# GSI GEISEL SOFTWARE

## GOVERNMENT CAPABILITIES

**Geisel Software is a rapidly growing software innovator with extensive experience in robotics, automation, and the Internet of Things (IoT).**  We specialize in creating custom software solutions that incorporate the most advanced technologies, including artificial intelligence, machine learning, computer vision, space-based mission software, augmented reality, and much more.  Our team of highly skilled engineers designs, develops, and deploys groundbreaking software solutions that meet and exceed the most stringent security standards.

Our small business has successfully completed numerous projects for both state and federal branches of the U.S. government, including both primary contracts and subcontracting. We have also earned a GSA MAS contract. Our client portfolio includes NASA, the Department of Veterans Affairs, the U.S. Army, Raytheon, Teledyne FLIR, among others. We have also successfully completed two STTRs and developed mission-critical flight software for NASA.

We are committed to helping the federal government improve their supplier diversity. We attend NASA's HBCU/MSI events and are working in close collaboration with multiple HBCUs and MSIs, helping them increase their contracts and interaction with industry and small business. We are also working directly with NASA to help facilitate a more diverse intern group to help young people in disadvantaged areas.

## GEISEL SOFTWARE DIFFERENTIATORS

**Expertise**
Over 20 years of experience across government, robotics, embedded, and advanced technologies.

**Industry Acumen**
Expertise working with Government procedures such as ITAR, EAR, HIPAA, ISO 13485, FAR, DFARS and can work with you to meet FDA requirements.

**Agile**
We can quickly assemble a team of U.S. person engineers to meet project requirements.

**World-Class Talent**
We hire only the top 1% of developers - over 100 applicants screened for every 1 engineer hired.

**Top Leadership**
- CEO Brian Geisel named 2020 SBA Small Business Person of the Year
- Named to the 2022 and 2023 Inc. 5000 list of fastest-growing private US companies

## GSA CONTRACT HOLDER

**DUNS:** 039391327
**CAGE:** 7WMX6
**Small Business Set-Aside**

### NAICS Codes
541511  Custom Programming Services
541715  Research and Development in the Physical, Engineering, and Life Sciences
541330   Engineering Services
541519   Other Computer Related Services

### SERVICES
- Software Architecture
- Software Engineering
- QA/Testing
- UI/UX Design
- Program Management
- Cybersecurity Expertise
- Content Creation

## TECHNICAL CAPABILITIES
Our broad skill set empowers us to choose the best technologies, tools and platforms for your project:

- Robotics
- ROS
- UGV / UAV / UAS
- Planetary Robotics
- Mission Software
- Application Software
- AI/Machine Learning
- GPU Custom Optimization
- Localization and Mapping
- AR/VR

- Embedded Development
- Swarming Robots
- Independent Robotic Tasking
- Autonomous Behavior
- Kernel
- AWS
- Cybersecurity
- Firmware
- Infrastructure as a Service (IaaS)
- Platform as a Service (PaaS)

- Electronic Manual Conversion
- Test Driven Development (TDD)
- Continuous Integration/ Continous Delivery (CI/CD)
- Automation
- Bluetooth
- RF
- Encryption
- Linux Device Driver
- Cloud
- RTOS

- Android
- BLE Wireless
- Angular JS
- Python
- Java
- Azure
- Swift
- C/C++
- OS / iPhone / iPad
- Real-time
- ...and many more

## NASA SWARMING UAV/UAS SOLUTION

In collaboration with the University of Nevada Las Vegas, Geisel Software is building a realistic, high-quality robotic simulator platform with embedded atmospheric conditions that will allow us to develop and test collaborative mobility and manipulation in a heterogeneous robotic environment. This includes the ability for robots to handle problem-solving on their own, as well as both high-level and direct control from humans when desired. The software platform will:

- Simulate UAVs navigating under different atmospheric conditions with radiation, particulate matter or dust, and other compounds.
- Simulate motion planning of UAV and UGV, optionally with satellites, for enhanced measurement capabilities including source search and mapping tasks and enabling many other future tasks.
- Embody scientific and engineering challenges related to both sensor development and its dynamic network design.
- Provide the ability to facilitate multi-agent coordination across entire planetary bodies, with less than ideal networking conditions and with optional human interaction when desirable.
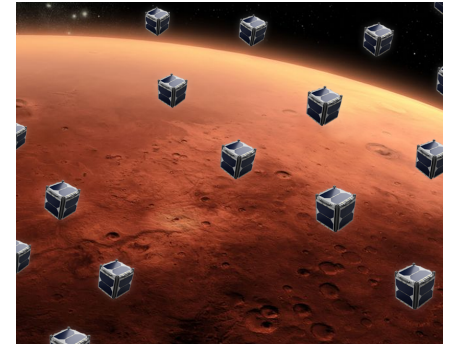
## NASA COMMUNICATIONLESS COORDINATION FOR INTENT PERCEPTION

Geisel Software, in collaboration with the University of Nevada Las Vegas, is developing technologies that enable cooperative operation of low-cardinality swarms of space vehicles in an unknown dynamic environment. We are developing algorithms for communicationless coordination that will observe and estimate the actions and intentions of other agents in a multiagent system in lunar and planetary exploration missions. The technical objectives of this project include:

- Developing set-based and probabilistic behavior and intent estimation/prediction algorithms to infer the set of possible models/behaviors/intents that are compatible with noisy observations and their associated likelihoods.
- Designing (optimal) intent-expressive/legible motion planning algorithms to render the intent estimation algorithms more effective in cooperative settings with the goal of increasing overall social/team performance.
- Building a realistic simulation platform to mimic rover driving on moon and planetary terrains with uncertain terrain parameters.
- Integrating and testing the intent estimation and intentexpressive motion planning algorithms within the simulation platform.

## REAL-TIME LOCALIZATION IN GPS-DENIED ENVIRONMENTS

Geisel Sofware is developing a localization framework that solves the fundamental problem of relative collaborative localization of multiple robotic agents or objects in GPS-denied or adhoc formed localization networks. Our novel solution for distributive relative collaborative localization (DRCL) of heterogeneous agents/robots (UGV and UAVs) uses a framework of disruptive, novel innovation to determine the relative distances and accurate localization of each agent relative to each other in centimeter accuracy.

There are unlimited direct applications for this breakthrough technology including DoD (aircraft, missiles, spacecraft, vehicles, objects, both manned and unmanned etc.) and commercial industries that currently utilize GPS or other localization system application:

- commercial space industry (launch vehicles, spacecraft, satellite, on-planet exploration vehicles)
- automotive (keyless entry, parking assist, autonomous driving, vehicle tracking/location)
- aviation (en-route navigation , approach/landing, collision avoidance, and airport management)
- logistical transports (navigation, fleet tracking, geo-fencing, people/asset tracking)
- marine (vessel navigation and information systems, precise harbor entrance systems)
- medical (patient monitoring and medical imaging)
- mapping (sub-centimeter positioning, utility mapping, navigation for visually impaired)
- subterranean exploration (real-time localization, collision avoidance, rescue management)
- construction (resource positioning/tracking, on-site safety management, hazard detection)
- mining and much more. (smart cities, smart enterprises, communications)

## CAPABILITIES-DRIVEN DASHBOARD FOR HUMAN-ROBOT TEAMING

Intra-Vehicular Activity (IVA) robots can perform a wide variety of tasks including systems inspection and monitoring, diagnostics and repair, logistics and consumables stowage, exploration capability testing, science measurements and more. A key aspect of realizing their potential is having operational subsystems that enable effective human-robot teaming. Geisel Software is working on a single unified dashboard that interfaces with all connected autonomous robotics systems, payloads, and core systems, which flexibly discovers the capabilities of those connected systems, and adaptively renders the appropriate controls. A unifying interoperability protocol allows compliant robotics system from any manufacturer to be controlled seamlessly by the dashboard.
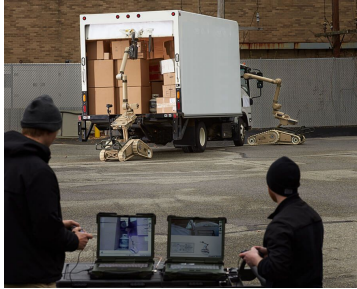
## FLIR SYSTEMS UNIVERSAL OPERATOR CONTROL INTERFACE

Geisel Software was hired to expeditiously develop an operator control user interface (UI) for FLIR's lifesaving, bomb-defusing robots. It features a universal controller that allows operators to view and control other UGVs, as well as unmanned aircraft, for improved battlefield awareness. It was a large-scale, complex project with a compressed six-month timeline and mission-critical deadline. The easy-to-use touchscreen has picture-inpicture video streaming and offers multiple camera angles, manual joystick and touch screen integration, plus preset poses to rapidly position the robot. Geisel's software development, architecture, project management, UI/UX, JavaScript and SQA skills, combined with their expertise in web applications, robotics and security, helped FLIR to complete the project on time and within budget.

## JIBO SOCIAL ROBOT

Jibo is a social robot that earned a spot on TIME magazine's Best Inventions of 2017 list. Utilizing advanced Natural Language Understanding (NLU) along with speech and facial recognition, this bot can recognize up to 16 different people and create personalized interactions. Jibo needed to develop test software that would assess the health of returned robots that were received at their service and remanufacturing center. Geisel Software developed software that could control the robot, run through a series of tests, provide the operator with feedback and log the results. They created a full Python app, which ran on a Raspberry Pi computer installed in the factory, that could remotely test each robot. They also created the database structure and a clear, simple GUI. Geisel's custom solution could interface with the available Jibo APIs for testing while ensuring the devices remained secure. Geisel's solution reduced total testing time on an individual robot from one hour to less than five minutes – a 92% time savings!
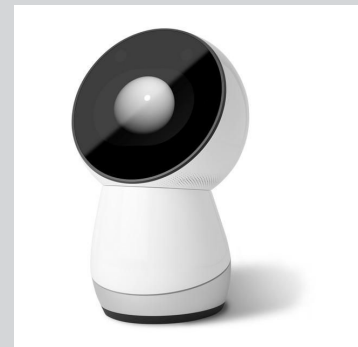
## iROBOT ConnectR ROBOT

Based on sibling robot Roomba's design, ConnectR featured two high-resolution video cameras along with a two-way audio system, and the capability to control the robot remotely. It was iRobot's first attempt manufacturing a highly-technical, connected robot and they needed someone who understood the challenges in preparing a connected product for mass production. iRobot hired Geisel Software for its extensive experience taking products from concept to commercialization. They developed a built-in test that ran through a comprehensive sequence of challenges and tests to ensure every system on the robot was functioning correctly. After the series of tests was complete, the robot would then send a message to a server that Geisel deployed on the factory floor indicating that the robot had passed or failed. If the robot passed, it would be shipped; if it failed, it would not. Audits could be conducted on returned units to determine if the robot had failed inspection at the manufacturing facility or if the defect happened after the unit was shipped.

## SAFE OPS SYSTEMS (SOS) COMMAND PLATFORM

SOS Live is an enterprise-grade, edge cloud solution that connects and automates mission-critical equipment to provide rapid, real-time situational awareness to first responders. The virtual command platform integrates UAVs, cameras, multiple sensors (thermal, lidar and visual), and mobile devices. An AI-based application preemptively detects threats and equips responders with mission-critical information. Geisel Software was hired to create a first-of-its kind compact UAS proof-of-concept. We performed: requirements, architecture, software development, integration, and demonstration. The solution include: HD and thermal streaming video from UAVs, cellular communication from UAV, on-board processing on the UAV, cloud application to support multiple UAVs streaming video simultaneously and administrative features, object avoidance based on county LIDAR maps of terrain and objects, and UAV safety features designed to earn FAA waivers for beyond-line-of-sight flights.

## U.S. ARMY, MTRS FIELD MAINTAINER MULTIMEDIA

Geisel Software developed an interactive web-based multimedia manual system designed to improve the end user experience and efficacy of the content over a traditional page-based manual. A custom data schema allows encoding of technical manual (TM) content in a way that can be easily validated and encourages heavy reuse of content, thereby eliminating duplication, simplifying long-term maintenance, and reducing costs. The application is built on a modern JavaScript application framework, easing the adoption of development practices like TDD and CI/CD. Custom scripted automation aids TM content creation, maintenance, and deliverable production. The software seeks to generalize the solution of TM production for use by end users of the MTRS system across four U.S. Military branches, as well as future users of other robotics systems implementing the manual framework.
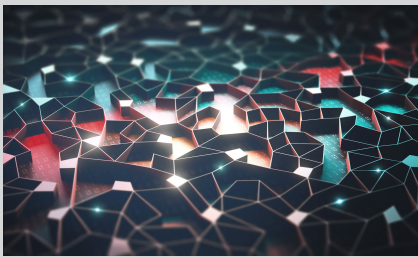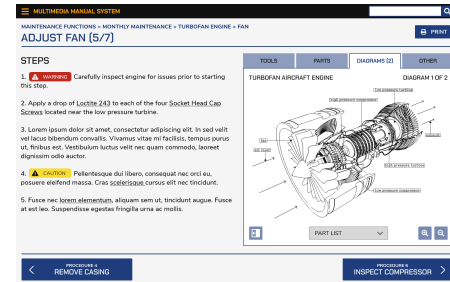
## OVERCOMING CATASTROPHIC FORGETTING IN NEURAL NETWORKS

State of the art neural networks have been able to surpass human players in competitive video games on a time span of around 35 minutes, but suffer from catastrophic forgetting when brought to the long timescales necessary for real-world applications. By creating a format to simplify, store, and recall historic data, Geisel Software is developing a system whereby agents can retrace their steps, to layer long term broad strategies with optimal moment-to-moment gameplay techniques, and to build a framework by which agents can interact with each other.

## AVIONICS DATA AND TOPOGRAPHY ANALYSIS AND PLAYBACK

Geisel Software is developing a solution that will compare UUT radar returns with known topographical data as part of a block upgrade cycle on aircraft. Relying on state-of-the-art technology to independently verify and validate radar data and using the power of a modern 3D game engine, the solution will deliver high-quality visual feedback to aircrew and flight test engineers during the IV&V of block upgrades.
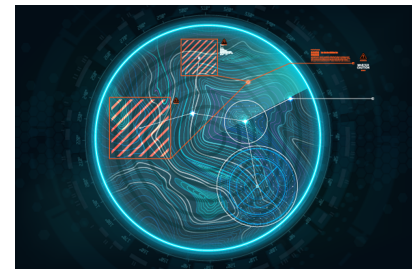
## CARBON BLACK SECURITY SOFTWARE

Carbon Black is one of the world's most respected security firms, delivering a form of application white listing that has taken the security world by storm. They hired Geisel Software to build the Linux version of their white-hot selling Windows application from scratch. The application itself is a Linux security module that winds itself into the Linux kernel to give it an added layer of protection against all kinds of malicious threats. This was a highly-invasive Linux kernel project that spanned everything from module loading, to file compilation, linking, and execution, to memory mapping and even compiling C++ into the Linux kernel itself.

## MICROLITE BACKUP AND RECOVERY SYSTEM

Microlite is the manufacturer of BackupEDGE, a fully-integrated backup, restore and bare metal recovery system for Linux and UNIX. Microlite needed a software development firm that would work around the clock to deliver two new product features and ensure they seamlessly integrated with Microlite's backup system software. Geisel Software, already had a mastery of C and C++, the two programming languages needed for the project, as well as Linux internals and excellent low-level OS knowledge. Geisel Software delivered features that were both fully-realized and elegantly designed, and integrated perfectly with Microlite's BackupEDGE software all while staying on schedule and within budget.

## GEOSPECIFIC TERRAIN GENERATION USING DEEP LEARNING

Geisel Software's client wanted to generate realistic environments for Unreal Engine for use in simulations and user trainings. Manually this process took a month per location and they wanted to streamline the process by using a neural network to accurately predict terrain and ground cover from a height map and an aerial photograph.

Geisel Software combined two deep learning neural networks to generate a prediction. First, a convolutional neural network was used for segmentation, to identify different types of ground cover including trees and other obstacles. Then, the trees and obstacles were treated as holes in the segmentation image and fed into a generative multi-column convolutional neural network to infill those holes with accurate data. The resulting segmentation data could then be combined with a height map and automatically loaded into accurate terrain in Unreal Engine.



## NASA CADRE MISSION-CRITICAL FLIGHT SOFTWARE



NASA's CADRE project is embarking on a groundbreaking mission in 2024 to deploy three carry-on bag-sized autonomous rovers to the Moon. These rovers are designed to work in unison, navigating the harsh lunar environment. Overcoming challenges posed by the Moon's low gravity and lack of atmosphere is crucial, as these factors significantly affect deployment and exploration. Geisel Software's role was pivotal, as they engineered sophisticated deployment software that allows for meticulous, real-time control from Earth, ensuring a safe and precise landing for the rovers.

The deployment software's successful integration into the CADRE system marks a significant stride toward autonomous lunar exploration. Geisel Software is now focusing on the rovers' ground-penetrating radar systems which will reveal the Moon's subsurface, potentially revealing water ice deposits and novel geological insights.
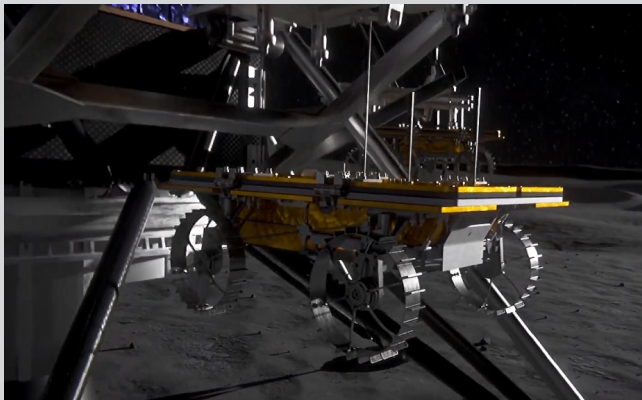
## GEISEL SOFTWARE: ADVANCING GOVERNMENT MISSIONS WITH INNOVATION

By partnering with Geisel Software, government agencies are positioned to not only capitalize on the latest technologies, but also ensure their software infrastructure is resilient, secure, and optimized for contemporary challenges.

With deep expertise in cutting-edge technologies, embedded software development, and IoT, the Geisel team stands ready to assist government agencies in seamlessly integrating and benefiting from the newest technological advancements.

CONTACT US:

https://geisel.software/government

JR Rodrigues, VP of Sales  .  jr@geisel.software  .  508-936-5097