National Aeronautics and Space Administration

NASAfacts

Satellite Servicing & Robotic Technology

NASA's Exploration & In-space Services (NExIS) at Goddard Space Flight Center (GSFC) is working toward an era of more sustainable, affordable and resilient spaceflight near Earth, the Moon and deep into the solar system through in-space servicing and assembly. For more than 25 years NExIS has mobilized a multi-disciplinary technical team to establish the hardware and software infrastructure to successfully develop over 200 in-space servicing technologies, cultivating a well-earned reputation for proven, accelerated, and economic approaches to demonstrate new capabilities. The NExIS legacy includues five successful Hubble Space Telescope Servicing Missions (1990-2009), the Satellite Servicing Capabilities Office (2009-2016), and the Satellite Servicing Projects Division (2016-2020).

Enabling a New Era

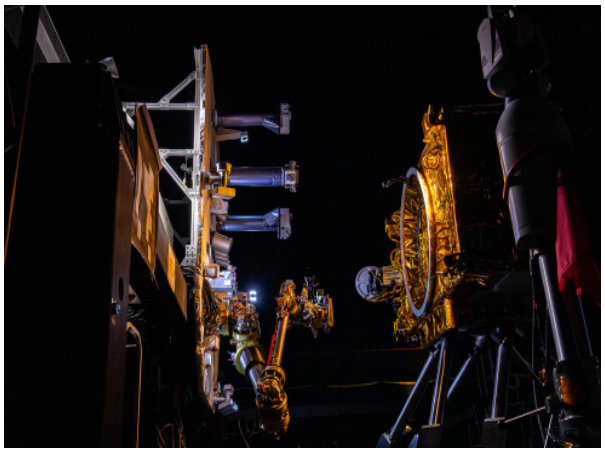
To capitalize on these innovations and enable extraordinary missions, NExIS is focused on several key initiatives.

- First, continue to develop groundbreaking technologies that pioneer In-space Servicing, Assembly, and Manufacturing (ISAM) capabilities critical to next-generation science and exploration mission concepts.

- Second, promote U.S. leadership and new industries through collaboration and technology transfer with government and industry.

- Lastly, empower sustainable, affordable, and resilient spaceflight by making ISAM a routine and integral function within space architectures and mission lifecycles.

It's important to take care of what we have. Take a moment to imagine dumping your car on the side of the road when it runs out of fuel or abandoning your house if a pipe leaks. To extend the life of spacecraft and explore further than ever before, it is essential to have the ability to repair, refuel and assemble parts in-space in an efficient and cost effective way. NExIS is powered by a drive for innovation and a passion to challenge the status quo of "One and Done"missions.



Detail shot of the On-orbit Servicing, Assembly, and Manufacturing 1 (OSAM-1) autocapture test bed during a test of the Robotic Servicing Arm inside the Robotic Operations Center (ROC) at NASA's Goddard Space Flight Center.

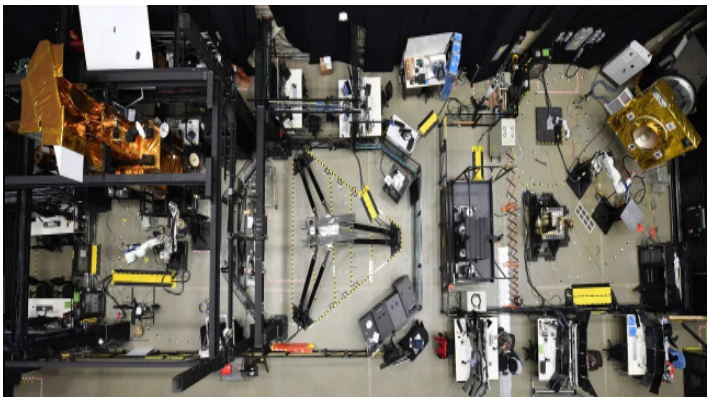
This is shown in all of the novel servicing technologies it has created: *Hubble Space Telescope tools (HST), the Hubble Robotic Service & Deorbit Mission (HRSDM), Robot Refueling Mission (RRM) Suite, On-orbit Servicing, Assembly, and Manufacturing 1 (OSAM-1), Alpha Magnetic Spectrometer (AMS), and International Space Station Support (ISS)*. All of these missions have allowed NExIS to continue to develop and utilized robotic tools and hardware to demonstrate robotic servicing techniques in-space.

Our Future in Space

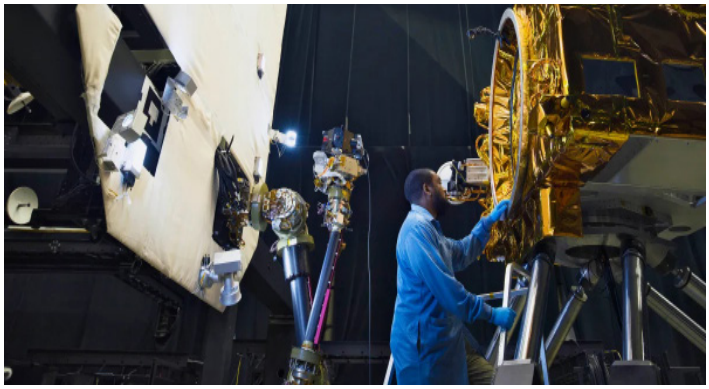
Robotic satellite servicing will push the boundaries of our ventures into space by extending the life expectancy and capabilites of spacecraft. At a general level, in order to push the boundaries of our ventures into space, we must advance beyond visitng desitnations with sophisticated systems that allow no room for failure, and beyond bringing everything we need with us. Robotic technology would allow large structures to be constructed in-space and servicing for large telescopes far away from Earth. Closer to Earth, not only could we repair statellites and spacecraft, these servicing capabilities can also be applied to managing orbital debris, an area of growing concern in Low Earth Orbit (LEO) as well as Geostationary Earth Orbit (GEO).

NExIS Facilities

The **Robotic Operations Center, or ROC**, is the newest facility for satellite servicing development. Within its black, curtain-lined walls, the team is testing technologies and operations for multiple exploration and science missions, including the OSAM-1 mission. The ROC has been continuing and expanding the work of the Servicing Technology Center since the summer of 2015, and houses multiple robots including a hexapod robot which simulates the movement of a satellite in space. The **Servicing Technology Center (STC)** has served as home base for technology and operations development since 2011. Used to develop, integrate, and test elements of NASA's Robotic Refueling Mission, or RRM— which demonstrated robotic satellite-servicing tools, technologies and techniques on the International Space Station, the STC hones techniques for the precise placement of cameras on the tools to robotic procedures and hardware development. The STC provides continuing to support to RRM's on-orbit operations on space station. The **West Virginia Research and Technology Center (WVRTC)** provides an additional test area for servicing technologies, inlcuding a combination of industrial and space-qualified robots, and full-scale "mockups," or models, of space vehicles.



An overhead view of the Robotic Operations Center (ROC) at Goddard Space Flight Center (GSFC).



The Robotic Operations Center (ROC) is a testbed for satellite servicing technologies that enable science and exploration.

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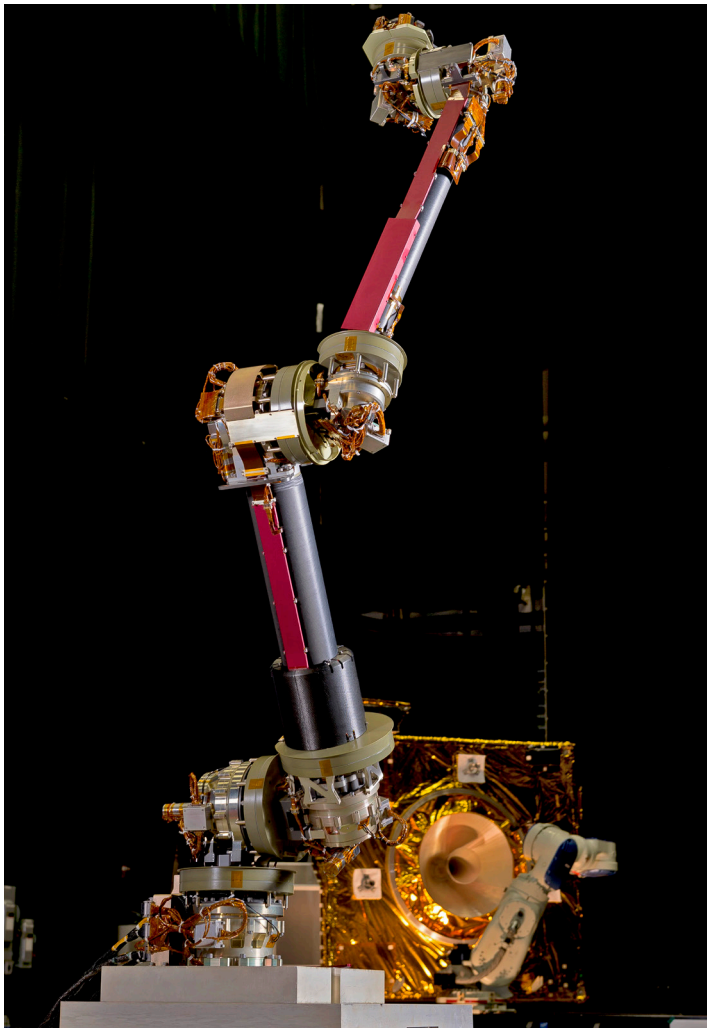
Robotic Servicing Arm

The robotic servicing arm is capable of dexterous and autonomous operations between two inertial bodies in space, enabling on-orbit satellite servicing, asteroid capture, and in-space assembly of large telescopes. Opening a door, grabbing a pencil, pouring a glass of water— these are all examples of simple, everyday tasks that use your arm. Like your arm, the NASA Servicing robot has "seven degrees of freedom", a three axis shoulder, a pitch actuator at the elbow, and a three-axis spherical wrist. Other features include a six-axis force/torque sensor at the end of the arm, and a flex harness that routes data, power, and video. In the process of building space hardware, an engineering design unit (EDU) is manufactured before final flight hardware. An EDU helps "work out the kinks." It is important to test a working, ground-based version that helps hone, refine, and evaluate the design before the "real" arm is built and destined for spaceflight.



Flight arm for the On-orbit Servicing, Assembly, and Manufacturing 1 (OSAM-1) satellite servicing payload.

For more information, visit:
https://www.nasa.gov/nexis/