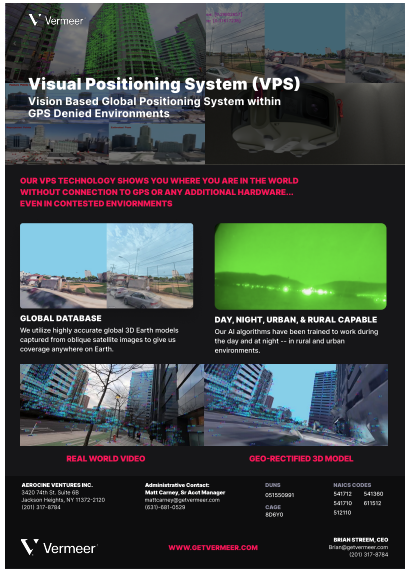
A-01: Navigation in a GPS Denied Environment utilizing visual positioning system, SLAM, Digital optometry and IMU

Naval Postgraduate School Joint Interagency Field Experimentation (JIFX)

NPS JIFX 22-4 | 15 – 19 August 2022



PROJECT INFORMATION

Organization Name:	Vermeer
Principal Investigator:	Derek Davis
Technology Readiness Level:	TRL 8: Actual system completed and qualified through test and demonstration.
Research Area of Interest:	A) Unmanned Aerial Systems
Experiment Location:	NPS Field Laboratory at Camp Roberts

PROPOSED EXPERIMENT OVERVIEW

Proposal to create a system that can provide live real-time global positioning estimates to warfighters using a variety of data and prior information, particularly in GPS denied, jammed, or corrupted environments. The proposed system can also accept GPS signals and seamlessly integrate when GPS or other navigation signals are available. . Organic visual odometry algorithms are in active development to process image data that enables feature extraction in various forms. The resulting output when combined with algorithmic models and result in high fidelity 3D data locally sourced data provides enhanced estimations of current location placing the object within 2 meters of exact GPS location.

SYSTEM DESCRIPTION

VISION BASED PNT: a computer vision system to determine location in gps denied/spoofed environments (drones, satellites, ATAK, ground vehicles, helicopters and other aircraft, more). and Vermeer technology, we have built VIO algorithms for image processing along with Simultaneous Localization and Mapping (SLAM) algorithms to provide a robust PN solution to the DoD's need for localization in GPS denied environments. Vermeer has demonstrated integration with a USG/DoD approved platforms for purposes of showcasing this capability.

A-02: AeroVironment GPS-Denied

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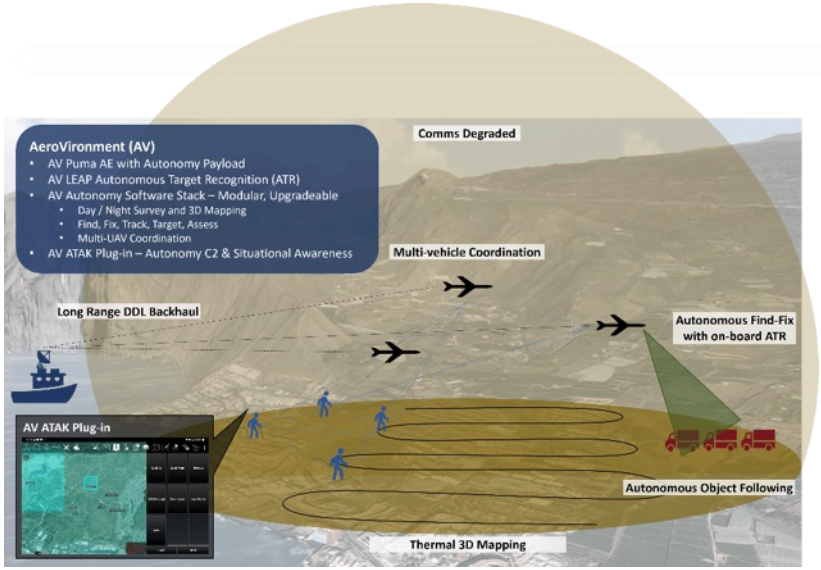

PROJECT INFORMATION

Organization Name:	AeroVironment
Principal Investigator:	Jillian Vlasko
Technology Readiness Level:	TRL 6: System/subsystem model or prototype demonstration in a relevant environment.
Research Area of Interest:	A) Unmanned Aerial Systems
Experiment Location:	NPS Field Laboratory at Camp Roberts

PROPOSED EXPERIMENT OVERVIEW

AV will experiment with a preliminary ATAK plug-in providing tasking to an autonomous Puma through a computer on-board the aircraft for autonomy functions.

- Look-at: will point the camera to a desired location in the map.
- Look-From: will navigate the Puma vehicle to the selected location and will make it loiter around that point.
- Region survey and map: the selected region will be surveyed and imagery will be collected for post processing.
- Object detection and tracking With the survey and mapping missions we will collect IR images of the terrain. These images will be post processed to generate a 3D rendering of the terrain. This terrain will be compared to that of one obtained with EO images. If successful, will experiment the capabilities at night and with comms-denied scenarios.

SYSTEM DESCRIPTION

The basic system to be tested consists of 3 main systems:

- Stock Puma AE with ground station
- Onboard COTS computer running autonomy algorithms
- ATAK enabled tablet

A-03: Shifting CG, Kickback, and Launching/Catching Drones

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PROJECT INFORMATION

Organization Name:	Rhoman Aerospace
Principal Investigator:	Thomas Youmans
Technology Readiness Level:	TRL 6: System/subsystem model or prototype demonstration in a relevant environment.
Research Area of Interest:	A) Unmanned Aerial Systems
Experiment Location:	NPS Field Laboratory at Camp Roberts

PROPOSED EXPERIMENT OVERVIEW

Drones with shifting payload, CG, and kickback: Launching and catching drones We've been working on control systems for drones that handle shifting cargo and shifting CG, and we've partnered with a company working on small drones that can launch from a box... we have a 5ft x 9ft hexacopter drone that we've brought to JIFX before, and now it's flying! And - we want to use CG adaptive control, and the ability to handle kickback, to carry a small box with five 7" drones on our large mothership drone, have the small drones fly around, then have the small drones land back in a net suspended from our mothership drone.

SYSTEM DESCRIPTION

At the core of our technology are algorithms that handle projectile kickback, ad hoc cargo and variable CG of drones and payload systems. We're also working on a technology that takes DARPA cave mapping spatial mapping, and deploys this above ground - for a 3D spatial area map (ie Digital Twin) based positioning system. This is not yet ready for testing.

A-04: AZ Flyer

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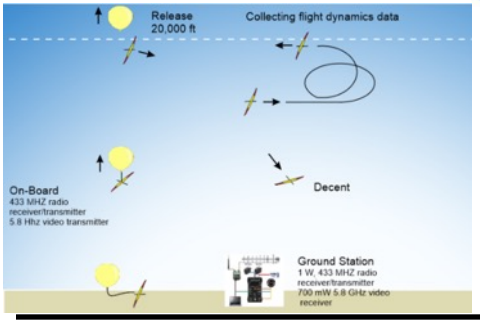

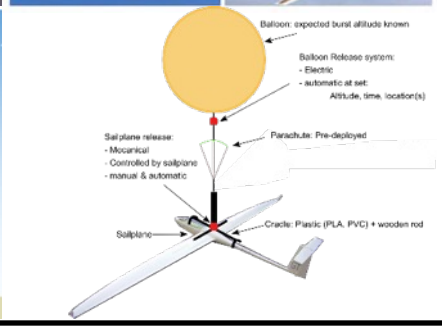

PROJECT INFORMATION

Organization Name:	University of Arizona
Principal Investigator:	Sergey Shkarayev
Technology Readiness Level:	TRL 5: Component and/or breadboard validation in relevant environment.
Research Area of Interest:	A) Unmanned Aerial Systems
Experiment Location:	NPS Field Laboratory at Camp Roberts

PROPOSED EXPERIMENT OVERVIEW

The main goal of the proposed testing campaigns is to verify the ability of a UAV glider to harvest energy from wind gradients in high-altitude jet streams via dynamic soaring for prolonging flight. This will involve a 12ft wingspan off the shelf electric glider UAV (RC Glider) with two key missions:

1. Testing of the communication systems and the autopilot's capabilities with a conventional powered flight up to 10,000ft.
2. Testing the glider's launch system, a high altitude balloon and glider release system up to 14,999 ft (or JIFX limits).

Both operations include testing of dynamic soaring routines with the assistance on an onboard computer. The objectives are system development and research data acquisition. Data from all sensors is stored onboard at high rate and transmitted to a dedicated ground station for live telemetry and remote piloting.

SYSTEM DESCRIPTION

Aircraft: the Diana 3.7m. An off the shelf glider scale model with 3.7m wind span manufactured by Icarus. Includes an electric motor propulsion system. Equipped with autopilot and sensor system: Pixhawk Cube autopilot and sensors with the ardupilot flight firmware (Stable release versions only). Along with an onboard computer: Raspberry pi 4, responsible for experimental dynamic soaring flight planning and data collection using in house software. Multiple backup position reporting systems available: APRS and Global-star Launch system: An off the shelf helium filled high altitude balloon with independent cutdown/flight termination system. Carrying a backup parachute an glider release cradle (with glider release mechanism) as it's payload Ground station and communications: Dedicated ground station with a live vide link (2.4Ghz) and a flight control and telemetry link (433Mhz). developed in house using laptops with the Mission Planner software for flight monitoring.

A-08: Alt-Nav using VIO and LASER range-finder

Naval Postgraduate School Joint Interagency Field Experimentation (JIFX)
NPS JIFX 22-4 | 15 – 19 August 2022

PROJECT INFORMATION

Organization Name:	USASOC SOTF-CDD
Principal Investigator:	Carlos Legoas
Technology Readiness Level:	TRL 5: Component and/or breadboard validation in relevant environment.
Research Area of Interest:	A) Unmanned Aerial Systems
Experiment Location:	NPS Field Laboratory at Camp Roberts

PROPOSED EXPERIMENT OVERVIEW

The validity of VIO and LASER range finding in determining the location of an air vehicle without the use of GPS (whether denied or as a backup system to GPS).

SYSTEM DESCRIPTION

A FreeFly Alta-X with an Aervironment AR kit that will use VIO and LASER range finding (based on DTED data) to determine its position in space.

B-03: Bat Mode Add-On Module for Existing UAS Enabling Persistent ISR, Mothership Swarms & Auto Recharging

Naval Postgraduate School Joint Interagency Field Experimentation (JIFX)

NPS JIFX 22-4 | 15 – 19 August 2022

PROJECT INFORMATION

Organization Name:	VRR (dba VR Robotics & VR Rehab)
Principal Investigator:	Kevin Hernandez
Technology Readiness Level:	TRL 7: System prototype demonstration in an operational environment.
Research Area of Interest:	B) Unmanned Systems (UxS) Design, Deployment, Operation, Networking and Control
Experiment Location:	NPS Field Laboratory at Camp Roberts

PROPOSED EXPERIMENT OVERVIEW

Test HellHive™ deployment. Swarm launching of at least five drones at a time, supplied by VRR/ASU and other partner drone manufacturers. Test Bat Mode capability enabling 36-hours+ Persistent ISR/CBRN Threat Monitoring with selected existing COTS sUAS on a single charge, including battery monitoring, meta-data, and video recording for use by other AI tools such as automated target recognition, etc. Test Bat Mode enabling Swarm Launching and Recovery from HellHives from Static and Moving Ground Vehicles, and UAS Motherships (Hovering = Threshold, Moving = Objective). Validate Swarm launch and recovery rates in static contexts, and test to failure how fast the moving vehicles can still succeed with. Test Bat Mode's "AI-Self-Parking" features with automated recharging with our own deployed wires = Threshold, using existing civilian powerlines = objective.

SYSTEM DESCRIPTION

VRR's innovative combinations of our HellHive™ and Bat Mode add-on modules enable disruptive new swarm and persistent military/commercial capabilities to existing drones. VRR's HellHive™ Swarm-enabling technologies provide safe storage, shipping, and direct launching of existing drones based upon inexpensive modifications to existing military and commercial shipping containers and light-weight dual launch sleeves module added to the existing drones. VRR's Bat Mode modules added on to existing drones enables: Persistent ISR/CBRN Threat Monitoring by existing drones for days on a single charge by enabling landing on wires, tree branches, etc. Includes VRR's new "AI-Self-Parking" feature. Remote Call For Fire while hanging for days on wires or branches near the target areas (versus wasting time and energy flying back and forth to recharge). VRR's HolloWarrior™ for CFF is already integrated with ATAK and CivTAK. Automated Launching, Recovery, and Recharging of existing drones exploiting our "AI-Self-Parking" and new COTS Mothership UAS capabilities.

B-05: Multi-Institutional All Domain Command and Control (MIAD-C2)

Naval Postgraduate School Joint Interagency Field Experimentation (JIFX)
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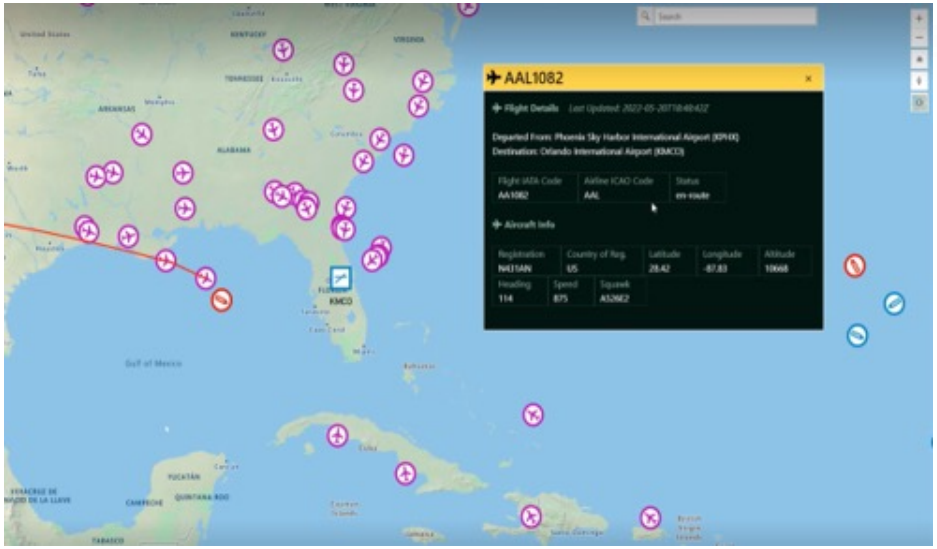


PROJECT INFORMATION

Organization Name:	The MITRE Corporation
Principal Investigator:	Trevor Bostic
Technology Readiness Level:	TRL 4: Component and/or breadboard validation in laboratory environment.
Research Area of Interest:	B) Unmanned Systems (UxS) Design, Deployment, Operation, Networking and Control
Experiment Location:	NPS Field Laboratory at Camp Roberts

PROPOSED EXPERIMENT OVERVIEW

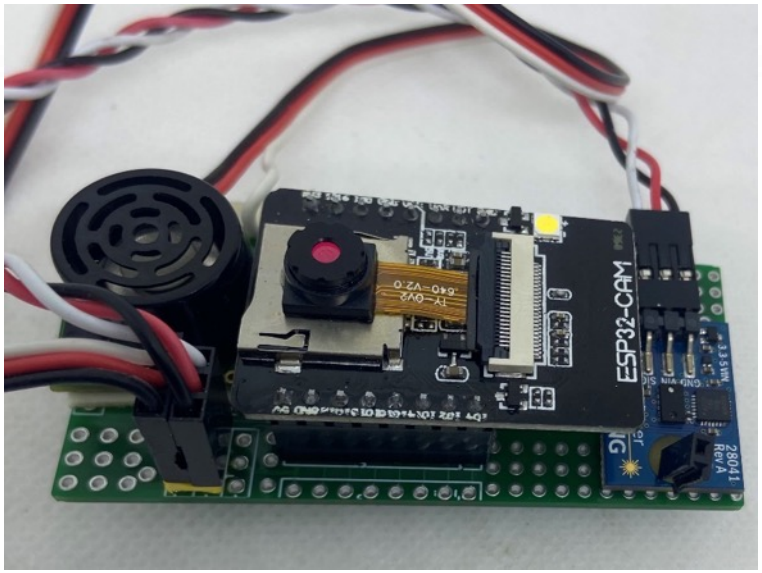
During JIFX, the tool will be used to support several pre-selected experiments proposed by participants. The main goals are to gather information and gain understanding about the types of data that are most useful to the operators, ease of data sharing and collaboration using the tool, and how the tool can support real-time and post-experiment AI and ML analysis. Additionally, we intend to experiment with expanding data and collaboration capabilities during the event to understand the need and impact of a highly adaptable system.

SYSTEM DESCRIPTION

MIAD-C2 is a multi-institutional data collection and sharing COP tool that utilizes a zero-trust architecture and scalable cloud environment to display system and experimentation data and enhance situational awareness for its users. The system is designed specifically to ingest and visualize data types unique to UxS and autonomous systems. Additionally, it supports AI and ML by storing and cleaning the data created during experiments.

B-06: Unobstructed Area Detection Sensor

Naval Postgraduate School Joint Interagency Field Experimentation (JIFX)
NPS JIFX 22-4 | 15 – 19 August 2022



PROJECT INFORMATION

Organization Name:	DropDrone
Principal Investigator:	Daniel Campbell
Technology Readiness Level:	TRL 6: System/subsystem model or prototype demonstration in a relevant environment.
Research Area of Interest:	B) Unmanned Systems (UxS) Design, Deployment, Operation, Networking and Control
Experiment Location:	NPS Field Laboratory at Camp Roberts

PROPOSED EXPERIMENT OVERVIEW

The self contained sensor can be integrated with any unmanned vehicle.
Experiment is measured:

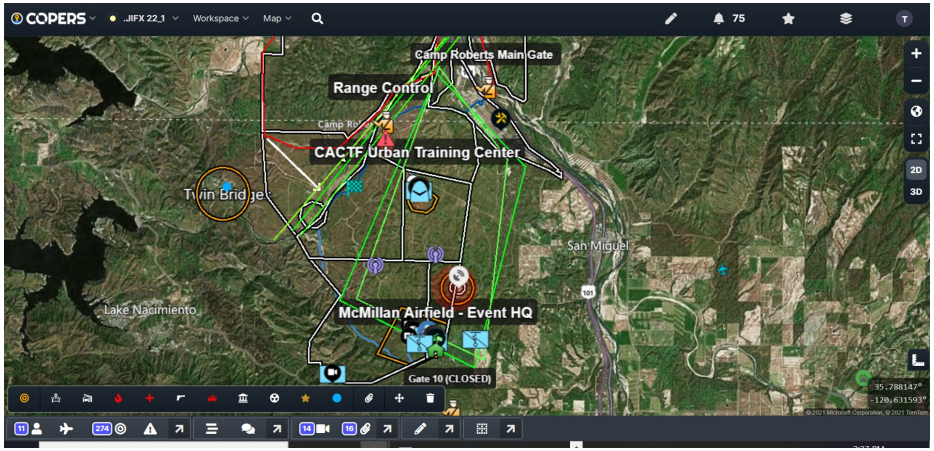
1. Total number of experimenters want to integrated their vehicle with unobstructed ground detection sensor.
2. Number of operating domains (air, ground, subterranean)
3. Enhanced capabilities UAS experiment opportunities:
   - Enable sUAS to detect helicopter landing zones in contested environments.
   - Enable sUAS to detect if sufficient unobstructed ground exists at unpaved runways.
   - Perform as a subsystem of an autonomous VTOL Landing Algorithm.

SYSTEM DESCRIPTION

Opportunity: Field GPS-independent unmanned vehicle autonomy with unprecedented SWaP-C. The algorithm + sensor suite can be integrated to any vehicle on GSA Schedule including but not limited to helicopters & DIU Blue UAS.
Anticipated impact: Providing operators with the option to reduce workload via adaptive autonomy; enabling air crews to dedicate focus to mission objectives; reducing dependence of drone fleets from radio, satellite navigation, and other infrastructure that may be disrupted.

B-07: MIAD C2 of IAS

Naval Postgraduate School Joint Interagency Field Experimentation (JIFX)
NPS JIFX 22-4 | 15 – 19 August 2022



PROJECT INFORMATION

Organization Name:	Naval Postgraduate School (IS Dept/CRUSER)
Principal Investigator:	Steve Mullins
Technology Readiness Level:	TRL 7: System prototype demonstration in an operational environment.
Research Area of Interest:	B) Unmanned Systems (UxS) Design, Deployment, Operation, Networking and Control
Experiment Location:	Naval Postgraduate School

PROPOSED EXPERIMENT OVERVIEW

What: determine transports, protocols, data structure; which gateways to implement; which APIs to access to ingest ISR data from partner systems. Goal: refine the OV-1. Where/When: Systems will feed data from geo-distributed remote locations and from JIFX sites to COPERS server, which will populate the COP in real-time. Goal: consortium systems send data simultaneously during 2hr time windows (17 Aug). How: Testers will analyze the COP visualization to adjust data feeds to optimize MOC SA & decision-making (@CENETIX). Goal: determine optimal / feasible parameters of platform feeds. Who: As many partner platforms/systems as able; UAVs, USVs, UUVs, high power computing, multiple comms nodes. USN and USCG test participants and support as able, including vessels. Enable interactive test participation by geo-distributed partners via the web-based COP. Employ a dynamic, tactical MIO scenario that requires MOC OIC to adjust priorities of platform/system tasks, such as hand-off of platform control between operators.

SYSTEM DESCRIPTION

Ingest and integrate simultaneous data feeds from multiple types of UxS sensor nodes and relays into a tailorable COP in real-time using a web-served software tool.

F-02: Expeditionary Artificial Intelligence and Behavior Analysis at-the-edge for Tactical Surveillance during Multi-Domain Operations

Naval Postgraduate School Joint Interagency Field Experimentation (JIFX)

NPS JIFX 22-4 | 15 – 19 August 2022

PROJECT INFORMATION

Organization Name:	Gantz-Mountain Intelligence Automation Systems, Inc.
Principal Investigator:	Greg Wilson
Technology Readiness Level:	TRL 7: System prototype demonstration in an operational environment.
Research Area of Interest:	F) Intelligence, Surveillance, and Reconnaissance (ISR)
Experiment Location:	NPS Field Laboratory at Camp Roberts

PROPOSED EXPERIMENT OVERVIEW

Gantz-Mountain is continuing to experiment with its tactical intelligence automation system with smart unattended ground surveillance systems that feature artificial intelligence and behavior analysis at-the-edge for expeditionary surveillance in support of multi-domain operations (MDO).

Capability Experimentation goals:

- Increase robustness of AI-driven Behavior Analysis at the Tactical Edge
- Increase robustness of comms backhaul to include MANET Radios
- Situational Awareness with Tip and cue UAS via WinTAK/ATAK
- AI target hand-off to autonomous ISR systems to compress targeting cycle

SYSTEM DESCRIPTION

Gantz-Mountain's Intelligence Automation System (MT-5-R) is a turn-key, multi-mission, smart tactical surveillance system featuring ruggedized, low-visibility, Unattended smart Ground Sensors (UGS) with artificial intelligence enabled behavior analysis and threat determination at the tactical edge. This easy to deploy expeditionary packaged technology forms a network of electronic observation providing tremendous force multiplication, manpower and RF bandwidth savings for improved decision making during rural and urban surveillance along with force protection applications.

F-03: Tactical Edge HPC to support real time and near real time AI, ML and Intelligence Modeling in support of Government Operations

Naval Postgraduate School Joint Interagency Field Experimentation (JIFX)
NPS JIFX 22-4 | 15 – 19 August 2022

PROJECT INFORMATION

Organization Name:	TMGcore Inc.
Principal Investigator:	Seamus Egan
Technology Readiness Level:	TRL 7: System prototype demonstration in an operational environment.
Research Area of Interest:	F) Intelligence, Surveillance, and Reconnaissance (ISR)
Experiment Location:	Virtual Participant

PROPOSED EXPERIMENT OVERVIEW

For JIFX 22-3 TMGcore has built an ISU-90 expeditionary containerized version of our HPC platform while materially increasing the compute deployed from our EdgeBox 30kW system. The systems will be fully contained with its own generator, chiller, UPS, HPC compute platform and network connectivity. We will test for performance, operating and environmental temperatures and any related impacts, remote network management, and continual system health while deployed cross country.

SYSTEM DESCRIPTION

TMGCore is a platform development company for High-Performance Computing (HPC) with Two Phase Liquid Immersion Cooling (2PLIC) “HPC 2PLIC” using the OTTO Platform which if fully deployable & mobile. Our systems allows for tactical Edge computing in support of C4ISR needs for big data analytics, AI, and provide large data storage capabilities while reducing targetability through reduced RF transmission, alleviate latency and data link bottlenecks of cloud computing, and reduced costs related to traditional logistics footprints of air-cooled data centers. This capability is achieved through the HPC 2PLIC system built into each customizable EdgeBox or OTTO Platform which can be operated out of an ISU-90 or on the back of of moving vehicle while in operation.

G-02: Dismounted Position & Navigation System (DPNS)

Naval Postgraduate School Joint Interagency Field Experimentation (JIFX)
NPS JIFX 22-4 | 15 – 19 August 2022

PROJECT INFORMATION

Organization Name:	Stucan Solutions Corporation
Principal Investigator:	Stuart Taylor
Technology Readiness Level:	TRL 6: System/subsystem model or prototype demonstration in a relevant environment.
Research Area of Interest:	G) Situational Awareness
Experiment Location:	NPS Field Laboratory at Camp Roberts

PROPOSED EXPERIMENT OVERVIEW

Dismounted Position and Navigation Sensor (DPNS) delivers an high accuracy/high resolution, relative 3D positioning, navigation and team tracking capability to the dismounted user, in the absence of any GPS (or alternative GNSS System) signal. This allows for precise 3D situational awareness and blue force tracking in GPS challenged (denied or degraded) environments such as buildings, caves, tunnels and areas with heavy Electronic Counter-Measures (ECM) and hostile RF jamming. DPNS can also augment a high/low quality GPS signal, increasing both accuracy and resolution. We would like to show DPNS in a GPS denied environment.

SYSTEM DESCRIPTION

DPNS is a dead-reckoning technology in which an Inertial Measurement Unit (IMU), comprising a 3-axis accelerometer and gyroscope, and a barometer is attached to the boot of dismounted personnel (referred to as the Boot Mounted Unit – BMU). The IMU and barometer data from the BMU is processed to track the motion of the boot. The motion data from the BMU is then forwarded to a display unit worn by the user (currently an Android smartphone) to provide an estimate of current position. The Android smartphone fuses the motion data from the BMU with GNSS (when GNSS is available) to provide a positional estimate more accurate than GNSS alone. When GNSS is lost, the displacement data from the BMU is integrated to provide a continuous dead-reckoning estimate of position. The device can also help in areas where GNSS is available but degraded such as in urban canyons or buildings.