**KVN 2.0**
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# DRONE KVN 2.0

**October 20**

## OVERVIEW

The main objective of the project is to create an autonomous fuselage repair unit that can detect anomalies in the exterior of a satellite in orbit a

nd later repair them with the help of tools and materials equipped in the KVN drones.

## OBJECTIVES

- To be able to make daily diagnoses of the fuselage in search of damages produced by MMOD.
- Repairing these faults is a fundamental part of the project.
- Research and data collection.

## MMOD

MMOD (micrometeorites and orbital debris) are called space junk, orbital debris or any useless artificial object that orbits the Earth. It consists of things as varied as large remains of old rockets and satellites, remains of explosions, or remains of rocket components.

Space debris has become a growing concern in recent years, since collisions at orbital speeds can be highly detrimental to the operation of satellites and can also produce even more space debris in a process called Kessler Syndrome. The International Space Station is shielded to mitigate the damage due to this danger.

Micrometeorites pose a serious threat to space exploration. Its speed with a spacecraft in orbit can be the order of the media per second, and the impact resistance of the micrometeorites in the design of

spaceships and spacesuits. However, these high-speed effects are constantly degraded in the outer deck of the ship. Long-term exposure can threaten the functionality of a spaceship's systems.

Impacts by small objects at high speed is a common issue in terminal ballistic research. The acceleration of objects up to such speeds is difficult; Current techniques include linear motors and hollow loads. The risk is greater for objects that are in space for long periods of time, such as satellites or hypothetical ships in interstellar travel.

## SPECIFICATIONS:

The KVN's are going to be inspired by mother nature on different mammals, insects and reptiles, such as geckos, pangolins, centipedes, caterpillars and oniscidea (better known in Argentina as "little bugs").

Having to locate the faults generated by the MMOD is the work of life of the KVN's, these devices will do a sweep of the satellite once a day to find possible hits of MMOD, when encountering one of these inconveniences is going to proceed to generate a report on the new orifice, next step will fill said hole with graphene.

One of the great challenges we faced was to think of a way to get a displacement of the KVN's on the outside of the fuselage. We are inspired by the legs of the geckos which have been of great scientific contribution thanks to their relationship with the forces of Van Der Waals

Attached information from a NASA document:

The science of the ISS for all:
Scientific objectives for all

Geckos have specialized hairs on their feet called “setas” that allow them to adhere to vertical or horizontal surfaces face down without falling off, and their adhesion does not disappear with repeated use. Gecko Gripper's research tests a gecko-adhesive grip device that can stay in control in the hostile environment of space. The technology promises to enable many new capabilities, including robotic trackers that could walk along the exteriors of spacecraft; tweezers that use a touching method to paste to catch and release objects; and sensor assemblies that can work on any surface and be reused several times

## Scientific results

## Experiment details:

## OpNom: Gecko Gripper

Principal investigator (s)
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Co-Investigator (s) / Collaborator (s) Developer (s) of

pending information NASA Jet Propulsion Laboratory, Pasadena, CA, United States sponsoring space National Agency of Aeronautics and Space Administration (NASA) Sponsorship Office of Organization Technology Demonstration (TDO) Research Benefits Scientific Discovery, Space Exploration ISS Expedition Duration March 2016 - September 2017 Assigned Expeditions 47 / 48,49 / 50,51 / 52 Previous Missions None

**Description:**

The collected data is compared to the data collected on the ground in a 1 g environment at the Jet Propulsion Laboratory (JPL). This allows researchers to better understand the physics and mechanisms of gecko adhesive tweezers and also to design improved tweezers for future applications inside and outside the ISS.

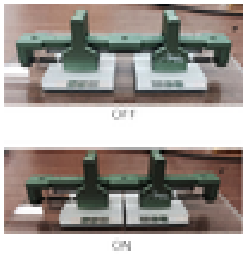
In recent years, there has been a growing interest in the robotic service of assets in space. Gecko adhesive clips could help robotic mobility in assets of large spaces, such as the ISS. An adhesive ON-OFF gripping tool would increase robotic capabilities by allowing the destination of more surfaces, useful for stabilizing the work surface, manipulating delicate features such as blankets and allowing the service spacecraft to remove many more points on the target. In the future, an adhesive clamp can even allow a much smaller spacecraft that can be coupled to the target in many different places to perform service operations, reducing launch and development costs through a lower mass and complexity.

The mitigation of orbital debris is a particularly urgent need as it currently poses a risk to human life on board the ISS and has forced astronauts to prepare for evacuation during close passes of debris. Gecko adhesive gripping tools can help solve this growing problem by providing a simple and reliable method to grab larger and more dangerous pieces of debris, such as dead satellites and spent rockets stages. Often, these objects do not have fixed grip points, or they are rotating / turning, which hinders access to

such points. This technology could allow a spacecraft to grab pieces of debris on virtually any surface and without the need for precision focus or control during the hook sequence.

Images:

**A small Gecko Gripper sticks to a glass plate in the laboratory. The clamp uses two pads, each 1 inch square in size, oriented in opposite directions to withstand forces in any direction. Image courtesy of Dr. Aaron Parness, NASA / JPL.**




Above: A Gecko claw in the off state. No shear load is applied to the pads and the adhesive is in a non-tacky state. Below: a Gecko claw in the ON state. The shear load is applied to the gecko-like adhesive material in the preferential direction (outward) by metal springs, activating the adhesion. Image courtesy of Dr. Aaron Parness, NASA / JPL.





https://www.nasa.gov/mission_pages/station/research/experiments/2324.html

### Van der Waals forces

in molecular physics, the van der Waals forces, named after Dutch scientist Johannes Diderik van der Waals, are distance-dependent interactions between atoms or molecules. Unlike ionic or covalent bonds, these attractions are not a result of any chemical electronic bond, and they are comparatively weak and more susceptible to being perturbed. Van der Waals forces quickly vanish at longer distances between interacting molecules.

$$F = -\frac{A_{\mathrm{H}}}{12\pi D^3}$$

Van der Waals forces play a fundamental role in fields as diverse as secondary school science, supramolecular chemistry, structural biology, polymer science, nanotechnology, surface science, and condensed matter physics. Van der Waals forces also define many properties of organic compounds and molecular solids, including their solubility in polar and non-polar media.

Van der Waals forces help geckos walk effortlessly along walls and ceilings, but this ability is mainly due to electrostatic interaction according to a recent study.

In May 2014, DARPA demonstrated the latest iteration of its Geckskin by having a 100 kg researcher (saddled with 20 kg of recording gear) scale an 8-metre-tall (26 ft) glass wall using only two climbing paddles. Tests are ongoing, but DARPA hopes one day to make the technology available for military use, giving soldiers Spider-Man-like abilities in urban combat.

### **Repair:**

The KVN through FPV(First Person View)  viewers will locate the damage and the next step once a hole produced by a MMOD has been discovered will proceed to repair it, which will be made up of four stages

1. Detection: Built-in cameras and sensors will allow to detect the holes
2. Collection of information: The KVN's recorded in their database the damages produced by collecting data such as (Date of incident, spatial location, location on the ship, dimensions of the hole, etc)

3. Filling: The hole will be filled using 3D printing technology, the chosen material will be graphene, due to its interesting properties.

4. Update: The KVN's database will be updated

## Filling for damages:

Once the fault is located, KVN goes to the damaged surface and continues to fill with Graphene, this material is used for the properties it has since it is an allotrope of carbon.
Graphene enters the hole damaged by the MMOD by means of a 3D printer.
Graphene has multiple properties that make it optimal for this type of satellite filler:

- It is extremely hard: 100 times stronger than a hypothetical steel sheet of the same thickness.
- It is very flexible and elastic.
- It's transparent.
- Self-cooling (according to some scientists from the University of Illinois).
- High thermal and electrical conductivity.
- It makes chemical reaction with other substances to produce compounds of different properties. This gives it great development potential.
- It serves as a support for ionizing radiation.
- It has great lightness, like carbon fiber, but more flexible.

# Technical specification

KVN's (fuselage repair unit) has a wide variety of high performance components that allows you to perform the tasks assigned to recognition, repair and logistics, for this the following components will be used:

## Battery systems

The unit of storage and battery discharge provided by each KVN is 11.1 Vlt, this varies with the novelty that is to be developed, it is predisposed to use LIPO batteries (ion li).

## System FPV

It refers to the flight with camera on board mounted in the front, in the back and in the mechanical arm that is in the lower part of KVN in scale and real size, allows the scanning and recognition of the work area, being able to monitor continuously

## Geolocation system

This system allows us to perform a geolocation of the location of KVN, by means of a VHF antenna of 117.2 MHZ (by way of example), and a transponder by means of morse or microwave, this system is based on VOR systems / DME used in the field of aeronautics more precisely called "Radioayudas" or "aids to air navigation", in the future the use of UHF or SHF antennas is foreseen.

## System  DBM

The DBM system or database allows us to collect both the scan of the total surface of the satellite as well as what is happening around it, after solving the novelty, returns to scan the area and generates a .dbm file to maintain constantly updated.

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