Architecting AI Drone Communication for the Military Using Free-Space Optical Communication

Sage, Drake (School: The Meadows School)

Collaborative Combat Aircraft (CCA) are AI-driven drones designed to operate alongside manned fighter jets as part of the Air Force’s Next Generation Air Dominance initiative. However, these systems require robust, secure communication to ensure effective coordination. Traditional radio-frequency (RF) communication is highly susceptible to electronic jamming, leading to potential mission failure. This research investigates Free-Space Optical Communication (FSOC) as a high-speed, jam-resistant alternative. FSOC utilizes infrared light for data transmission, offering increased security and reliability. Inspired by biological communication models such as the honeybee waggle dance, this study tests whether AI-driven CCAs can interpret modulated FSOC signals for real-time data exchange. A prototype infrared communication system was developed using a Raspberry Pi transmitter and an Arduino Uno receiver, with AI models trained to encode and decode IR signals. Latency and accuracy were analyzed across different signal complexities, and FSOC was tested under simulated electronic jamming conditions alongside RF. Results demonstrated that FSOC maintained stable latency under interference, while RF exhibited high variability. However, accuracy declined with increasing signal complexity, highlighting the need for further refinement. These findings show that FSOC presents a viable solution for secure AI communication and will become increasingly consistent with additional advancements in hardware and AI-driven interpretation. Future research can incorporate NEC protocols and advanced AI learning models to enhance the accuracy and efficiency of FSOC in military drone operations, improving mission success rates, pilot safety, and overall air superiority.

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