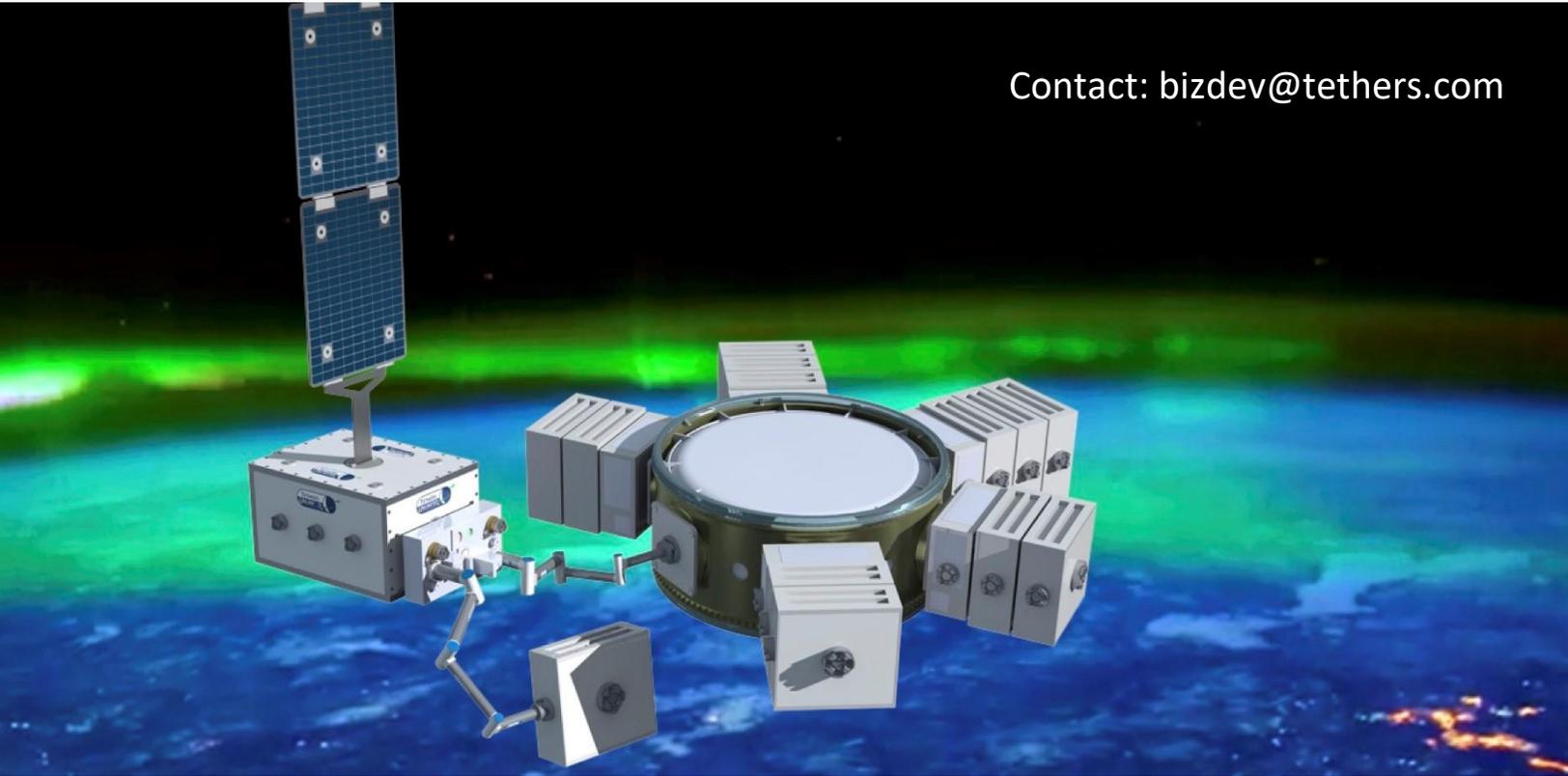


# White Paper

## GAUNTLET Robotic Payload System

Contact: [bizdev@tethers.com](mailto:bizdev@tethers.com)



## Executive Summary

### The Problem

- Heritage space robotics have high costs that limit the value proposition for In-Space Servicing, Assembly, and Manufacturing (ISAM) capabilities.
- Current space robotics do not provide modularity to support frequent upgrades of capabilities.
- Traditional space robotics architectures have high Size, Weight, & Power (SWaP) that drive large system mass and cost with cumbersome operation constraints.

### The Solution

- The GAUNTLET Robotic Payload System with cost-effective & low SWaP manipulation of space objects.

### Benefits

- Low recurring costs & low SWaP
- Modular, configurable, and upgradable
- Supports a wide range of robotics CONOPS.

## Problem Definition

Current state of the art robotic payload systems rely upon reliability architectures that result in very high recurring costs. They do not implement advances force control or compliance, and thus must be designed for maximum peak loads that drive them to be large and massive. As a result, they require large host spacecraft, driving costs for space servicing capabilities to high levels that make it difficult to close a business case for ISAM services.

Additionally, traditional space robotic architectures do not implement modularity to enable technology repair, refresh, and upgrades, and thus, they are typically designed for high reliability for 15+ year lifetimes. This drives high cost which results in the technology being decades out of date for most of their operational lifetime. A resilient, robotic, manipulation solution with ISAM is needed to overcome these common and complex restrictions.

## High Level Solution

Tethers Unlimited, Inc. (TUI) has developed GAUNTLET, a highly modular, robotics payload system with low-SWaP, advanced control systems that implement force control, and machine vision solutions. This multi-arm robotics payload suite enables spacecrafts to perform ISAM services with traditional space robotics solutions. The GAUNTLET system is designed for operations in GEO and XGEO, enabling it to support ISAM capabilities in environments extending from LEO to cis-lunar space.

TUI has developed a cost-effective radiation hardening strategy, focusing on immunity to destructive single event effects (SEE), and high-reliability design controls for critical hazards, as defined by the commercial aircraft industry (SAE ARP4754). This approach, when compared to blanket redundancy, allows for a smaller, more cost-effective option that has not previously been available.

GAUNTLET enables smaller, lower-cost space systems to provide ISAM services. Its' low recurring cost and modular design makes it affordable to replace and upgrade GAUNTLET payloads frequently while producing greater ROI than traditional robotic solutions. The current state of the art for space qualified robotic servicing technology, developed in the RSGS and OSAM-1 projects by DARPA and NASA, are large, complex, and expensive. Furthermore, they require large space platforms to host them that are not well suited for responsive deployment.

GAUNTLET consists of two KRAKEN robotic arms, a modular AXON connector system, a machine vision system for workspace situational awareness, and TUI's SILON robotic control software for coordinated control of free-flying robotic manipulators. Together, GAUNTLET enables simultaneous use of multiple manipulators on a single servicer vehicle for safe grappling, manipulation, and servicing in ISAM missions. GAUNTLET can integrate with heritage spacecraft buses to provide a responsive and affordable ISAM capability.

## Business Benefits

GAUNTLET implements a cost-effective radiation resilience architecture and modularity solutions that enable robotic servicing capabilities at low recurring cost, as well as "future-proofing" through affordable upgradability. Compared to traditional space robotic solutions, GAUNTLET's low cost and upgradability enable dramatic improvements in value proposition and ROI for ISAM systems.

TUI's GAUNTLET provides innovative space missions with a dependable, low-recurring cost solution, high modularity, and is an easy-to-implement solution across multiple missions.



## Summary

GAUNTLET represents the future standard of robotic manipulation for ISAM missions. This robotic manipulation payload solution is reliable, easy-to-implement and has low-recurring costs.

Tethers Unlimited GAUNTLET system provides the modular and cost-effective reliability architecture to close ISAM business cases. We want to offer you this adaptable and implementable solution. Contact [bizdev@tethers.com](mailto:bizdev@tethers.com) to use GAUNTLET for your next mission.