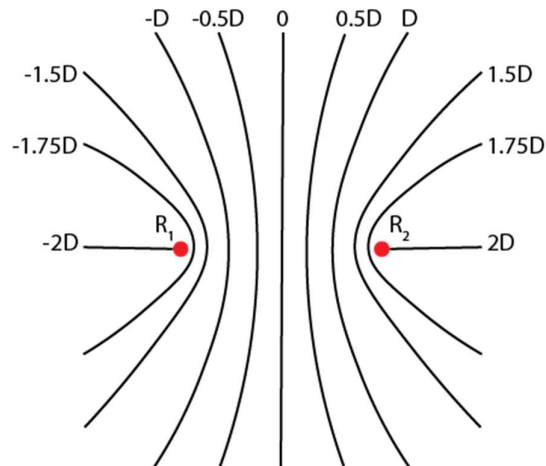
and therefore

$$\sqrt{(x + D)^2 + y^2} - \sqrt{(x - D)^2 + y^2} = \delta_1$$

This can be rearranged to

$$\frac{4x^2}{\delta_1^2} - \frac{4y^2}{(4D^2 - \delta_1^2)} = 1$$

For any given value of δ_1 , this equation can be satisfied by a continuous line of points constituting a hyperbola. **Error! Reference source not found.** illustrates this, with hyperbolas plotting out given differences in distance from the two receivers.

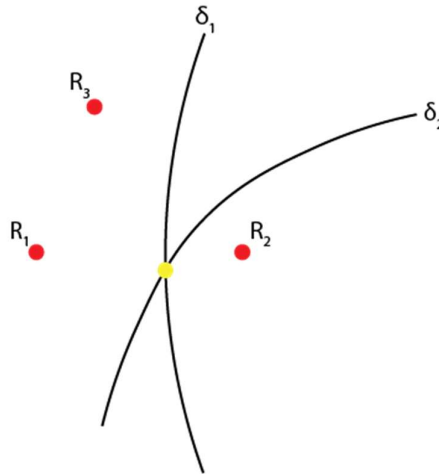


Curves indicating possible transmitter locations that correspond to various values of δ_1

So if we have just two receivers, we can only say that the source lies somewhere along the relevant hyperbola. A third receiver, R_3 , is required, with a time difference T' between receipt of the signal at R_3 and R_2 . We then know that the source is a distance

$$\delta_2 = cT'$$

closer to R_3 than R_2 . The set of points located δ_2 farther from R_3 than R_2 also traces out a hyperbola, and the source will be located at the point where the two hyperbolas intersect.

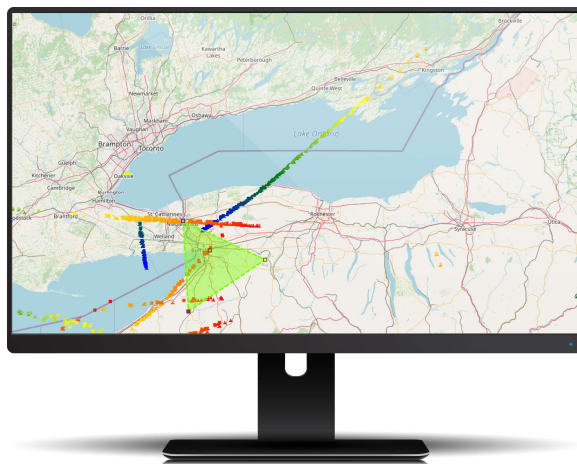


Two hyperbolas intersect at the source location

The time difference between arrival at R_3 and R_1 can also be used in the same way, resulting in a third hyperbola that intersects the other two at the same point.

TDOA can also be used to determine the position of a source in three dimensions. The set of points in 3D that are a given distance further from one receiver than another is not a curve but is instead a surface – the three-dimensional extension of a hyperbola 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.

This screen shows aircraft being tracked across Buffalo NY on the CRFS demonstration network. Here we have four receivers roughly 75Km apart (capable of tracking ground, marine and aircraft transmissions). Specifically, here we are looking at ADS-B, TACAN and IFF transmissions, but we could equally select, data communication protocols or any other RF signal.



Aircraft locations plotted in 3 dimensions

(More detail on 3D TDOA can be found in CRFS <https://www.crfs.com/white-papers/3d-tdoa-white-paper/>)



Why Are We Called 'Crows'?

What is in a name - Old Crows. Tales of the versions of the origin of the Association's name.

The info below from the Old Crow website offers a very formal history of the name for the AOC:

*During World War II Allied ECM officers, tasked to disrupt enemy communications and radars, were given the code name of "Raven" to provide a degree of security to their existence; the designation Raven had been coined by British ECM operators and adopted by the Americans. After WWII, a group of Raven operators were directed to establish a Strategic Air Command flying course in ECM operations at McGuire AFB, New Jersey. From all accounts from those present at the time, the students changed the name to **"Crows" and those engaged in the profession became known as Old Crows.***

*In early 1942, Mel Jackson was the first officer assigned to ECM duties in the US Army Air Corps and he served in ECM staff positions throughout WWII. Mel Jackson was also the first to come up with the **idea of an Association of Old Crows.** Sometime around 1953, while he was a marketing manager for CGS Associates doing business in ECM equipment, Mel Jackson had membership certificates made, had some identifying coins minted, and began passing out memberships to the military personnel he was dealing with, as a sort of honorarium from his company. Mel Jackson adopted a logo for the association from the one used by the Aircraft Radiation Laboratory (ARL) at Wright-Patterson AFB, Ohio in 1953.*

An alternative and more appealing version was told to me when I joined the Crows in the early 1980's.



At a gathering of the founders of what became known as the Crows, they were searching around for a name for the group without any success, when one of them saw the label on the bourbon whiskey they were drinking Old Crow. They all agreed

what a good choice and we have continued to use this name over the years.

More about Old Crow a low-priced brand of Kentucky-made straight bourbon whiskey distilled by Beam Suntory can be seen at https://en.wikipedia.org/wiki/Old_Crow

But that is not the end of the story. A long-standing UK Chapter BOD Director – Wg Cdr Dave Kitching RAF Retired collected very old, but empty, Old Crow whiskey bottles, see photo to left. Before he died, he asked that on his death, I should be given a couple of bottles, which I now proudly display near my drinks cabinet and regularly bore visitors with this story, which is usually concluded with one of two questions. What is EW or why have you kept such a silly name?



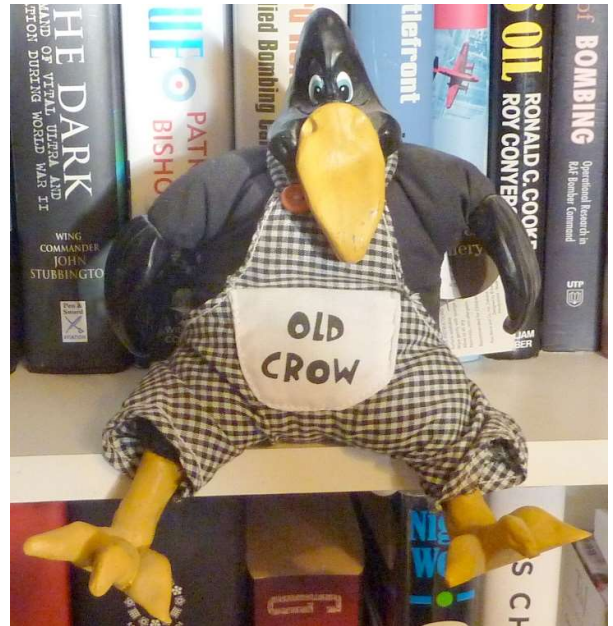
Contributions to the name discussion by other members of the UK Chapter BOD:
 There is also the view that the original airborne EW operators were listeners rather than jammers, hence raven from the 2 ravens that were the "eyes in the sky" provided info and warning to the Norse god Odin.
 Raven is, strictly, a brevity word (i.e., a shorthand) rather than a codeword (referring to something classified).
 Old Crow may also have just been a derogatory term used by other crew members, along with EWO being extra weight onboard and ECM being extra crew member.

More images below supplied by Wg Cdr John Stubbington RAF Retired.

Left: The Cagey Old Crow ...

... is shown in his natural habitat in this original scratchboard rendering by Florida artist J. Ercel. This drawing was specially commissioned by Sperry Electronic Tube Division, Sperry Rand Corporation, for friends and fellow members in the Association of Old Crows. This item has been hanging in John's office for over 25 years.

Right: Another exhibit Old Crow, which is self-explanatory and was given to John by a member of his family.



*Finally, for those who need a name for their wife / girlfriend / partner it is to my wife's disgust that I use the term **"Old Crows Mate"**.*

(Article supplied by UK Chapter Board Member, David J Peck – Thank You)

Future Events/Visits

AOC Region 1 Chapters' Virtual Presentations – After the first two extremely popular and successful running of these events by both Norway and UK, the third presentation in this series will be hosted by the Italian Chapter. This will commence at 1800 UK time on Tuesday 20 April 2021. To take part you simply need to register with the AOC Region 1 Director, Dr Sue Robertson @ sue@gpl.co.uk

AOC Europe – Online Summit, Virtual Event – 18 May 2021

Registration of interest here: <https://www.aoceurope.org/online-summit>

DSEI Excel, London, AOC Booth - 14 - 17 September 2021 <https://www.dsei.co.uk/>

AOC Europe 2021 - Liverpool 11-13 Oct 2021

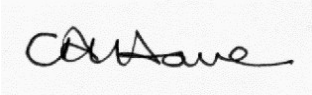
Full details here: <https://www.aoceurope.org/welcome>

UK Chapter Christmas Dinner – Friday 10 Dec 2021, RAF Club, London – Flyer tbn

Finally

Do remember, the UK Chapter is all about you, so please stay engaged and let the Board know what you want. Feedback is always most welcome; otherwise, we are in danger of operating in a vacuum. We need more diverse and young members to become actively involved in what the UK Chapter does – any ideas will be greatly appreciated.

Take care out there everyone and please stay safe.



Chris Howe MBE
AOC UK Chapter - President

Check out the UK Chapter website at:

www.ukaoc.org