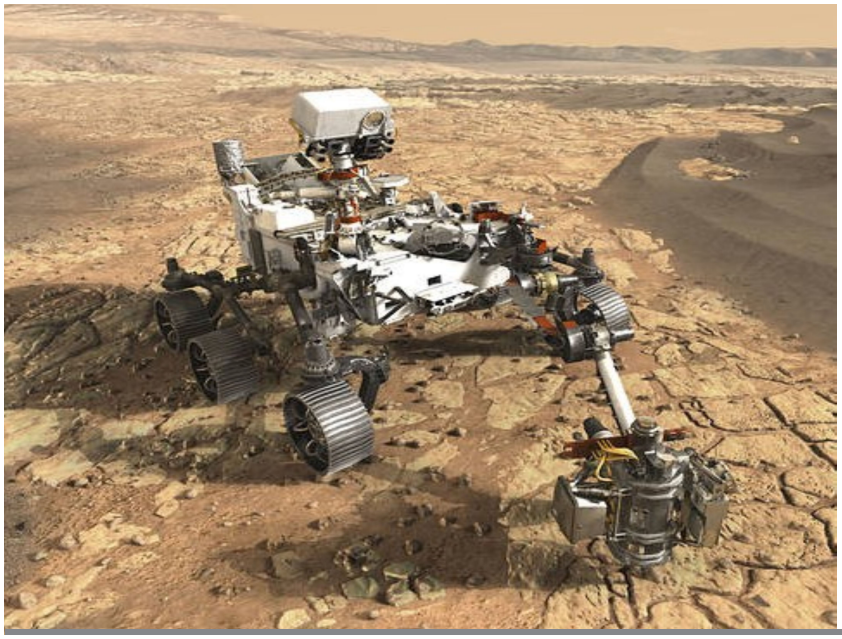

National Aeronautics and Space Administration

TECHNOLOGY SOLUTION

Mechanical and Fluid Systems

Multi-Link Spherical Joint

Single joint allows six attachments with independent movement

Innovators at NASA Johnson Space Center have designed a spherical joint which allows up to six linearly actuated links or attachments to rotate about a co-located center. Originally designed to provide joint flexibility necessary for a variable geometry truss system, the new spherical joint also allows power and data lines to pass through it without the lines being subjected to structural forces. This technology can be key for creating a deployable, variable geometry truss system, with a compact form factor that can reduce payload volume within the confines of a launch or other transport vehicle. Typically, flexible truss systems rely on joints where each of the links do not rotate around the same point, creating instability in the joints and the entire structure. The Multi-Link Spherical Joint removes those instabilities, allowing for a durable and adaptable technology with multiple space and terrestrial applications.

BENEFITS

- Flexible: each attachment rotates independently
- Controllable: each link can be independently controlled
- Customizable: six possible links instead of the typical two
- Deployable: promotes smaller form factor deployable systems
- Manufacturable: shell-and-cup design can be easily made and assembled

THE TECHNOLOGY

The Multi-Link Spherical Joint developed at NASA Johnson Space Center provides a substantial improvement over typical joints in which only two linearly actuated links move independently from one another. It was determined that the rotation point of a trussed link needed to be collocated at a shared point in space for maximum articulation. If not allowed separate rotation, the line of action through a universal joint and hinge acts effectively as another linkage. This leads to a much more complex and uncontrollable structure, especially when considering multiple dimensions.

Comprising the Multi-Link Spherical Joint, a spherical shell encases the cupped ends of each six possible attachments and allows each of those attachments to be independently controlled and rotated without inhibiting the motion of the others. To do this, each link is precisely limited to 15 degrees of rotation off the link centerline, thus allowing a total of 30 degrees of rotation for each link. The shell-and-cup structure can handle the loads of linear actuators that may be used to control and vary the geometry of a truss system utilizing the new joint technology. The calculated operating load that the truss system must handle can be used to scale the size of the joint, further allowing customization of any potential truss system. Additionally, the incorporated linear actuators can be controlled and powered by wiring routed through the joint without putting undo stress on the wires during operation. Accordingly, this innovative joint technology enables more efficient deployment and precise operation of articulating structures.

The Multi-Link Spherical Joint is at technology readiness level (TRL) 4 (component and/or breadboard validation in laboratory environment) and is available for patent licensing. Please note that NASA does not manufacture products itself for commercial sale.

Shown (left): CAD Design and (right) 3D-printed prototype of the Multi-Link Spherical Joint.

APPLICATIONS

The technology has several potential applications:

- Aerospace: robotic manipulator arms; space telescope structures; surface habitats
- Robotics: articulating appendages, parallel robotics such as flight simulator platforms

PUBLICATIONS

Patent No: 11635107

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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.

MSC-26694-1, MSC-TOPS-109

More Information

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NP-2022-05-3056-HQ