Addressing the Gap within SIGINT PED Analysis with the Utilization of Artificial Intelligence

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Current Army signals intelligence (SIGINT) processing, exploitation, and dissemination (PED) is insufficient to support maneuver functions and MDO over-the-horizon radar tracking (OTHR-T) capabilities (Army Futures Command, 2020). This shortcoming will limit warfighters' targeting and maneuverability, emphasizing the urgent need for improvement. The Army Futures Command must integrate Artificial Intelligence (AI) into Signals Analysis, Processing, and Dissemination to significantly reduce analyst workload, increase sustainability, and improve target accuracy (Army Technology Transfer Program, n.d.).

Daily, SIGINT platforms generate terabytes of data from communication intercepts, radar emissions, and electronic signals, among other sources. This data varies by type, frequency, modulation, and complexity, necessitating sophisticated algorithms for detection, classification, and prioritization during processing and analysis. Manual processing of each Signal of Interest takes 12 to 18 person-hours and requires physical hardware and processing power over virtual instances. In contrast, AI-enabled digital signal processing is two to three times faster, reduces latency by up to 50%, consumes 20 to 30% less power, and eliminates irrelevant data before passing the relevant information to data-processing elements such as general-purpose processors, field-programmable gate arrays (FPGAs), and general-purpose graphics processing units (GPGPUs) (National Instruments Corporation, 2024). Introducing AI into PED operations will enable Military Intelligence, specifically SIGINT professionals, to analyze and identify new MDO targeting opportunities more efficiently (Ramirez, 2019). Sensor proliferation and the exponential growth in data and computing have transformed operational environments. AI can automate and simplify intelligence collection, processing, and analysis, streamlining the process of identifying and prioritizing collection targets across various varieties of intelligence functions and providing insights for warfighters (Center for Strategic and International Studies, n.d.).

Large Scale Combat Operations (LSCO) require rapid and decisive action to maintain a competitive edge over near-peer adversaries. The information and intelligence needed for quick decision-making in intense, lethal, and complex operations must be supported by real-time or near-real-time processing. The Army Modernization Strategy (Whitley et al., 2021) focuses on increasing speed and enhancing the agility of the US Army by developing capabilities that enable faster deployment, quicker decision-making, and more efficient execution of operations. Specifically, the strategy includes updating technology, training, and organizational structure to ensure that the Army can operate at a pace that outmatches adversaries (Whitley et al., 2021).

The current demand for skilled analysts often exceeds the available supply. Analysts spend significant time on routine tasks, which reduces their availability for higher-level analysis and decision support crucial for effective intelligence operations (CSIS, 2023). Training new analysts to the required level of expertise takes time, while unfilled positions delay information processing and create bottlenecks, leading to missed opportunities in intelligence exploitation. However, implementing artificial intelligence software algorithms into the PED process can mitigate these challenges. AI-driven automation preprocesses raw SIGINT data, including noise reduction, signal detection, and feature extraction, while machine learning models automatically classify and identify signals, reducing the need for manual effort. Additionally, AI prioritizes intercepted signals based on relevance and urgency, ensuring that critical intelligence receives immediate attention (AI2C, n.d.).

Furthermore, real-time processing through AI models deployed on SIGINT platforms for edge computing and streaming analytics literally analyzes data as it is collected. Human-AI collaboration is enhanced through augmented intelligence systems that assist analysts by highlighting significant findings, generating hypotheses, and providing context for complex signals. Moreover, designing AI systems with modular architecture and integrating cloud computing allows for scalable and adaptable AI processing, meeting evolving signal types and operational requirements (National Instruments Corporation, 2024).

Before AI, SIGINT professionals divided their time among gathering, processing, analyzing, and delivering intelligence to the warfighter. However, time spent on these tasks diminished the actionable effectiveness of that intelligence. AI enables SIGINT professionals to concentrate on analyzing preprocessed data to mitigate risks to the force. SIGINT analysts empowered with AI will advise units more accurately and rapidly on potential targets and threats.

Processing capabilities designed to leverage artificial intelligence enhance data processing and intelligence production speed. PED analysis powered by artificial intelligence boosts the accuracy and effectiveness of relevant intelligence by reducing response time. The same principle applies to artificial intelligence in the hands of SIGINT professionals (Ramirez, 2019).

The US Army must address the ever-broadening gap in SIGINT analysis and PED. Failure to implement artificial intelligence will increase vulnerability to enemy attacks, delay response times, reduce the effectiveness of intelligence operations (AFC, 2020), and jeopardize the Army's ability to win future conflicts. Adversary artificial intelligence will impact on the Army's ability to remain competitive and potentially cost the lives of tens of thousands of US service members (CSIS, 2023).

AFC and HQDA G-2 must develop and safely integrate AI systems into programs of record to improve the Intelligence Cycle. Implementing AI in SIGINT PED enhances data processing speed, accuracy, and relevance capabilities. Consequently, intelligence agencies can significantly improve efficiency, responsiveness, and intelligence exploitation. This approach streamlines data processing and analysis, fostering human-AI collaboration and empowering analysts to make informed decisions faster in complex and rapidly changing operational environments. As technology evolves, leveraging AI in SIGINT operations remains crucial for maintaining national security and effectively countering emerging threats (Artificial Intelligence Integration Center, AI2C).

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