International Space Station Imagery

A Critical Tool for Science, Technology Development, and Global Outreach

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ISS Imagery – A Background

Cosmonaut Yuri P. Gidzenko (center) holds an IMAX camera while floating with his crew mates in the Destiny laboratory on the International Space Station (ISS). Also pictured are cosmonaut Sergei Krikalev (left), and Bill Shepherd, mission commander.

Since Expedition 1 began in 2001, imagery has played a prominent role on the International Space Station. Whether we're testing new technologies on the orbiting platform, using images to verify science data, or documenting the daily activities for the historical record, imagery has always supported the mission.

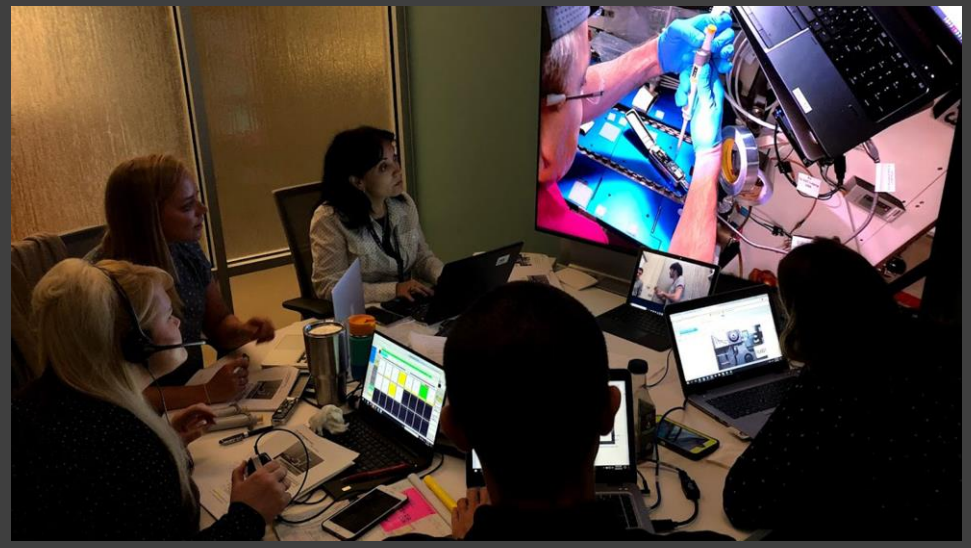
To date, ISS crew members have acquired over 6 million images from the space station. As new technologies enable more efficient imagery acquisition, downlink, processing, and distribution, we expect that number to continue to grow significantly during the **Decade of Results**.

ISS030E126655 – Taken on March 7, 2012, believed to be the one millionth image acquired by Space Station crew members.

ISS Imagery In Support of Science

The space station orbits approximately 250 miles above the Earth, which puts most researchers out of arm's reach of their experiments.

In order to ensure that hardware is set up properly and experiments are run as intended, researchers follow along with the crew using real-time video downlink to monitor experiment runs.



Through a complement of professional camera hardware – including digital SLRs, professional camcorders, and ultra high definition digital cinema cameras, space station crew members capture the science in greater resolution and detail than ever before.

In addition, the space station supports up to 8 simultaneous video downlink channels to support a number of concurrent investigations, plus additional video-over-IP capabilities as needed.

ISS Imagery as Science

ISS056E102554 – Taken on August 2, 2018, this image features wildfires in California and Nevada.

Crew Earth Observation (CEO) imagery takes advantage of one of the most unique aspects of space flight – the view of Earth from an orbiting platform. Recently, crew members participated in the Avian Migration Aerial Surface Space (AMASS) project, which takes advantage of thousands of images captured by astronauts to map the routes taken by seven endangered or threatened bird species. The images enable researchers to highlight along those routes habitat changes caused mainly by human activities.

A series of images taken during the second run of the Burning and Suppression of Solids (BASS) experiment.

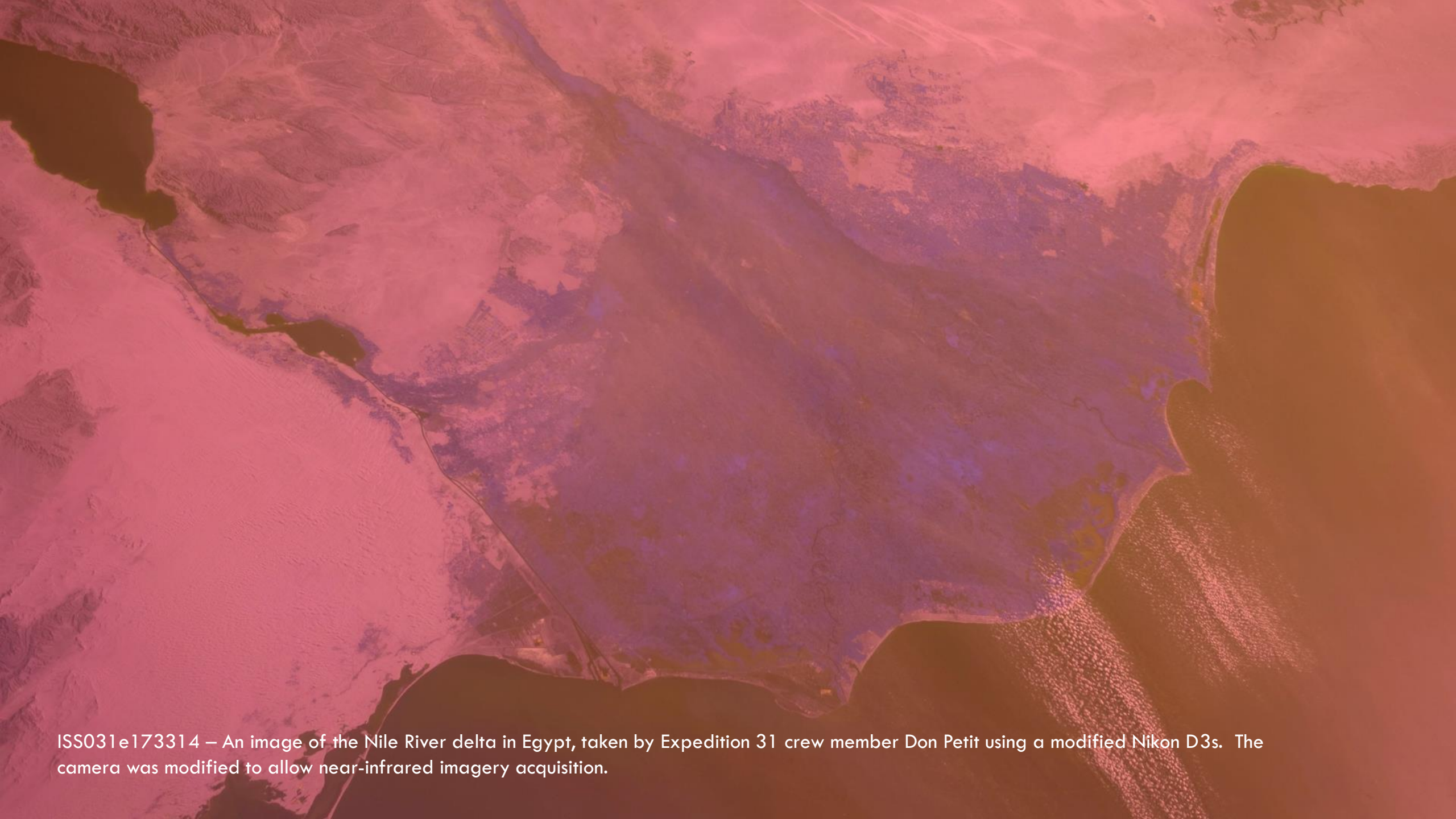
BASS examines the burning and extinction characteristics of a wide variety of fuel samples in microgravity.

Results of the investigation contribute to the combustion computational models used in the design of fire detection and suppression systems in space and on Earth.

HICO Image of algal bloom on Lake Erie, Ohio, in September, 2011

Space Station imagery reaches beyond human-visible wavelengths. From 2009 to 2014, the Hyperspectral Imager for the Coastal Ocean (HICO) payload acquired imagery of coastal areas across 128 spectral bands. Scientists used the information in the images to estimate concentrations of healthy and harmful phytoplankton, identify harmful algal blooms in reservoirs, and assess water quality.

Recently, the Japan Aerospace Exploration Agency (JAXA) developed the Hyperspectral Imager Suite (HISUI) – a spaceborne hyperspectral Earth imaging system – to acquire imagery of the Earth in the near-infrared and shortwave infrared regions.



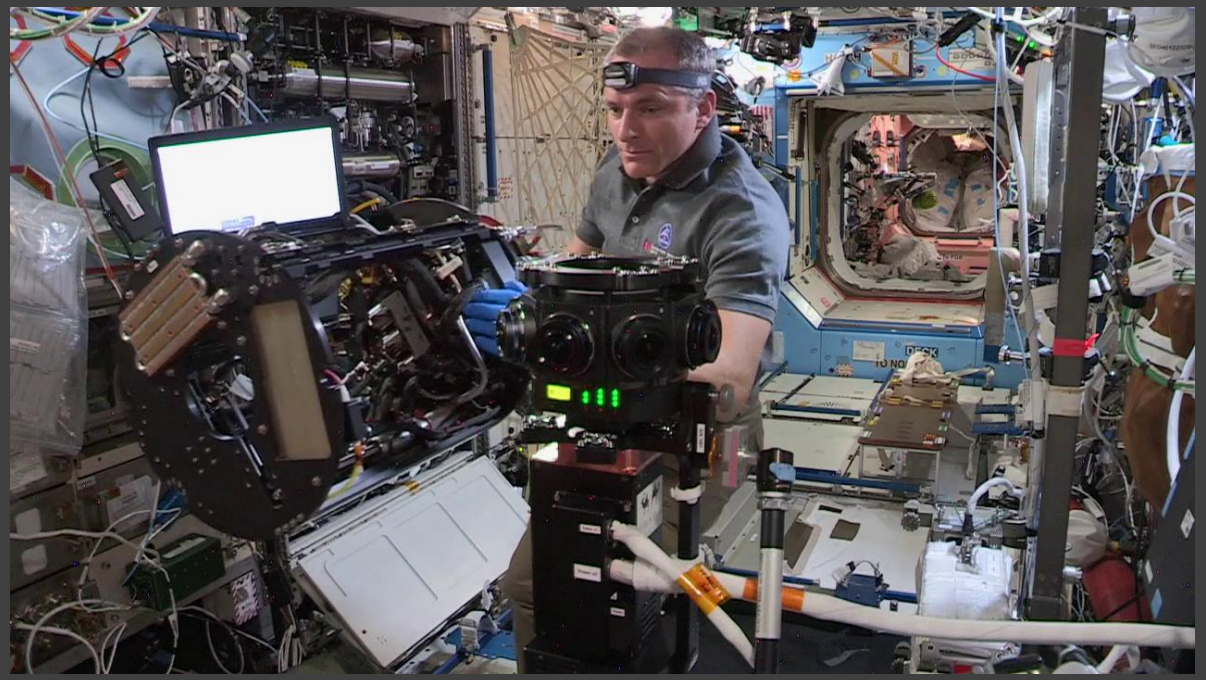
ISS031e173314 – An image of the Nile River delta in Egypt, taken by Expedition 31 crew member Don Petit using a modified Nikon D3s. The camera was modified to allow near-infrared imagery acquisition.

Technology Development and Demonstration

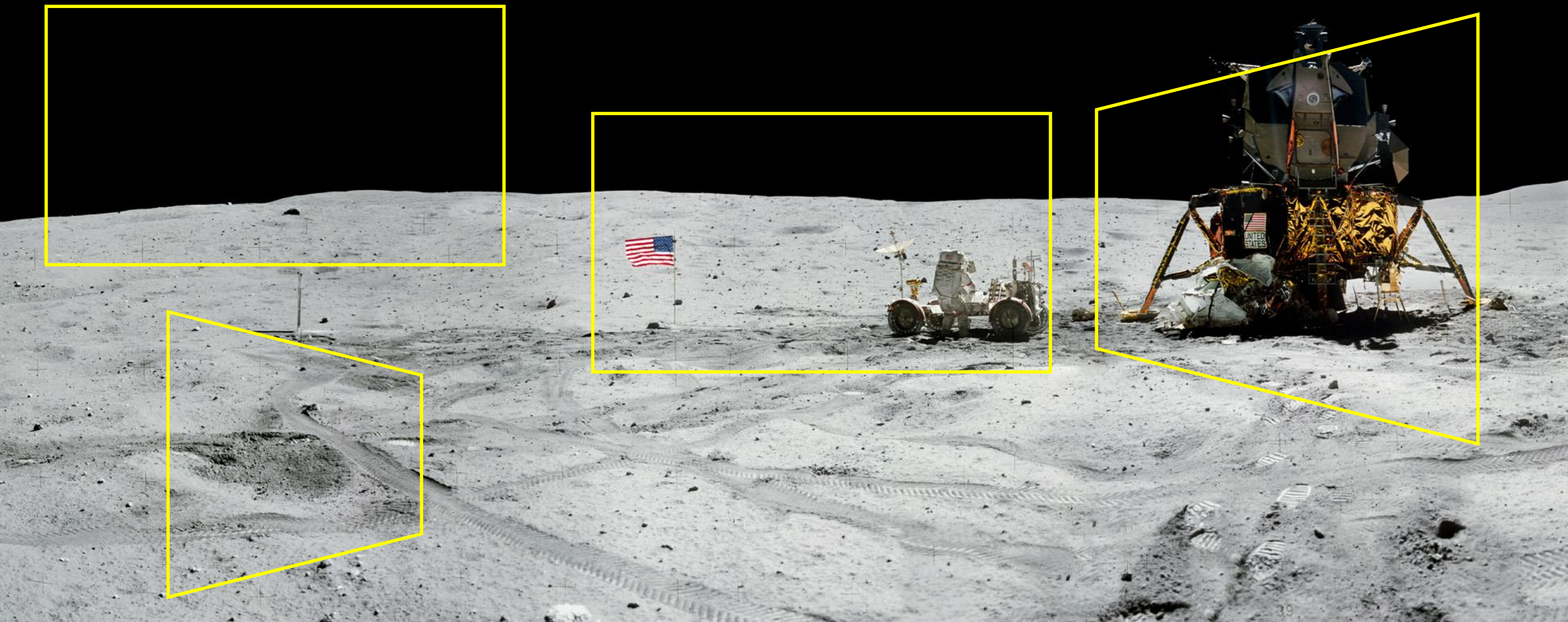
ISS066E085176 – ESA astronaut Matthias Maurer poses in the Cupola. This image was taken with a GoPro Max 360 camera.

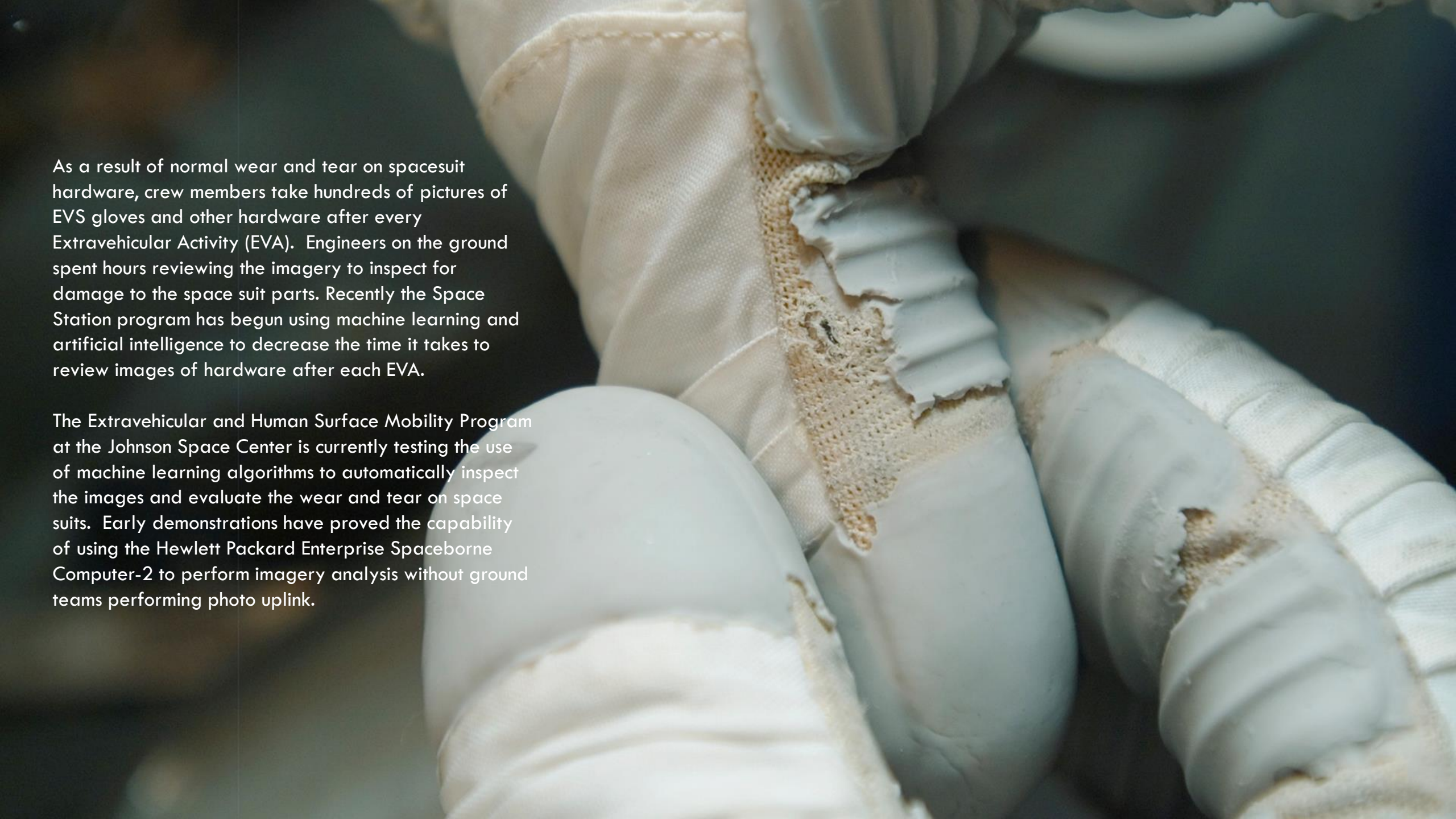
The space station continues to investigate new methods of imagery acquisition and distribution. In 2021, Felix and Paul Studios released the final episode of their Emmy-award winning series, Space Explorers: The ISS Experience. The ISS Experience is a 4-part documentary series featuring video acquired on the space station using a purpose-built 3D 360-degree camera.

The series was presented in virtual reality, and the video was further incorporated into The Infinite, a multisensory virtual reality experience. Building on the success of The ISS Experience and The Infinite, the space station program is investigating the capability of a live 360-degree video downlink.



In addition to the novel use for public engagement, the space station has incorporated virtual and augmented reality imaging systems into a number of different activities, including robotic control and ground assistance in maintenance tasks. 360-degree camera systems may ultimately prove beneficial to future exploration missions to reduce the weight and complexity of pan/tilt units.





As a result of normal wear and tear on spacesuit hardware, crew members take hundreds of pictures of EVS gloves and other hardware after every Extravehicular Activity (EVA). Engineers on the ground spent hours reviewing the imagery to inspect for damage to the space suit parts. Recently the Space Station program has begun using machine learning and artificial intelligence to decrease the time it takes to review images of hardware after each EVA.

The Extravehicular and Human Surface Mobility Program at the Johnson Space Center is currently testing the use of machine learning algorithms to automatically inspect the images and evaluate the wear and tear on space suits. Early demonstrations have proved the capability of using the Hewlett Packard Enterprise Spaceborne Computer-2 to perform imagery analysis without ground teams performing photo uplink.

The Space Station program is evaluating Augmented Reality (AR) systems to enable ground teams to better communicate with astronauts during maintenance tasks.

In one recent example, astronaut Megan McArthur donned a Microsoft HoloLens while she removed a piece of hardware from inside the Cold Atom Lab (CAL) and replaced it with a new one. Through the HoloLens, McArthur could easily see the U.S. Destiny module around her. A small front-facing camera on the headset allowed CAL team members to see what she was seeing, whereas normally they would rely on a camera positioned behind or above the astronaut to provide an often-obscured view of the hardware. The CAL team also could add virtual graphics, such as text or drawings, to McArthur's field of view. For example, as she looked at a large cable harness, the team could add an arrow in her field of view designating a particular cable to unplug or a zip tie to cut.

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