BRIDGES Space Superiority Consortium

Space Infrastructure Laboratory Corp. (SIL)

Company Overview

Our Mission: *SIL develops next-gen space combat power projection capabilities and disruptive space architectures to enable space power disciplines.*

SIL is aspiring to be a DoD University Affiliated Research Center (UARC) at Cornell University

SIL's members consist of faculty, research staff, and graduate students in Aerospace Engineering, Computer Science, Electrical Engineering/Computer Engineering, & Mechanical Engineering.

- Established in Q1 2024
- UEI: D1FGAFWKKSZ3
- CAGE code: 9VB04

Headquarters:

Ithaca, New York

Our Partners:

Cornell University,
AFRL Hub,
New York Consortium for Space Technology

Key Personnel of SIL

Dr. Gregory Falco

DARPA Young Faculty Awardee
Assistant Professor
Aerospace Engineering
Chair, IEEE International Standard for Space System Cybersecurity

Dr. Mason Peck

Former Chief Technologist of NASA
Stephen J. Fujikawa '77 Professor of Astronautical Engineering

Dr. Elaine Petro

AFOSR Young Investigator Awardee
Assistant Professor
Sibley School of Mechanical and Aerospace Engineering

Dr. Meredith Silberstein

DARPA, DOE and NSF Young Faculty Awardee
Associate Professor
Sibley School of Mechanical and Aerospace Engineering

Dr. Amit Lal

DoD Exceptional Service Awardee
Best PM Awardee at DARPA
Professor of Electrical and Computer Engineering

Dr. Sadaf Sobhani

NASA Early Career Faculty Awardee
Assistant Professor
Sibley School of Mechanical and Aerospace Engineering

SIL is aspiring to be a DoD University Affiliated Research Center (UARC) at Cornell University

SIL is operated by Cornell University faculty seeking to contribute to high technology readiness level national security efforts.

Technical Expertise

- Information Mobility
- Space Systems Architectures and Mechanisms
- Space Defense and Security
- Verification and Validation
- Space Combat Power Projection
- Assured Autonomy
- Materials for Space Applications
- Space Propulsion and Thermal Management
- Spacecraft Guidance, Navigation and Control

UARC Capabilities

Company Capabilities

We do IV&V for Counterspace

SIL is at the forefront of non-kinetic counterspace weapon development, employing directed energy, cyber, and electronic warfare methodologies to enable disruptive capabilities for space CPP and space power disciplines.

NEW YORK CONSORTIUM for SPACE TECHNOLOGY INNOVATION & DEVELOPMENT

A Department of Defense Designated Defense Manufacturing Community

- High-bay for spacecraft development, assembly, integration; on-orbit mission simulations
- Mission control center for hardware testing/simulation and real-world on-orbit operation
- Environmental testing equipment, Class 10000 cleanroom and ESD isolation workspaces
- Available Resources: Cornell High Energy Synchrotron Source and Cornell Center for Materials Research

Organizational Structure

affiliated

NYCST

Diversified Funding from Gov + Industry

AFRL HUB

Funding from Gov

funds & personnel

SIL (UARC)

Classified Gov Programs

Technical Experience

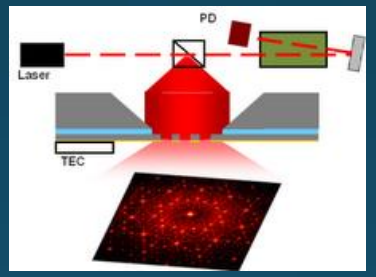
SIL currently consists of 6 integrated directorates:

Develops next-gen counterspace capabilities and disruptive space technology

Develops space technology that exploits spacecraft physics

Develops spacecraft propulsion technology and architectures

SonicMEMS Lab

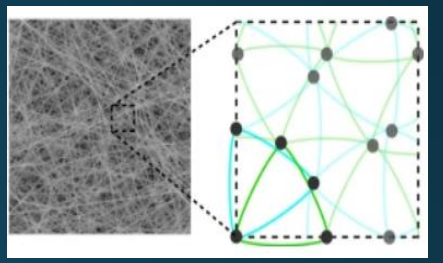


Develops advanced Micro-Electro-Mechanical Systems

Sobhani Lab

Develops high-efficiency, robust thermal management and energy conversion technologies

MMD Lab



Develops nano to millimeter scale structure-function relations to drive materials innovations

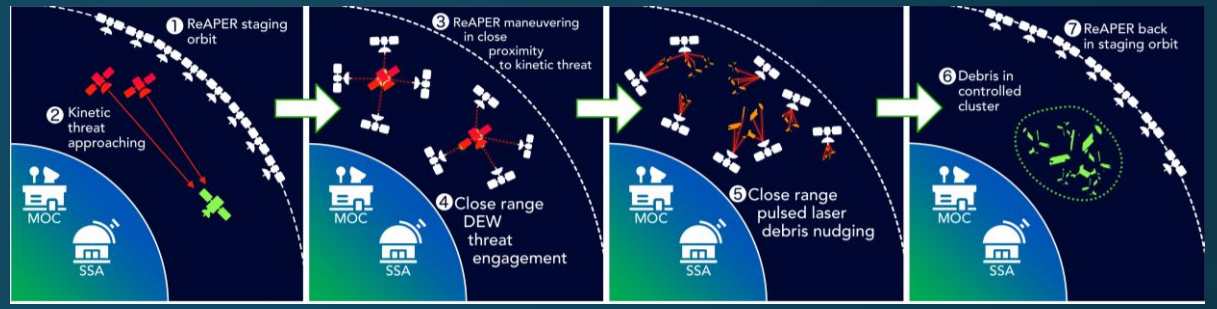
Space Technology Experience

- Space Cyber Operations and Electronic Warfare
- Pulsed Powered Technologies
- Artificial Intelligence & Machine Learning
- Space-Based ISR
- SATCOM
- vLEO & HAAPS
- Spacecraft Hardware
- Dynamics & Control
- Novel Space Architectures
- Thermal Management
- Propulsion
- High Energy Physics
- Optics
- Gigahertz Ultrasonic Comms, Sensing and Compute
- Near-zero power sensors for IoT
- Chip-scale manipulation of electron and ion beams

Key Innovations

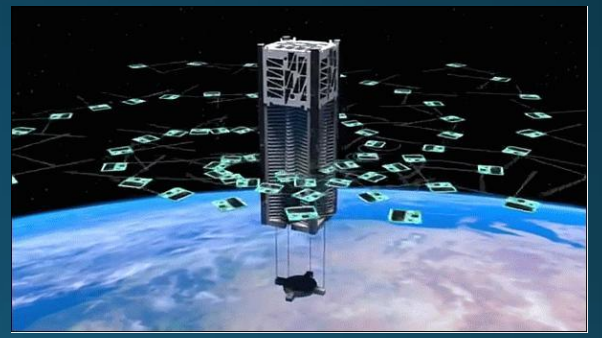
ReAPER: Reinforcement learning for Autonomous Point of Entry debris Remediation

- ReAPERs are summoned upon ground detection of a kinetic threat.
- When summoned, each ReAPER will be tasked to a distinct region of the surrounding threat field, at which point each satellite will autonomously detect, prioritize, and actuate the threat while station keeping.



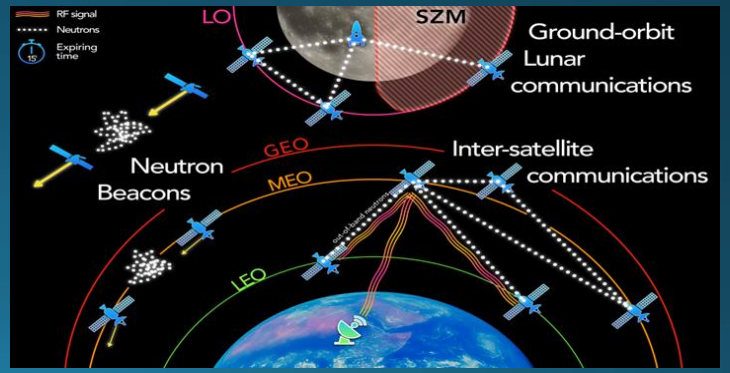
Disintegrating Chipsats for Data Exfiltration

- The cracker-sized Sprites weigh just 4 grams each but carry their own power source, a variety of sensors and a communications system on a 1.4-inch square circuit board.
- Transmit short bursts of frequencies in the 400 megahertz range with only milliwatts of power



NeMeSIS: Neutron Message System for Intelligent in Space

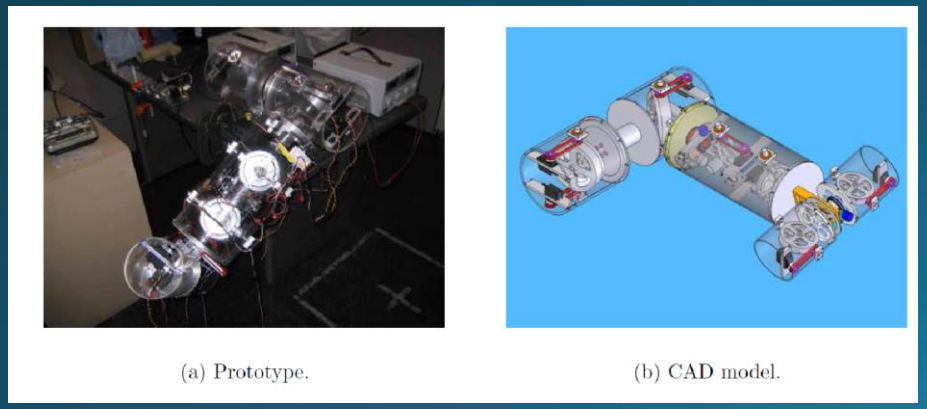
- NeMeSIS provides a means for out-of-band communication in space domains where RF and optical systems are unviable or unsafe.
- NeMeSIS offers: resilience to space weather, extremely low jitter, penetrability opportunities, non-line-of-sight communications, and unique security benefits, as they can neither be intercepted nor disrupted with current existing technologies.



Key Innovations

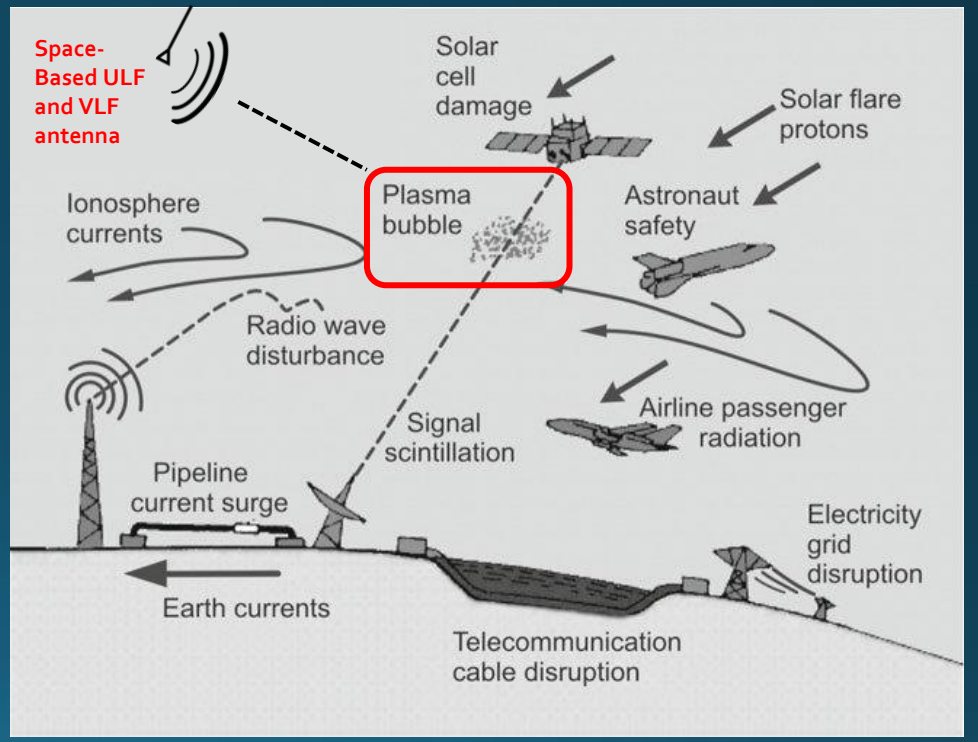
CMG Robotics

- Grappling an uncooperative resident space object can introduce large torques and momentum disturbances in the chaser or servicing spacecraft.
- Control-Moment Gyroscopes (CMGs) offer a means to absorb such momentum changes quickly, eliminating attitude excursions without propellant.
- Control-moment gyroscopes produce low-power torque for high-agility reactionless robotics
- Power savings vs. traditional joint motors range 50%-98%
- Prototypes flown on microgravity aircraft



(a) Prototype. (b) CAD model.

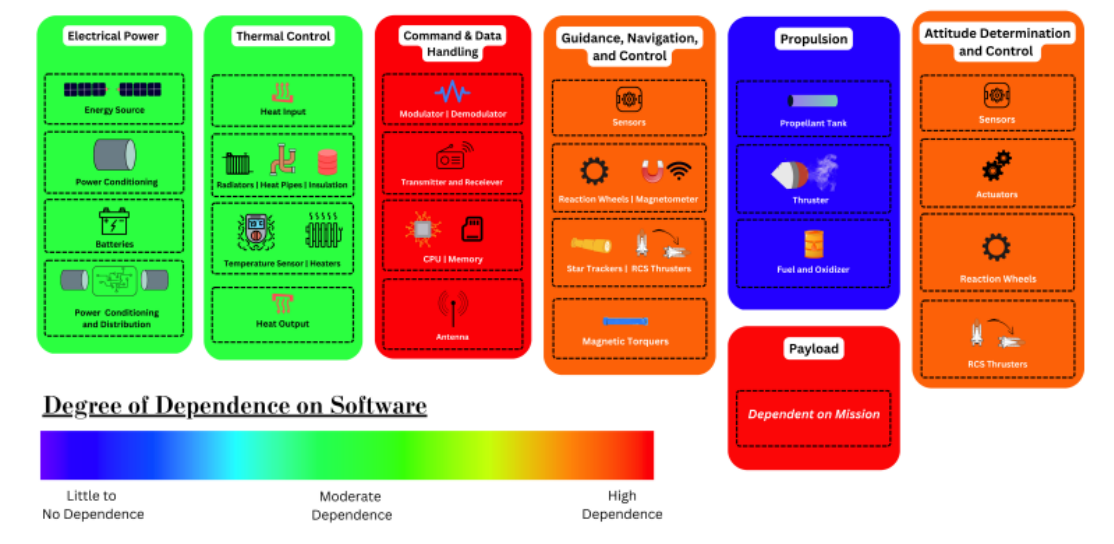
Plasma Control and Manipulation



Key Innovations

WannaFly: Satellite Ransomware

- Ransomware for deployment on space vehicles running NASA's core flight system to exploit our identified vulnerability and successfully deployed it on a satellite testbed.



Adversarial ML Attacks on Spacecraft

- AML Malware that disables a spacecraft's autonomous capabilities (tested on NASA's core flight system)
- Disables AutoNAV, Image Classifiers, etc.

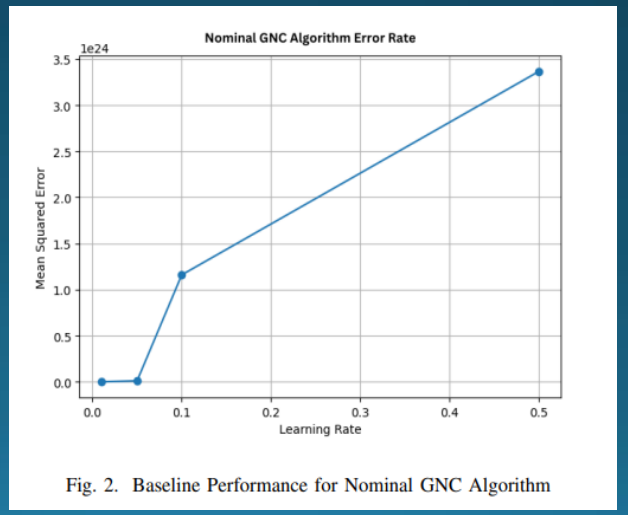


Fig. 2. Baseline Performance for Nominal GNC Algorithm

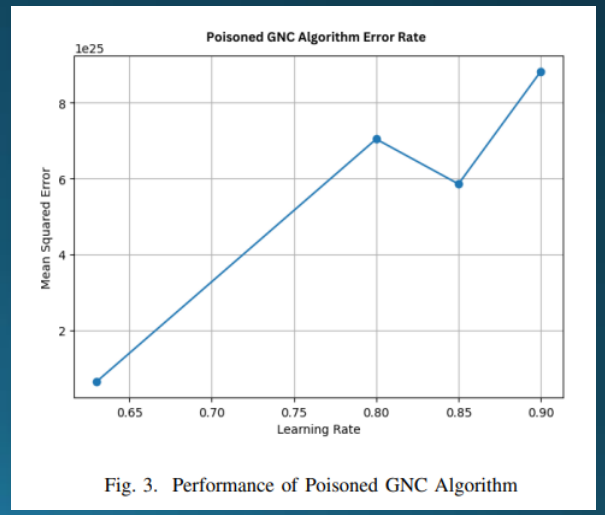


Fig. 3. Performance of Poisoned GNC Algorithm

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