Protean Industries is a surveying, spatial analysis, and geospatial robotics company. We focus on aquanautic-to-astronautic planetary science & technology analog research by leveraging computer sciences, remote sensing, 3D printing, virtual reality, and human factor systems engineering for applications on land, underwater, and in outer space. We provide our omni-environmental geographic information science and technology (GIST) perspective to CONFERS and our clients for research, assessment, and development of the architecture, infrastructure, and human elements required for safe and efficient operations.

Our goal is to promote the next generation of scientific discovery in our Solar System for human exploration and development of space through robotics, surveying, spatial analysis, application development, and commercial astronautics. Our vision is to fortify long-term literacy in science, technology, engineering, art, and mathematics. We provide GIST educational courses and materials that are at the core of our company function related to surveying and robotics. Our central focus is production of the 'model-T' autonomous survey vehicle for GIST toolkit applications to make sea, land, air, and space more accessible than ever to prospective explorers, researchers, and collaborators.

EVA system design variables such as joint range impact the ability of astronauts to perform safe, efficient, and effective EVAs on satellites and other orbital platforms are critical. Suit joint range and location impact astronaut ergonomics, dexterity, and fatigue. As crew members will most likely perform prolonged EVAs, the success of each repair mission is dependent upon appropriate systems design. We must not overlook the maximization of human performance while minimizing health and safety risks.

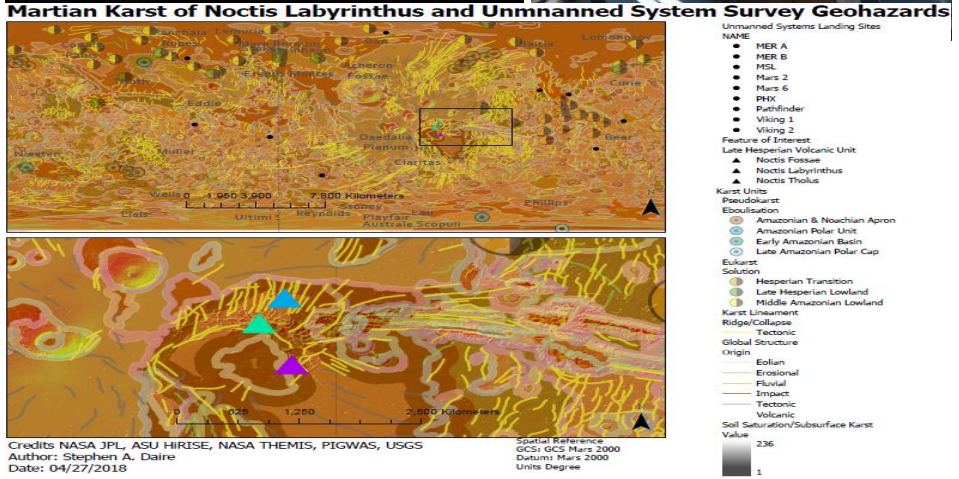
When considering the challenges of maintaining satellite and orbital stations, the most difficult aspect is access to the components. Upgrades and repairs to stations can be completed via human EVA. However, the limitations of suit functionality hinder the dexterity and mobility of astronauts. Autonomous and remotely operated robotics systems can facilitate maintenance without requiring human contact with orbital payloads. A self-propelled maintenance system can be leveraged to complete required work on orbital systems. Multiple arms and camera systems can be utilized to provide the necessary perspective for remote operation and the required variety of tools to allow for complex repairs. Components can be added or removed using drivers and mechanical arms. Intricate repairs to electronics via soldering of circuits can be accomplished.

The delivery of components and fuel to orbital systems allows for the increased longevity of payloads as well as the option to adapt aging systems for more advanced operations. Existing systems can be recovered after failure through repair, maintenance, and upgrades. Operation extensions will prevent debris from cluttering critical orbital heights. In order to extend the lifespan of deployed satellite platforms a more widespread orbital facility to maintain assets needs to be developed. This future capability would include methods and equipment to approach the satellite, attach, repair or upgrade, and finally return them to active service. The maintenance phase has the capability to temporarily or permanently modify the orbit. Operations will be semi-autonomous; however, we advocate for human-in-the-loop inclusion to support flexible and nuanced teleoperation from ground- or orbital-based stations and EVAs. The data gathered from these missions will be used to develop autonomous or machine-assisted operations in the future.

We propose a flexible sensing platform that includes the ability to survey other satellites in order to more accurately assess their integrity and functionality as well as augment ongoing space debris monitoring efforts. We intend to focus efforts on space debris and policy as it contributes to the challenge of ensuring that satellites, spacecraft, and other human projects in space can safely operate. With all methods of traditional governance far removed, responsibility for space debris requires concrete policy and cooperation between nations. Policy and governance require further institutional development as human activities in space increase along with the evolution of the complex nature of this domain. A forward-thinking approach is required to solve problems before they become systemic.

Protean Industries is dedicated to:

- Providing analog mission, EVA, virtual reality (VR) training, and on-orbit servicing support via human factors considerations for all space operations
- Developing & employing synergistic robotics, VR training, space situational awareness, and EVA toolkits to ensure the safe, highest quality outcomes
- Maximizing situational awareness training and operational confidence based on the tenets of cognitive psychology
- Developing best methods, support, and consultation for VR training systems based on metacomprehension and metacognition
- Ensure risk reduction by providing high fidelity immersive training environments in a controlled setting without the safety risks of the actual situation
- Leveraging human, algorithmic, & decision tree hierarchical processes informing AI-human collaboration, ensuring contextual information perceptions
- Development & incorporation of haptic sensors for real time feedback from remote robotics to human systems operators.
- Integrate & advise human-in-the-loop protocols to ensure retention of specialist skills
- Providing systems analysis of unanticipated, near miss, or critical events with the Human Factors Investigation Tool (HFIT)



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