Joint Aircraft Survivability Program (JASP)

In FY23, the Joint Aircraft Survivability Program (JASP) continued to advance tools, processes, infrastructure, and workforce to transform the OT&E and LFT&E of aircraft survivability. For example, JASP delivered new digital tool capabilities enabling: 1) enhanced evaluations of the effects of red threat engagements against blue rotary wing aircraft in the low altitude battlespace and 2) improved capability to predict engagement induced aircraft fires, with increased confidence.

In FY23, JASP also continued the development of new techniques and technologies demonstrating the potential to enhance the survivability of U.S. aircraft in contested, multi-domain operations. For example, JASP delivered: 1) new electronic attack (EA) techniques to counter advanced radar threats, 2) new application of a fielded 2-Color infrared (IR) missile warning system to detect a new class of missile threats, 3) enhanced man-portable air-defense systems hardware-in-the-loop simulation capabilities by utilizing actual missile seeker tracking and guidance hardware, 4) a high output, low divergence laser prototype capable of providing improved IR countermeasures aircraft defense, and 5) a new light-weight self-sealing aircraft fuel bladder design.

PROGRAM OVERVIEW

The Joint Technical Coordinating Group on Aircraft Survivability (JTCG/AS) was chartered in 1971, in response to high aircraft loss rates experienced during the Vietnam War. The JTCG/AS initially focused on aircraft susceptibility reduction (design characteristics that make an aircraft harder to detect) and aircraft vulnerability reduction (design characteristics that give an aircraft the ability to withstand a hit). The JTCG/AS focus later grew to include modeling and simulation and establishing aircraft survivability as a design discipline through the development of a formal curriculum at the Naval Postgraduate School.

In 1985, the oversight responsibility of the JTCG/AS was assigned to the newly established Joint Aeronautical Commanders Group (JACG). Funding for the JTCG/AS was consolidated under what is now the DOT&E.

In January 2003, the JACG signed a new charter establishing JASP to replace the JTCG/AS while expanding the JTCG/AS charter to include the Joint Combat Assessment Team (JCAT).

In 2005, the service aviation systems commands (U.S. Army Aviation and Missile Command, U.S. Air Force Life Cycle Management Center, and Naval Air Systems Command) chartered JASP as it is known today.

MISSION

JASP develops cross-Service aircraft survivability solutions and evaluation methods needed to dominate the air domain and mitigate U.S. aircraft losses in combat. Specifically, JASP:

- Advances the capability and credibility of joint aircraft combat effectiveness tools used in combat mission planning, training, and weapon schools to support the development of air combat tactics, techniques, and procedures.
- Develops and manages enterprise-level digital tools required to support comprehensive evaluation of aircraft effectiveness and survivability, with confidence.
- Collects and analyzes U.S. aircraft combat damage and losses via the Joint Combat Assessment Team, to develop the requirements for joint aircraft survivability solutions that provide force protection and remedy operational shortfalls.
- Leverages advances in science and technology to develop innovative aircraft survivability enhancement features.

FY23 KEY ACTIVITIES

» ADVANCING THE CAPABILITY AND CREDIBILITY OF JOINT AIRCRAFT COMBAT EFFECTIVENESS TOOLS

JASP, in coordination with the Joint Technical Coordinating Group for Munitions Effectiveness (JTCG/ME), continued the co-development of the Air Combat Effects Library (ACEL) – the joint suite of Intelligence Community threat models and Service-based simulations for use in multi-domain combat simulations. ACEL underpins the Survivability and Lethality of Aircraft in a Tactical Environment (SLATE) v1.x and Joint Anti-Air Model (JAAM) v6.x applications shown in Figure 1. ACEL enables a collection of hostile and U.S. systems simulations across air, sea, and surface domains with multiple weapon classes enabling evaluation of the combat survivability and lethality kill chains. SLATE supports one-on-one, few-on-few engagements, or batch runs with large collections of engagement permutations. SLATE supports acquisition system evaluations and long-lead ACEL development of credible simulations. Once ACEL capabilities are demonstrated within SLATE, they are migrated for use in JAAM supporting operational warfighters' tactics, techniques, and procedures development, debriefing and training across the DoD.

Air Combat Effects Library (ACEL)

In FY23, JASP advanced ACEL for the low-altitude and high-altitude battlespace, by maturing the helicopter aero performance simulation (BlueMax), and

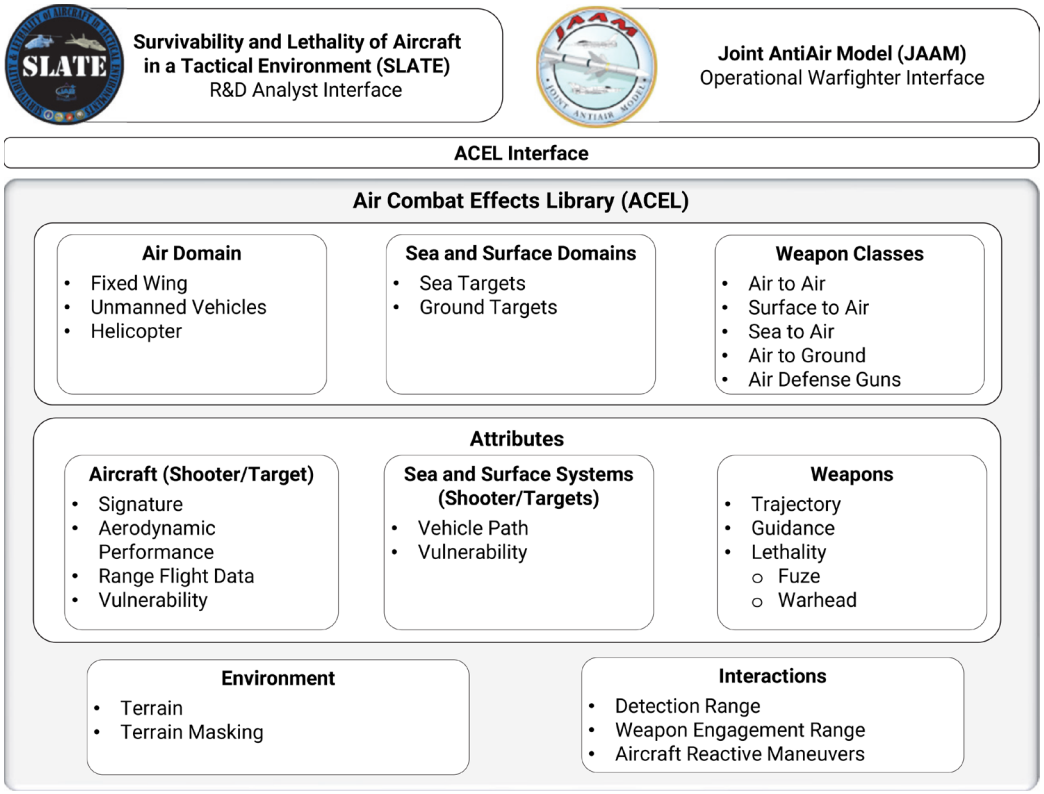

Figure 1. Air Combat Effects Library Architecture

weapon simulations for surface, sea, and air-artillery weapons. JASP continued a multi-year investment in helicopter aero performance methodology (BlueMax) for single main rotor, tandem rotor, and tilt-rotor vehicles. BlueMax's fourth helicopter aero data set was provided for use in ACEL. Figure 2 illustrates the helicopter aerodynamic simulation capabilities in ACEL that include takeoff, flight, hover, and landing.

In FY23, JASP and JTCG/ME also: 1) streamlined the process and reduced the migration of Intelligence Center surface to air missile (SAM) simulations into ACEL from four months to two weeks and 2) advanced ACEL's weapon lethality and helicopter target vulnerability simulation and data for missiles and air-artillery projectile attack.

Survivability and Lethality of Aircraft in a Tactical Environment (SLATE)

In FY23, JASP evolved the SLATE application's graphical displays along with development of ACEL's new capabilities. SLATE was used to demonstrate simulation capability in areas of high-fidelity terrain, terrain masking, radio frequency (RF) signal propagation, enhanced chaff displays, bursts of air-artillery projectiles flyouts, naval SAM flyouts, and helicopter dynamic blade flash signature. Figure 3 illustrates a simulation of a helicopter reactive maneuver with chaff against incoming hostile missile.

In FY23, JASP conducted the first phase of the Joint Aircraft Threat Modeling Simulation Validation effort to validate Integrated Air Defense System digital tools

Figure 2. Helicopter Aerodynamics Simulation

Figure 3. SLATE Low-Altitude Helicopter/SAM Engagement

and their engagement with the U.S. Army UH/HH-60M aircraft equipped with radar countermeasures. JASP successfully validated the SLATE graphical interface, Enhanced Surface-to-Air Missile Simulation (ESAMS), and BlueMax7 using flight these test data.

Joint Anti-Air Model (JAAM)

JAAM's broad usage provides common operational insight regardless of squadron or test range's debriefing tool. In FY23, the JTCG/ME's JAAM application was used daily by warfighters at operational squadrons, test and training ranges, mission rehearsals, and debriefing to evolve tactics. The user base included 360 sites and 4,000 personnel:

- Operational Squadrons and Intelligence Community
- Test/Training ranges, mission playback and debriefing applications
- Joint Mission Planning System

In FY23, JTCG/ME in coordination with JASP, developed a beta version of the next generation JAAM application. The JAAM user interface was designed to provide warfighter intuitive workflow and advanced graphical displays. The new design uses a modern graphical engine to enable agile development and integration with ACEL's shooters and targets across air, sea, and land domains. ACEL's new helicopter capabilities will further expand the JAAM user base in the out-years.

» DEVELOPING AND MANAGING ENTERPRISE-LEVEL DIGITAL TOOLS

In FY23, through tri-Service configuration control boards, JASP continued the management of major digital tools used to estimate air combat effectiveness and survivability against an array of operationally representative kinetic threats. The toolsets include the air-to-air combat simulation Brawler, the surface-to-air engagement model ESAMS, multiple domain air combat simulation SLATE, and the vulnerability analysis code Computation of Vulnerable Area Tool (COVART), along with its supporting penetration and fire prediction codes Projectile Penetration, Fast Air Target Encounter Penetration, and the Next Generation Fire Model (NGFM). Table 1 provides a matrix of JASP-supported modeling tools used for acquisition programs under DOT&E oversight.

Table 1. DOT&E Oversight Programs Supported by JASP Tools

Acquisition Program Type	ACAT/ BCAT	Brawler	ESAMS	SLATE	COVART	NGFM
Bomber Aircraft	-	1	1		1	1
Fighter Aircraft	ID, IC, II	5	5		4	1
Rotary-Wing Aircraft	IB, IC		3	3	2	2
Transport/Tanker Aircraft	IC		1		2	1
Special Use Aircraft	ID, III		1		2	2
Weapons	IC	1				
Totals		***7***	***11***	***3***	***11***	***7***

Acronyms: ACAT – Acquisition Category; BCAT – Business System Category; COVART – Computation of Vulnerable Area Tool; ESAMS – Enhanced Surface-to-Air Missile Simulation; NGFM – Next Generation Fire Model; SLATE – Survivability and Lethality of Aircraft in Tactical Environments

In FY23, JASP also:

- Continued the Machine Assisted Exploitability Simulation for Testing Resilient Operations effort to add cyber survivability evaluation capability to the COLE tool. Advancements included the

- representation of threat actor capabilities, aircraft operational technologies, system and mission state models and vulnerability assessments. This effort, in collaboration with the Air Force, Army, and Navy aviation cyber survivability communities, provides digital tool capability and data standardization to develop and evaluate aircraft survivability in contested cyberspace.
- Advanced efforts to inform survivable design decisions by coordinating requirements for a survivability digital ecosystem to provide joint community access to authoritative aircraft survivability data and enhance the efficiency and speed of acquisition, T&E, and design decisions.
- Released the initial version of the Next Generation Fire Model tool for use by the community to inform acquisition decision-making regarding aircraft vulnerability to fires – one of the largest aircraft vulnerability contributors.

Collect and Analyze U.S. Aircraft Combat Damage and Losses using the Joint Combat Assessment Team

In FY23, JASP continued to enable aircraft combat damage incident reporting through the JCAT. The JCAT is heavily engaged with Indo-Pacific Command and European Command supporting operational commanders with combat data collections while also leveraging operational exercises. They developed new concept of operations utilizing Title 50 (i.e., intelligence) tools to enable the near real time forensics of aircraft combat damage.

JASP also transitioned the Combat Damage Incident Reporting System from the National Ground Intelligence Center to the U.S. Army Corps of Engineers Engineer Research and Development Center to enable combat incident reporting and data sharing across the DoD, Services, and combatant commands. Combat Damage Incident Reporting System is available via SIPRNet.

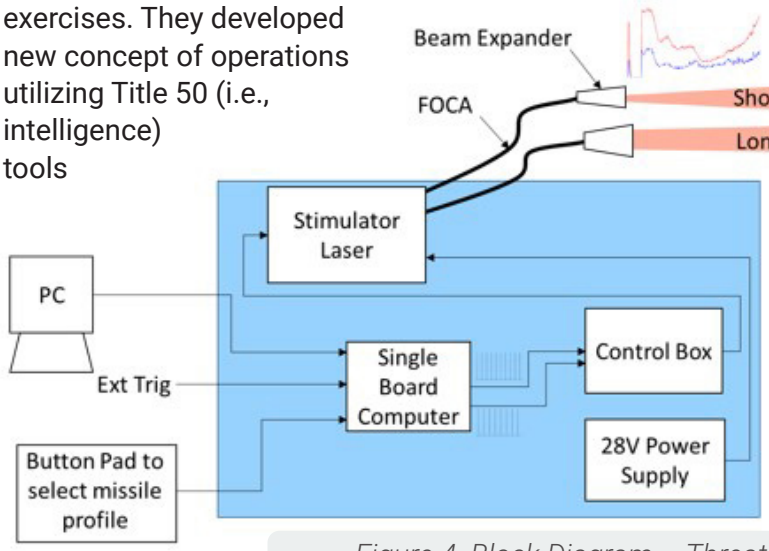

Figure 4. Block Diagram – Threat Launch Simulator 2CIR MWS

» DELIVERING INNOVATIVE SURVIVABILITY ENHANCEMENT FEATURES

Threat Detection and Countermeasures Technologies

In FY23, in collaboration with the OSD and Service organizations, JASP matured threat detection and countermeasure technologies needed to defeat advanced electro-optical (EO)/IR- and RF-guided threat systems. For example, the RF Threat Launch Detection and Track project was designed to develop algorithms to allow currently deployed DoD IR warning systems to detect and track RF missile threats and is transitioning into an Air Force Special Operations Command acquisition program. In partnership with the Naval Research Laboratory, JASP continued the development and demonstration of aircraft self-protection RF EA technologies and EO/IR technologies. JASP leveraged the validated threat simulator at the Naval Air Systems Command Electronic Combat Simulation and Evaluation Laboratory, to demonstrate the effectiveness of advanced techniques against a class of stressing RF threats. Specifically, the modern anti-countermeasures effort has demonstrated new EA techniques, including coordinated EA and determining effectiveness to countering such systems. Where validated threat simulators were not available, JASP, in coordination with the intelligence community, developed an electronic warfare environment for a specific type of threat to further develop and test EA

techniques to counter such specific type of threats. This provided the Services with a unique capability for development of countermeasure techniques.

In addition, JASP supported the development of a successful prototype system that can produce transmitted missile signatures detectible by aircraft in the field – the threat launch simulator 2-Color IR Missile Warning System (2CIR MWS). The Naval Research Laboratory demonstrated the capability to produce the simulated missile signatures suitable for 2CIR MWS performance testing. Figure 4 depicts a block diagram of the Threat Launch Simulator 2CIR MWS.

JASP continued the development of a Reconfigurable Signal Injection Missile Simulation Hardware-in-the-Loop (HITL) Simulation of Advanced Threats. This HITL simulator for multiple reticle-based IR missiles utilizes actual missile seeker tracking and guidance hardware and will support testing against advanced threats that were previously unavailable.

In FY23, JASP funded development of a 20-watt Mid-Wave Infrared laser which could provide improved infrared countermeasures aircraft defense. JASP supported the fabrication of all laser subcomponents to include a completed laser driver that accepts external waveforms.

Force Protection Technologies

In FY23, JASP successfully tested a design optimization methodology for self-sealing fuel cell bladders that demonstrated an up to 35 percent decrease in weight while meeting the predetermined crashworthiness requirements. Other JASP testing further quantified the decrease in ballistic ignition of aircraft coolant fluid treated with a mist control additive which could reduce aircraft vulnerability with minimal weight impact.