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Spatial Integrated Systems

Unmanned Systems

WWW.SISINC.ORG

Spatial Integrated Systems

Spatial Integrated Systems, Inc. (SIS) specializes in the design, development, implementation, and fielding of process-oriented solutions for government and commercial customers. SIS offers an integrated set of products and services supporting reverse engineering, design, rapid prototyping, manufacturing integration, IT and robotics. SIS is an industry leader in the development and integration of solutions incorporating next generation digital 3D data capture and processing technologies. SIS products, solutions, and services address challenges ranging from optimally leveraging advanced technologies to adding value to commercial off-the-shelf (COTS) software and hardware to implementing unique enterprise-wide IT systems. SIS's concepts, designs, and solutions provide new levels of innovation for improving the effectiveness of today's warfighter and commercial processes.

Memberships:

VIRGINIA UNMANNED SYSTEMS

AUVSI ALL THINGS UNMANNED

NATIONAL ADVANCED MOBILITY CONSORTIUM

National Armaments Consortium NAC Providing the Decisive Edge

DoD Ordnance Technology Consortium GOVERNMENT DOTC PRAESTANTIA PER CONSORTIA

CCAM COMMONWEALTH CENTER FOR ADVANCED MANUFACTURING

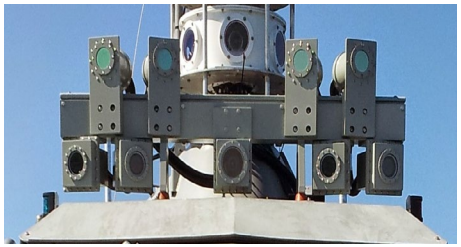
ncms National Center for Manufacturing Sciences

eleVAte Skills for Jobs and Business Growth

Virginia Manufacturers Association VMA

Projects

SwampWorks - Safe Navigation in Challenging Environments

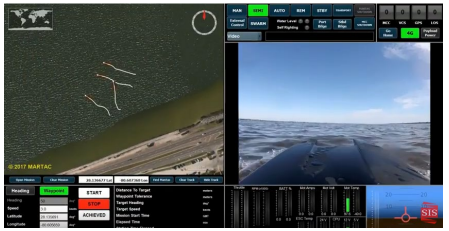


The ONR SwampWorks version of the stereo EO HammerHead builds upon the original system by increasing the capabilities and operating environment of this passive detection system for harsh environments.

Purpose/Scope

- Design, fabrication, integration, and testing of a sensing/autonomy system onboard a USV that can safely operate in challenging environments (Sea State 3, intermittent sensor feed, night/fog)
- Night-time operations
- Safer daytime operations
- Environmentally aware autonomous perception
- More/less/no COLREGS compliance based on human set parameters

SIS & MARTAC Swarm Collaboration



As part of SIS's continuing effort to improve and advance its autonomous systems, SIS works extensively with Maritime Tactical Systems, Inc. (MARTAC) and their Man-Portable Tactical Autonomous System (MANTAS) Unmanned Surface Vehicle (USV) to provide intelligent autonomous control to their vessels. SIS engineers collaborated with MARTAC engineers to design the control interface between the ONR and the MANTAS USVs. All of this work was done remotely, with the SIS team working out of Virginia Beach, Virginia offices and the MANTAS team and vessels operating out of the MARTAC offices in Satellite Beach, Florida. Once the interface was designed and thoroughly tested in simulation, the team commenced to prove the on-water operations, with SAS operating from Virginia Beach with a remote IP connection to the MANTAS craft operating in Florida, a distance of over 650 miles. Following the launch and stationing of four MANTAS craft, by MARTAC, using local Mission Control Consoles, control of the four vessels was transferred to SAS, which then directed them to arrange themselves into a formation for transit to a series of waypoints. During the transit, SAS optimized the route of each MANTAS crafts to achieve both relative formation positioning and the most efficient path to the waypoint.

Robotic & Unmanned Systems

Capability Description:

SIS's autonomous control system represents state of the art in maritime autonomy, enabling mission oriented, self-navigation and full obstacle avoidance during all weather, day or night operations. The heart of SIS's autonomous capabilities is an architecture called CARACaS (Control Architecture for Robotic Agent Command and Sensing), a flight-derived software package with origins in the NASA Mars Rover program. First adapted for maritime robotics in 2006, CARACaS has been selected by the Office of Naval Research (ONR), the Defense Advanced Projects Research Agency (DARPA), the Office of the Secretary of Defense Strategic Capabilities Office (OSD SCO) and the US Army Tank Automotive Research Development and Engineering Center (TARDEC), to serve as the autonomy backbone for numerous Unmanned Surface, Underwater and Ground Vehicles (USVs, UUVs and UGVs).

CARACaS is considered one of the most mature fielded maritime autonomy systems and has the greatest at-sea time of any fielded intelligent autonomy system. CARACaS has provided the autonomy for numerous US Navy and US Marine Corps demonstrations. In August 2014 the largest autonomous multi-USV demonstration to date was conducted on the James River, Virginia, the Chief of Naval Operations (CNO) USV Swarm Demonstration. In this demonstration, a team of CARACaS-equipped, fully unmanned vessels completed warfare operations as a coordinated group, exhibiting escort, intercept, and blocking behaviors. A second demonstration in October 2016 was a follow-on Swarm that centered on Harbor Defense. In this demonstration, several cooperative USVs patrolled a harbor area, located intruders, identified them as friendly or hostile and then took actions based on vessel classification. Two follow-on demonstrations then validated the capabilities to logistically supply Marines ashore through a Ship-to-Shore autonomous connector and during a recent Marine Corps exercise to conduct riverine, hydro-graphic survey and fires missions with multiple USVs, UUVs and UAVs.

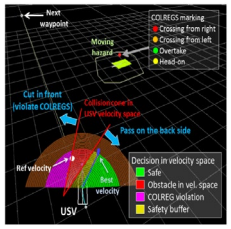
In these events, CARACaS has demonstrated several multi-vehicle mission-level capabilities including Mine Warfare (MIW); Force Protection (FP); Intelligence, Surveillance, and Reconnaissance (ISR) in highly dynamic environments; rapid response to irregular threats; coordinated phased protection of high value units (HVUs) to respond to high speed adversarial incursions; and adaptive on-the-fly behaviors to mitigate sensor and/or vehicle degradation.

The underlying NASA robotic technology enables USVs to maneuver and navigate independently in an area populated by multiple vehicles, permanent structures, changing topography, and shifting environmental and operational factors. Vessels using CARACaS can deploy and perform missions continuously at great distances, over long-time periods, and with minimal to no human supervision, limited only by the physical limitations of the platform, payloads and fuel. Situational awareness is derived using data from multiple sources; including, but not limited to, RADAR, LIDAR, GPS/IMU, Electronic/Digital Nautical Charts (ENC/DNC), Stereo Electro-Optical/Infrared (EO/IR), long-range 360-degree EO, Automatic Identification System (AIS), and other platform/mission-specific sensors.

SIS's demonstrated advanced intelligent autonomous behavior and control is setting the standard for Unmanned Systems

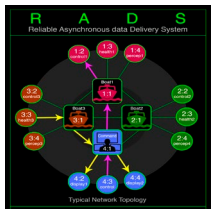
Products

SIS Autonomous Systems (SAS)



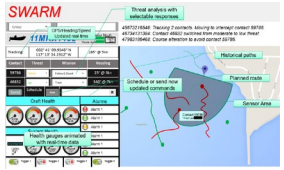
SAS is the foundational software behind all our autonomous vehicles. Based on the NASA-JPL CARACaS (Control Architecture for Robotic Agent Command and Sensing) software designed for the Mars Rover program, SAS provides an intelligent, goal-oriented vehicle control system that can turn any vehicle into an intelligent robot. SAS architecture allows for complete modularity and can easily be modified to interface with any current vehicle low-level autonomy control system.

Reliable Asynchronous Data Delivery System (RADS)



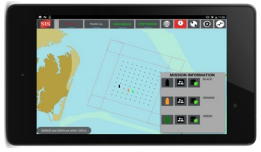
RADS™ was designed by SIS to provide a highly reliable communications layer between any number of autonomous vehicles. Based on DDS standards, RADS™ allows multiple clients to be connected to a RADS™ server to synchronize data between systems through any communication layer, regardless of the bandwidth available. RADS™ scales with the allowed bandwidth, passing the highest importance data with priority, then synching other data as space is available.

Multi-Agent Command & Control (MAC2)



MAC2™ provides a solution to the problems faced when using multiple robotic systems. Current C2 systems are not optimized to interact with the state-of-the-art autonomous control system developed by SIS and are only able to provide input to only a single platform at a time. MAC2™ solves this issue, providing collaborative control of multiple autonomous platforms in the execution of complicated missions, optimizing platforms for the most efficient solution in the least amount of time. MAC2™ provides the operator with an intuitive, easy to understand interface that builds situational awareness of multiple platforms at a glance.

Handheld Autonomous Vehicle Operator Console (HAVOC)



SIS has developed HAVOC, a tablet version of the Multi-Agent Command and Control (MAC2™) system to provide mobile command of autonomous vessels. The MAC2™ Tablet enables watchstanders and Commanders to be "on the move" during critical evolutions where staying in one location for C2 would be impractical or too restrictive. SIS eveloped the tablet-based version after extensive consulting and trials with Fleet users uring actual demonstrations.

Mission

SIS develops and integrates end to end technology solutions resulting in exceptional value for our Government & Commercial customers, enabled by its core competencies:

- Digital 3D imaging and visualization
- Reverse engineering and rapid prototyping
- Product data and lifecycle management
- Robotics & Unmanned Systems

Unmanned Capabilities:

- Full Intelligent Autonomous Control
- Portability & flexibility of system (any vessel)
- Mission Behaviors Developed & Tailored for Sensor Payloads/ Warfare Missions
- Cooperative Group Operations
- Maritime Rules of the Road compliant (COLREGS)
- Persistent At-Sea Presence
- Minimal Reliance on Communication Links
- Minimal Required Human Supervision
- Proven at-sea performance
- Demonstrated warfare missions:

    - Minesweeping (MIW)
    - Force Protection (FP)
    - Intelligence, Surveillance, Reconnaissance (ISR)
    - High Value Unit Escort
    - Anti-Submarine (ASW)
    - Riverine
    - Anti-Surface (ASUW)