Mechanics/Machinery

Lexan Linear Shaped Charge Holder With Magnets and Backing Plate

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A method was developed for cutting a fabric structural member in an inflatable module, without damaging the internal structure of the module, using linear shaped charge. Lexan and magnets are used in a charge holder to precisely position the linear shaped charge over the desired cut area. Two types of charge holders have been designed, each with its own backing plate. One holder cuts fabric straps in the vertical configuration, and the other charge holder cuts fabric straps in the horizontal configuration.

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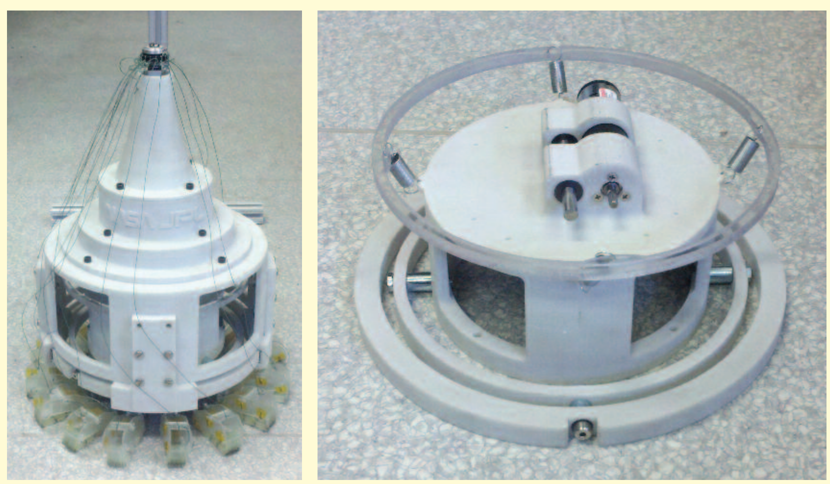
Robotic Ankle for Omnidirectional Rock Anchors

This mechanism could provide mobility for military robots on vertical cliff faces or on ceilings.

NASA's Jet Propulsion Laboratory, Pasadena, California

Future robotic exploration of near-Earth asteroids and the vertical and inverted rock walls of lava caves and cliff faces on Mars and other planetary bodies would require a method of gripping their rocky surfaces to allow mobility without gravitational assistance. In order to successfully navigate this terrain and drill for samples, the grippers must be able to produce anchoring forces in excess of 100 N. Additionally, the grippers must be able to support the inertial forces of a moving robot, as well gravitational forces for demonstrations on Earth. One possible solution would be to use microspine arrays to anchor to rock surfaces and provide the necessary load-bearing abilities for robotic exploration of asteroids.



The **Ankle Mechanism** (left), and the interior of the ankle (right), showing the gimbal systems, springs, and actuation device for the engagement wires.

Microspine arrays comprise dozens of small steel hooks supported on individual suspensions. When these arrays are dragged along a rock surface, the steel hooks engage with asperities and holes on the surface. The suspensions allow for individual hooks to engage with asperities while the remaining hooks continue to drag along the surface. This ensures that the maximum possible number of hooks engage with the surface, thereby increasing the load-bearing abilities of the gripper. Using the microspine array grippers described above as the end-effectors of a robot would allow it to traverse terrain previously unreachable by traditional wheeled robots. Furthermore, microspine-gripping robots that can perch on cliffs or rocky walls could enable a new class of persistent surveillance devices for military applications.

In order to interface these microspine grippers with a legged robot, an ankle is needed that can robotically actuate the gripper, as well as allow it to conform to the large-scale irregularities in the rock. The anchor serves three main purposes: deploy and release the anchor, conform to roughness or misalignment with the surface, and cancel out any moments about the anchor that could cause unintentional detachment.

The ankle design contains a rotary DC motor that can drag the microspine arrays across the surface to engage them with asperities, as well as a linear actuator to disengage the hooks from the surface. Additionally, the ankle allows the gripper to rotate freely about all three axes so that when the robot takes a step, the gripper may optimally orient itself with respect to the wall or ground. Finally, the ankle contains some minimal