

ELECTRONIC WARFARE and ARTIFICIAL INTELLIGENCE

Nicolae Sfetcu

MultiMedia Publishing

Electronic Warfare and Artificial Intelligence

BOOK PREVIEW

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Electronic Warfare and Artificial Intelligence

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Abstract

Electronic warfare is a critical component of modern military operations and has undergone significant advances in recent years. This book provides an overview of electronic warfare, its historical development, key components, and its role in contemporary conflict scenarios. It also discusses emerging trends and challenges in electronic warfare and its contemporary relevance in an era of advanced technology and cyber threats, emphasizing the need for continued research and development in this area.

The book explores the burgeoning intersection of artificial intelligence and electronic warfare, highlighting the evolving landscape of modern conflicts and the implications of integrating advanced technologies. The multifaceted roles of artificial intelligence in electronic warfare are highlighted, examining its potential advantages, ethical considerations, and challenges associated with its integration.

Keywords: electronic warfare, artificial intelligence, machine learning, cognitive warfare, asymmetric warfare, electromagnetic spectrum

Electronic warfare

Electronic warfare (EW) assists air, ground, naval, and space forces at multiple levels of conflict by limiting the use of the radio frequency (RF) spectrum (Lazarov 2019). A nation's defense system relies on EMS for its command and control (C&C) infrastructure, communications links, weapon systems, and support technologies.

EW enables kinetic warfare, which is simply ineffective in modern warfare without EW (Duke 2023).

Definitions

Electronic warfare (EW) includes “Military action involving the use of electromagnetic and directed energy to control the electromagnetic spectrum or to attack the enemy.” (Army 2016).

Electronic warfare includes three major subdivisions: electronic attack (EA), electronic protection (EP), and electronic warfare support (ES) (Army 2000, sec. I-1).

Electronic warfare refers to the use of electronic means in EMS to disrupt, deny, degrade, or deceive an adversary's information or communications systems without causing physical damage (Army 1996).

Information: Facts, data, or instructions in any medium or form. Information also refers to the meaning a human assigns to data through the known conventions used in representing it (Army 2016).

Information Operation (IO): IO is described as the integrated engagement of electronic warfare (EW), computer network operations (CNO), psychological operations (PSYOP), military deception (MILDEC), and operations security (OPSEC), along with specified support and related capabilities, to influence, disrupt, corrupt, or usurp adversarial and automated human decision-making while protecting us (Army 2020a).

Information Warfare (IW): Information operations conducted during a crisis or conflict to achieve or advance specific objectives on an adversary.

Information superiority: A state of equilibrium in one's favor in the information domain (Army 2020b, 8) or the operational advantage derived from the ability to collect, process, and disseminate an uninterrupted flow of information while exploiting or denying an adversary's ability to do the same (Army 2016, 257).

Information environment: The aggregate of people, organizations and systems that collect, process, disseminate or act on information (Army 2016, 257).

Electromagnetic environment: The resultant product of the power and time distribution, over various frequency ranges, of the levels of radiated or directed electromagnetic emissions likely to be encountered by a military force, system or platform when performing its assigned mission in its intended operational environment. It is the sum of electromagnetic interference; electromagnetic pulse; electromagnetic radiation hazards to personnel, artillery and volatile materials; and the effects of natural phenomena of lightning and static precipitation (Army 2016, 175).

Operational electromagnetic energy: A combination of the strength, frequency, and duration of electromagnetic emissions that may be encountered by a military force while performing its assigned mission (Army 2000, sec. I-1).

Directed energy: A general term that defines technologies related to the production of a beam of concentrated electromagnetic energy, atomic particles, or subatomic particles. It is used to damage or destroy an adversary's equipment, personnel, and installations (Army 2000, sec. I-4).

Electronic Intelligence (ELINT): The intelligence obtained from non-communicative external EM radiation. Electronic intelligence can be technical, geospatial or both (Kucukozyigit 2006).

Electronic security: The activity aimed at prohibiting unauthorized persons from accessing valuable information, resulting in the protection of friendly systems against activities such as interception or non-communications radiation (Kucukozyigit 2006).

Electronic reprogramming: Represents changes to EW and target-sensitive systems to accommodate changes in equipment, tactics, and the EM environment. These changes can be due to friendly or hostile activities. The desired outcome of electronic reprogramming is to support and increase the effectiveness of sensitive EW and targeting systems and devices used in defensive or offensive weapons and intelligence collection systems (Kucukozyigit 2006).

Emission Control (EMCON): The selective and controlled use of EM, acoustic and other emitters to achieve optimal C&C capabilities (Kucukozyigit 2006).

Spectrum management: is the planning, coordination and management of the EM spectrum. The objective is to create an EM environment in which friendly electronic systems can perform their functions without interference or confusion (Army 2000, sec. I-6–7).

Historical development

Electronic warfare has its roots in early radio and radar technologies. They can be traced back to the US Civil War in 1861. With the outbreak of the Civil War in 1861, telegraph wires became one of the most important targets. Military telegraph traffic was diverted to the wrong destinations, false orders were passed to Union commanders, and wires were cut to intercept information to Union forces (Price 1984, 1–2). These can be considered early applications of command, control, communications and intelligence (C3I), early examples of intelligence, jamming and deception (J. P. R. Browne and Thurbon 1998, 3).

The earliest documented use of EW was during the Boer War (1899–1902), when the British Army used a searchlight for Morse code signals from the clouds. The Boers noticed this and used one of their own searchlights in an attempt to jam the British signals (Judd and Surridge 2013).

The first known case of intentional jamming was, surprisingly, not for military purposes, but for civilian purposes, during the 1901 America's Cup yacht races in the United States. That

year, Marconi obtained a contract from the Associated Press. Another company, the Wireless Telegraph Company of America, also won a contract. A third company, the American Wireless Telephone and Telegraph Co., was unable to secure a sponsor, so it decided to jam the others using a more powerful transmitter (Price 1984, 3).

The first intentional use of radio jamming by the military occurred in 1902 during British naval exercises in the Mediterranean, then in 1903 during US naval maneuvers (Price 1984, 4).

During the Russo-Japanese War of 1904–1905, the Japanese located the Russian fleet in the Tsushima Strait and transmitted the information "wirelessly" to the Japanese fleet headquarters. On July 13, 1904, Russian wireless telegraph stations successfully disrupted communication between a group of Japanese battleships. This was also the first example of electronic countermeasures. Later, the captain of the Russian warship Ural requested permission to disrupt Japanese communications with a stronger radio signal, but Russian Admiral Zinovy Rozhdestvensky refused, thus allowing the Japanese to win a decisive battle at Tsushima (Rambo 2009).

During World War I and World War II, EW primarily involved radio jamming and radar deception. In 1939, just before the outbreak of World War II, the first ELINT mission was carried out by the German airship Graf Zeppelin along the east coast of Great Britain (Kucukozyigit 2006).

In World War II, the Allies turned to EW in the "Battle of the Beams", using navigational radars to direct bombers, with adversaries attempting to defeat those navigational radars (Rambo 2009). Chaff was used by the Royal Air Force (code name Window) during World War II to defeat radar tracking systems (McArthur 1990). In the first example of ECCM, the Germans increased the power of their radio transmitter in an attempt to "get through" or overcome British jamming, and this is still one of the main methods of ECCM today.

The Cold War era saw substantial advances in electronic warfare as the superpowers engaged in a technological arms race to overcome each other's surveillance and communications systems. Cold War developments included anti-radiation missiles designed to target enemy radar transmitters (Polmar 1979).

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During the Korean War (1950–1953) under General Mac Arthur, the US deployed 100 B-29 Superfortress heavy bombers to the theater of war. The North Koreans installed early warning radars and radar-controlled anti-aircraft artillery (AAA), so that aircraft losses became unacceptable (J. P. R. Browne and Thurbon 1998, 26).

Electronic warfare also played a major role during the Vietnam War, where aircraft often relied on EW to survive the battle, although the Vietnamese ECCM operated successfully (Dickson 1987).

In the First Gulf War (Operation DESERT STORM) in 1991, stealth fighters ventured into enemy airspace dropping decoys to trigger enemy radar into action; some carrying anti-radiation missiles that activated instantly as the radars appeared (Campen 1992, XIV).

In 2007, an Israeli strike during Operation Outside the Box (or Operation Orchard) used EW to disrupt Syria's air defenses (Fulghum and Wall 2007) (Katz 2010).

In the early days of the Russian invasion of Ukraine in 2022, Russian EW disrupted enemy radars and communications, disrupting ground-based air defense systems as well as their own communications (Bronk, Reynolds, and Watling 2022). Russian ability to disrupt GPS signals is credited with reducing the success of Ukrainian use of HIMARS and JDAM bombs (Mizokami 2023). According to a report by the Royal United Services Institute on May 19, 2023, Ukraine had lost approximately 10,000 drones per month due to Russian electronic warfare (Jankowicz 2023).

In modern warfare, electronic warfare has become a critical component. With the integration of sophisticated sensors, communication systems and information networks, the electromagnetic spectrum is crowded and contested. EW plays a vital role in gaining the edge in terms of situational awareness and tactical advantage.

EW in asymmetric warfare: EW is not exclusive to conventional warfare. It has gained importance in asymmetric conflicts, counterinsurgency operations, and counterterrorism efforts. Insurgent groups and non-state actors have also adopted rudimentary electronic warfare techniques.

Cyber-electronic convergence: The convergence of cyber warfare and electronic warfare has seen significant development. Adversaries are increasingly using cyber-attacks to disrupt electronic systems, blurring the lines between the two domains.

Space and electromagnetic spectrum dominance: As space becomes a critical domain for military operations, control of the electromagnetic spectrum in space is paramount. Satellites and space assets are vulnerable to EW attacks.

Contents

Abstract

Abbreviations

Introduction

- Electronic warfare
 - - Definitions
 - - Historical development
 - - The key components
 - - - Electronic attack (EA)
 - - - Electronic protection
 - - - Electronic support
- Techniques and tactics
- EW systems
 - - Radar
- Relationship of EW to other combat capabilities
 - - Cyber electronic warfare
- The main competitors
 - - US
 - - China
 - - Russia
 - - NATO
 - - European Union
- Challenges and trends
- Asymmetric warfare

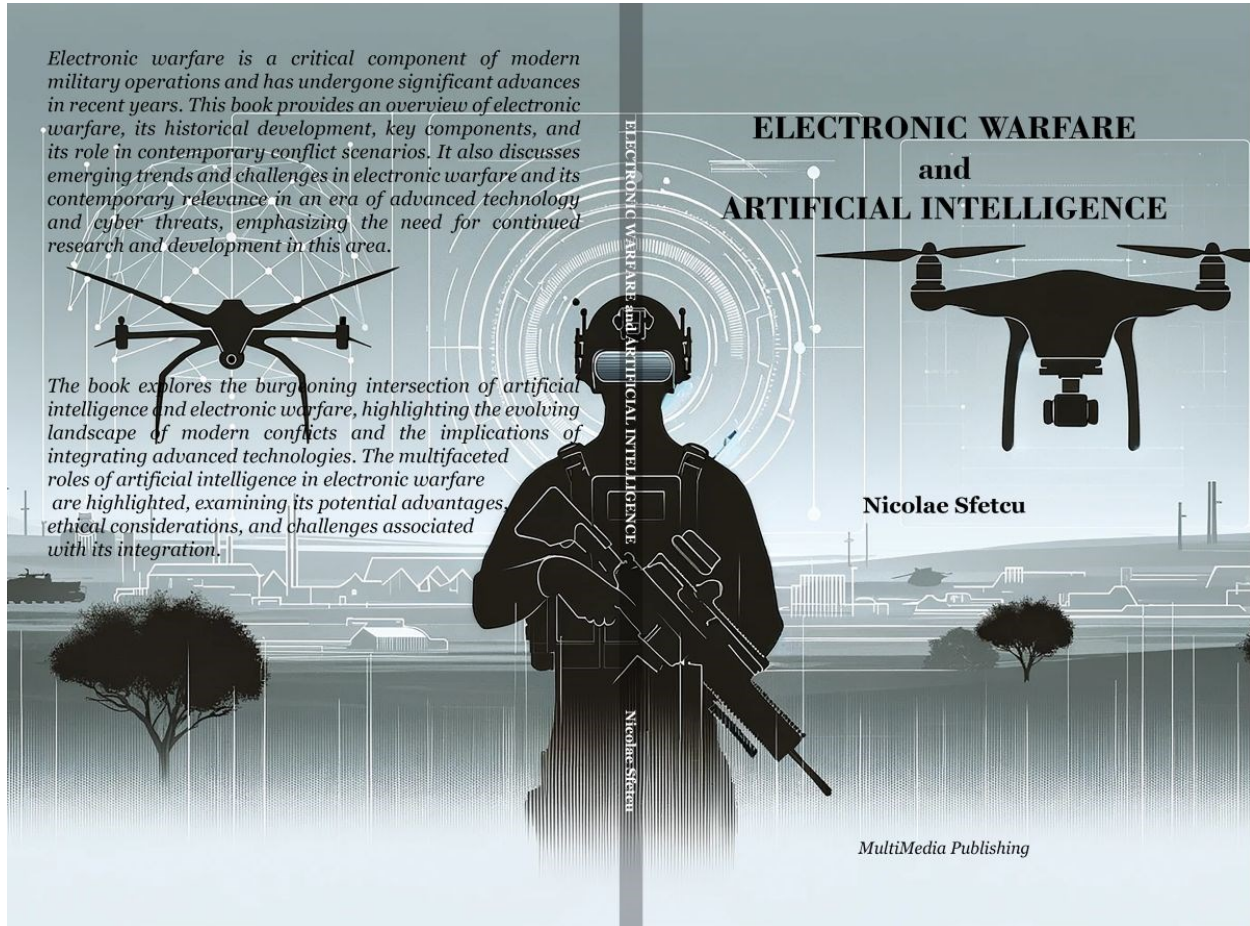
Artificial intelligence

- The historical background of electronic warfare
- The role of artificial intelligence in electronic warfare
 - - Specific applications
 - AI techniques
 - - Machine learning
 - - Fuzzy systems
 - - Genetic algorithm
- Trends
- Challenges and risks
 - - Ethical considerations
- Cognitive EW

Conclusion

Bibliography

Book



This book is ideal for business professionals, military strategists, or academic audiences.

- **Book Title:** *Electronic Warfare and Artificial Intelligence*
- **Author:** Nicolae Sfetcu
- **Publisher:** MultiMedia Publishing
- **Tagline:** *Redefining Modern Warfare Through Technology*

Why This Book is Essential

- **Critical Relevance:** Explores the intersection of artificial intelligence (AI) and electronic warfare (EW), pivotal in modern conflicts.
- **Timely Insights:** Focuses on emerging threats, including cyber warfare, AI in battlefield applications, and asymmetric warfare.

- **Expert Author:** Nicolae Sfetcu combines in-depth research with a forward-looking analysis.

Key Features of the Book

1. **Comprehensive Coverage:**
 - History of electronic warfare from its origins to the present.
 - Detailed analysis of key players: the US, China, Russia, NATO.
2. **Advanced Technology Insight:**
 - Role of AI in EW, including machine learning and cognitive EW.
 - Integration of electronic and cyber warfare.
3. **Strategic Focus:**
 - Practical applications for military and defense.
 - Challenges and ethical implications of AI in warfare.

Who Should Read This Book?

- **Military Professionals:** Gain an edge in strategic planning and EW operations.
- **Defense Contractors:** Understand market needs for emerging technology.
- **Academics & Researchers:** Explore interdisciplinary approaches in AI and warfare.
- **Policy Makers:** Frame international strategies for AI-enabled defense mechanisms.

Topics Covered

1. **History and Evolution of EW**
2. **Core Components of Electronic Warfare:**
 - Electronic Attack
 - Electronic Protection
 - Electronic Support
3. **AI Techniques in EW:**
 - Machine Learning
 - Fuzzy Systems
 - Genetic Algorithms
4. **Global Trends & Players:**
 - Cyber Warfare Integration

- Role of Major Powers: US, China, Russia

5. Ethical and Operational Challenges

Unique Selling Points

- **Cutting-Edge Content:** First-hand insights into the latest technological advancements.
- **Global Context:** Explains how EW and AI are transforming international power dynamics.
- **Actionable Insights:** Practical advice for defense and technology professionals.

What Readers Will Learn

- How AI is revolutionizing battlefield strategies.
- Techniques to counter asymmetric warfare threats.
- The future trajectory of EW systems and their global implications.
- Ethical frameworks to balance innovation with accountability.

Praise for the Book

- *"Nicolae Sfetcu's work is a landmark study that offers both breadth and depth in the rapidly evolving field of electronic warfare and AI."* - [MultiMedia]
- *"A must-read for defense professionals navigating the complexities of modern conflict."* - [MultiMedia]

Where to Buy

- Available at: [Publisher's Website](#)
- ISBN: 978-606-033-844-4
- Format: E-book and print editions.

Dive into the future of warfare and secure your copy of *Electronic Warfare and Artificial Intelligence* today!

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