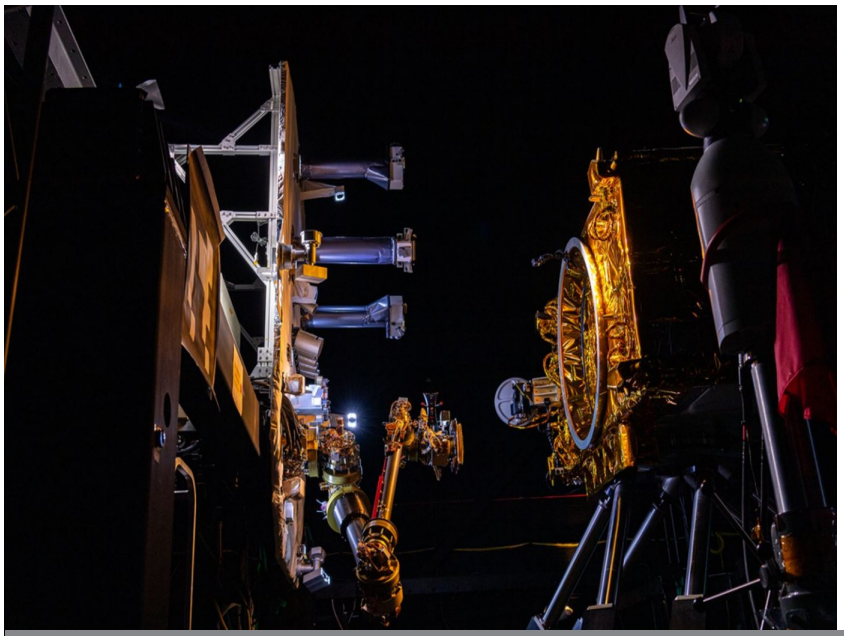


National Aeronautics and Space Administration

TECHNOLOGY SOLUTION

Robotics, Automation and Control

New motors for next-generation in-space servicing

Innovative components for the Advanced Tool Drive System

Brushless direct current (BLDC) motors are of interest to drive tools for in-space servicing due to their reliability, efficiency, and controllability. Current BLDC motors do not meet the needs of space environments, nor do they have common interfaces, limiting their versatility.

NASA inventors have developed four BLDC motors to power a variety of tools for in-space servicing. The motors are part of the Advanced Tool Drive System (ATDS) that is attached to the end of a robotic arm providing the power for the servicing tools. While the motors have differing performance characteristics to drive various tools, they have been designed with a common gearhead for versatility within a single frame size. The motors are built to withstand the wide temperature variations and radiation conditions of geosynchronous orbit.

The BLDC motors and the ATDS will be used for spacecraft servicing in manned and unmanned missions and may also apply to terrestrial robotic systems.

BENEFITS

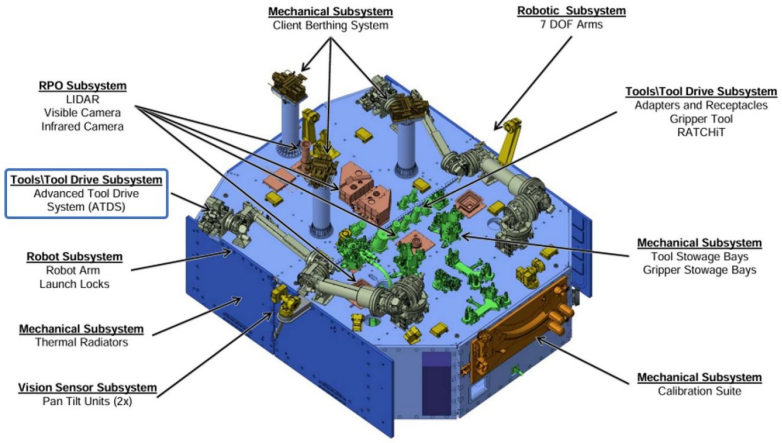
- Robust: Built to survive the harsh environment (temperature variations and high levels of radiation) of geosynchronous earth orbit
- Lightweight and smaller footprint: The new ATDS motor system is smaller and lighter than previous or commercially available BLDC motors
- Multipurpose: the BLDC motors can power multiple tools for in-space servicing
- Customizable: the BLDC motors can be further customized and developed for changing load, speed, and torque requirements

THE TECHNOLOGY

Satellites and other spacecraft require maintenance and service after being deployed in orbit, requiring a wide variety of tools that perform multiple maintenance tasks (grip, cut, refuel, etc.). Current drive systems for the tool interfaces on the robotic arms that perform these service tasks are not as robust nor packaged properly for use in the ATDS. The ATDS is one part of a larger in-space servicing system (example shown in the figure below) that must be versatile and perform multiple jobs.

Here, innovators at the NASA Goddard Space Flight Center have developed new BLDC motors to provide the torque necessary to drive the wide variety of tools needed for in-space servicing. The four motors provide torque to the coupler drive, linear drive, inner rotary drive, and outer rotary drive of the ATDS. The new BLDC motors will enable the tools attached to the ATDS to be operated in multiple modes of operation.

Each of the four motors have been customized with different speed and torque capabilities to meet the different performance requirements of the various actuator drive trains while maintaining a common gearhead across all the motors. Further, the packaging surrounding the motors has been tailored to reduce the overall weight of the motors and reduce the motor footprint to meet the needs of the ATDS. The BLDC motors for the ATDS are available for patent licensing.



Schematic of a legacy in-space refueling system—named Restore-L—showing the various subsystems including the Advanced Tool Drive System (ATDS).

APPLICATIONS

The technology has several potential applications:

- In-space servicing and assembly: the BLDC motors can be used to drive tools for servicing (and assembly) of spacecraft in orbit
- Terrestrial robotics and automation: these motors may also be used for robotic or automated manufacturing processes terrestrially

PUBLICATIONS

Patent Pending

technology.nasa.gov

NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

GSC-16872-1, GSC-TOPS-351

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FS-2023-12-196-GSFC