

Air Force to Develop AI/ML EW Technologies Under Project Kaiju

The Air Force Research Lab's Sensors Directorate (Wright-Patterson AFB, OH) is planning to embark on a major research and development effort that focuses on developing Artificial Intelligence (AI) and Machine Learning (ML) technologies for electromagnetic warfare (EW) applications.

Last month, the Directorate's Spectrum Warfare Division, RF Electronic Warfare Branch (AFRL/RWE) issued a Notice of Contract Action (NOCA) for Project Kaiju, a five-year, \$150 million effort to develop a range of AI/ML-related technologies and resources to advance EW technology against emerging Integrated Air Defense System (IADS) capabilities. The program description states, "As IADS advance towards employing multi-spectrum capabilities, a foreseeable problem is the relevancy and effectiveness of countermeasures (CMs) developed for a single spectrum when they are employed against a multi-spectrum threat." Potential adversaries are developing multi-spectral sensor and missile seeker technologies that combine RF, EO and IR performance on a single air defense system or missile, which will challenge the Air Force's single-mode EW systems. The description goes on to say, "With adversaries understanding the importance of HVAA [High Value Airborne Assets] to mission success, as well as their vulnerabilities, HVAA may become a likely target for emerging longer-range advanced threats. Continued HVAA Protection is key for the AF to maintain air superiority and satisfy their core mission goals (e.g., Intelligence, surveillance, and reconnaissance (ISR), Global Reach, command and control (C₂), etc.)."

The goal of Project Kaiju is to develop autonomous AI/ML-based

EW systems that do not depend on communicating with AI/ML resources in other locations. The program description explains, “As AI/ML advances, it will be able to process and utilize larger amounts of data in real-time, opening the potential for autonomous EW on an asset. This ability to have the capability for on-board data collect and analysis will be necessary for future closed-loop real-time autonomous reactions to changes or unknowns in the perceived Electromagnetic Spectrum (EMS) environment (i.e., closed-loop sensing and self-protect jamming). Essential for rapid insertion and assessment of AI/ML technology are the adoption of open standards, agile Devops/algorithm development, and process validation tools environments.” (For more on AI/ML-based EW, see the September 2021 *JED*.)

Project Kaiju comprises nine research areas that will investigate many facets of AI/ML technology, from modeling and simulation to software defined radios to algorithm development. In keeping with the project name (Kaiju refers to the genre of Japanese monster movies), all nine research areas are named after classic movie “creatures.” Here are the descriptions from the NOCA:

(Gamera) Big Data for Cognitive EW (CEW) Research: Conduct a study that investigates which key community developed tools should be integrated into a common and modular framework to generate “Big Data.”

(King Ghidorah) Software-Defined Radio (SDR) Research: SDR code library requires in- depth investigation of target system hardware for the purpose of understanding its operation for the purpose of creating the best possible SDR emulation of the target system. Procurement of target systems, development of data links to interface with SDRs and other equipment to command and control systems, disassembly (to include destructive testing) of target systems, lab, field and flight testing, and procurement of candidate SDR hardware/software.

(Mecha Rodan) Multi-Spectrum Threat Defeat: Refine existing Multi-Spectrum modeling and simulation environments to add advanced capabilities (including model accuracy) that span across Electronic Support (ES) and Electronic Attack (EA).

(Kumonga) RAPTURE Laboratory: Design, fabricate, test, and document special-purpose hardware to meet research and development test requirements for Size, Weight, and Power (SWAP)-constrained program requirements. Perform lab and field testing of custom designed hardware (includes soldering surface mount Printed Circuit Board (PCB)'s, modifying PCB's, assembling custom cables, computer aided design (CAD) of custom enclosures, and assembly of the final product).

(Mothra) EA Demo: Build a reconfigurable EA processing framework for assessment of EA capabilities (emitter tracking, technique selection, technique generation).

(King Kong) Real Time Algorithm Development: Utilize government-furnished hardware architecture description to determine the viability of government-furnished non-real-time machine learning algorithms for real-time applications.

(Baragon) RF EW Demonstrator (REWD) for Next Sortie Mission Data Reprogramming: Develop, mature, and evaluate advanced EW algorithmic concepts to detect, sort, identify, disambiguate, and track complex emitters in complex environments. This includes leveraging algorithms developed under Defense Advanced Research Projects Agency's Adaptive Radar Countermeasures (ARC), AFRL's Electronic Support Critical Experiment (ESCE), and ONR's Reactive Electronic Attack Measures (REAM) programs. Baragon will also include integrating multi-sourced processing chains, closed-loop software component control and tuning, component performance comparison, analysis and visualization products to aid human/machine teaming and trust.

(Colossus) Advanced Threat Defeat (ATD): Develop novel and

cognitive electronic warfare capabilities to generate multi-layered EA techniques resulting in long-range kill webs. Leverage distributed sensing, machine learning and AI and align with Advanced Battle Management System (ABMS) concepts for autonomous vehicles to enable Joint All Domain Command and Control (JADC₂) resulting in coordinated joint fires and convergence of EW effects.

(Godzilla) Program Management: Perform program management of scope, schedule, cost, and risk for the overall contract and for each individual research project and development activity.

The NOCA also notes, “Additionally, this BAA will address the issues both individually and collectively. No R&D conducted under this program will be done in isolation, but rather in full consideration of how the new technologies can progress toward full integration with large, complex systems, ready to transition to support of the warfighter.”

Project Kaiju is expected to run for 63 months with a total program budget of \$150 million. AFRL expects to award two contracts. The main contract, valued at \$135 million, covers all tasks and technical objectives. The second is a \$15 million “niche” contract that will incorporate Godzilla and focus on one or more of the Mothra, King Kong, Baragon and Colossus efforts.

AFRL expects to hold a Project Kaiju Industry Day later this month, which will likely be a virtual event. It plans to issue a Broad Agency Announcement (BAA FA8650-22-S-1004) in January. The technical point of contact is Gary Kaufman, AFRL/RWYE, (937) 713-4007, e-mail gary.kaufman.1@us.af.mil. – J. Knowles