

Day 1: Introduction to EW

- **Welcome and Introduction**
 - **Speakers:** Thomas Peacock & Col Hoffman
 - **Description:** Thomas Peacock will welcome participants and introduce the aims and general theme of the summer school, including safety and security. Col Hoffman will provide an overview of the NATO Science and Technology Organisation (STO).
- **Keynote Address**
 - **Speaker:** Col Alston
 - **Description:** Col Alston, Assistant Head of the UK Land CEMA Programme, will discuss the military's use of EW, its growing importance, future direction, and how science and technology feed into defence expectations.
- **History of EW**
 - **Speaker:** Hugh Griffiths (UCL)
 - **Description:** The history of EW and radar is certainly worthy of study. It is useful to understand the origins of ideas and techniques - our predecessors were pretty smart. On the other hand, in some cases the technology of the time did not allow practical realisations, but the technologies that are now available to us mean that that has changed. The lecture will describe a selection of techniques from the early 20th century through to the current conflict in Ukraine, illustrated by examples of their use operationally.
- **EW in Action**
 - **Speaker:** Martin Clarke
 - **Description:** Martin Clarke will explain how a NATO force would use EW in an operational deployment.
- **EW as a System**
 - **Speaker:** Hans Peter Stuch (Fraunhofer FKIE)
 - **Description:** The session will cover the comprehensive approach to EW, including system structure, technological options and limits, and the operator's involvement in EW operations. It will also discuss EW beyond RF, such as optics and acoustics, and compare radar and communications technologies, highlighting their similarities and differences.
- **RF Fundamentals 1: Antenna arrays**
 - **Speaker:** Steven Weiss
 - **Description:** Antenna arrays are a critical component of many antenna systems. Simple models predict array patterns employing the concept of pattern multiplication – a first order technique that ignores mutual coupling. More sophisticated models include mutual coupling in the analysis. Mutual coupling effects can lead to unwanted problems such as scan blindness. Mitigation of such an effect is discussed as are models that can predict its existence. The concept of active impedance and the active reflection coefficient are reviewed. Additionally, the concept of the embedded element pattern is discussed. Array edge effects are considered as are impedance mitigation techniques using Wide Angle Impedance Match (WAIM) radome covers.

- **RF Fundamentals 2: Signal Processing and Modulation**
 - **Speaker:** Matt Ritchie (UCL)
 - **Description:** This session will introduce the principles of signal processing and modulation in an EW context, highlighting similarities and differences between RADAR and communications.
- **RF Hardware 1: Analogue**
 - **Speaker:** SaeJune Park (QMUL)
 - **Description:** This lecture will introduce the analogue devices that make up a RF chain in a typical communications system, including parts such as: modulator, upconverter, bandpass filter, power amplifier, circulator, matching network, low noise amplifier, mixer, demodulator etc. It will focus in more detail on a few critical parts, preparing the students to better understand Comms EW concepts later in the week. We will touch upon the likely effects (intentional) noise can have on different parts of the communications chain.
- **RF Hardware 2: Digital**
 - **Speaker:** David Lázaro (Indra)
 - **Description:** This session offers a practical introduction to the fundamentals of digital RF hardware within the context of modern Electronic Warfare (EW) systems. We will explore the signal processing chain from analogue-to-digital (ADC) and digital-to-analogue converters (DAC), to the integration of these functions in cutting-edge platforms such as SDRs, RFSocCs, and direct RF architectures. Emphasis will be placed on how these technologies disrupt traditional RF system design, enabling greater flexibility, bandwidth, and real-time adaptability — key capabilities for next-generation EW applications. The talk aims to give attendees a high-level yet insightful overview of the hardware evolution shaping the future of electromagnetic dominance.

Day 2: RADAR EW

- **RADAR EW Overview**
 - **Speaker:** Floris Kalff (TNO)
 - **Description:** Overview of RADAR Electromagnetic Warfare systems, techniques, and operations.
- **RADAR ES Systems**
 - **Speakers:** Paula Parrado and Amalia Cano (Indra)
 - **Description:** Detailed discussion of various RADAR ES systems, including architecture, functionalities, and signal detection processes.
- **RADAR EA Overview**
 - **Speaker:** Daniel O'Hagan (Fraunhofer FHR)
 - **Description:** Overview of RADAR Electromagnetic Attack systems, techniques, and operations.
- **RADAR Practical and Demonstration Sessions**
 - **Speakers:** Various
 - **Description:** Participants will rotate between practical and demonstrations relating to EW in RADAR.
- **Novel Waveforms in RADAR**
 - **Speaker:** Wim Van Rossum (TNO)
 - **Description:** Discussion on classical radar waveforms, jamming techniques, and novel waveforms for ECCM.
- **Threat Analysis**
 - **Speaker:** Krzysztof Kulpa (Warsaw University of Technology)
 - **Description:** Future EW threats from a scientific perspective.
- **Panel Session**
 - **Speakers:** All
 - **Description:** Presenters will take questions from participants.

Day 3: Communications EW

- **Comms EW Overview**
 - **Speaker:** TBC
 - **Description:** Overview of Communications Electromagnetic Warfare systems, techniques, and operations.
- **Comms ES Systems**
 - **Speaker:** Naomi Zirkind
 - **Description:** Discussion on various Communications ES systems.
- **Comms EA Overview**
 - **Speaker:** Hans Peter Stuch (Fraunhofer FKIE)
 - **Description:** This session will cover threat analysis, including remote-controlled IEDs, drones, and satellites. It will discuss jamming and spoofing techniques, ECM hardware and systems, signal interference issues, and interoperability with ES and blue communications.
- **Comms Practical and Demonstration Sessions**
 - **Speakers:** Various
 - **Description:** Participants will rotate between practical and demonstrations relating to EW in Communications.
- **Threat Analysis**
 - **Speaker:** Maj Dave Keegan
 - **Description:** Future EW threats from a military perspective.
- **Future Communications**
 - **Speaker:** Eva Fernandez Rodriguez
 - **Title:** "Guardians of the Sky: The role of Electromagnetic Warfare in modern satellite communications"
 - **Description:** Eva Fernandez Rodriguez will guide the audience through the history and architectures of satellite communications, discussing current and future constellations, both military and commercially relevant. The talk will also cover security aspects, including vulnerabilities and attacks in the satcom context.
- **Panel Session**
 - **Speakers:** All
 - **Description:** Presenters will take questions from participants.

Day 4: Advanced EW Systems

- **Multifunction RF Systems in the Context of EW Applications**
 - **Speaker:** Michael Brandfass (Hensoldt Sensors)
 - **Description:** The rapid advances in ultrabroadband digital and RF technologies are driving novel capabilities by integrating Radar, Electronic Support Measures (ESM), Electronic Countermeasures (ECM), and COMMs functions across an ultrawide frequency spectrum, all through a common Active Electronically Scanned Array (AESA). Such systems known as Multifunctional RF Systems (MFRFS) are not in operation today, however, they offer unprecedented operational versatility for airborne, shipborne, and ground-based assets in the future. This lecture will briefly explore some cutting-edge concepts, highlighting how shared ultrabroadband AESA apertures along with their resp. RF architectures redefine detection, jamming and electronic warfare across all domains.
- **Distributed EW Systems**
 - **Speaker:** TBC
 - **Description:** Discussion on distributed/multi-platform approaches to EW systems.
- **Future EA**
 - **Speaker:** Chris Williams (Roke Manor)
 - **Description:** TBC
- **Practical Session**
 - **Speakers:** Capt Rene Raden and LtCol Marco Mehling
 - **Description:** Introduction and demonstration of Cooperative Electronic Support Measure Operations (CESMO), traditionally used for locating red and blue forces.
- **Practical Session**
 - **Speakers:** Maj Dave Keegan
 - **Description:** Introduction to the wargame participants will take part in on the last day, discussing the impact of future technologies on the battlefield.
- **Cognitive EW**
 - **Speaker:** Karen Haigh
 - **Description:** Overview of how cognitive systems and AI can be used in EW to respond quickly and effectively to battlefield conditions.

Day 5: Future Technologies in EW

- **Advanced Materials**
 - **Speaker:** Prof. Will Whittow (Loughborough University)
 - **Description:** With the new upcoming technologies such as 5G/6G networks, internet of things, vehicle-to-everything networks, satellite communications, satellite constellations and integrated communication & sensing; there have been significant improvements in developing new reconfigurable RF frontend systems such as antennas and metasurfaces. This talk will present some of the work developed by the Wireless Communications Research Group at Loughborough University focusing on additive manufacturing for RF systems, optically transparent antennas, intelligent beam-steering antennas, and new electromagnetic metasurfaces, and reducing radar cross section.
- **Spectrum Management**
 - **Speaker:** Leonardo Provvedi
 - **Description:** Leonardo Provvedi will discuss the importance of spectrum management, various approaches (manual, centralized, distributed, policy-based, cognitive radio), and standards (e.g., IEEE P1900). The session will cover spectrum management in a military context, including battlespace spectrum management and UK Defence Spectrum Management, the NATO approach, and the applications of machine learning and AI to spectrum management. The evolution of 5G and its applications, as well as a brief look ahead to the future of 6G, will also be included to provide context.
- **Future EW Wargame**
 - **Speakers:** Maj Dave Keegan and various
 - **Description:** Military personnel will facilitate a wargame focussed on how the future technologies presented by the summer school can be used in a simulated battlefield scenario.
- **Wrap Up**
 - **Speakers:** Maj Dave Keegan and various
 - **Description:** Closing remarks and presentation of certificates to participants.