



## Amorphous Rover

This rover would maneuver on terrain by altering its shape.

*Goddard Space Flight Center, Greenbelt, Maryland*

A proposed mobile robot, denoted the amorphous rover, would vary its own size and shape in order to traverse terrain by means of rolling and/or slithering action. The amorphous rover was conceived as a robust, lightweight alternative to the wheeled rover-class robotic vehicle heretofore used in exploration of Mars. Unlike a wheeled rover, the amorphous rover would not have a pre-

defined front, back, top, bottom, or sides. Hence, maneuvering of the amorphous rover would be more robust: the amorphous rover would not be vulnerable to overturning, could move backward or sideways as well as forward, and could even narrow itself to squeeze through small openings. Examples of potential terrestrial applications of the amorphous rover include exploration or

military reconnaissance on rough terrain, inspection inside narrow tunnels, and searching for victims trapped in rubble of collapsed buildings.

The main structure of the amorphous rover would consist of a tetrahedral mesh of nodes connected by variable-length struts, covered with a stretchable fabric connected to the outer nodes (see Figure 1). The rolling and/or slithering

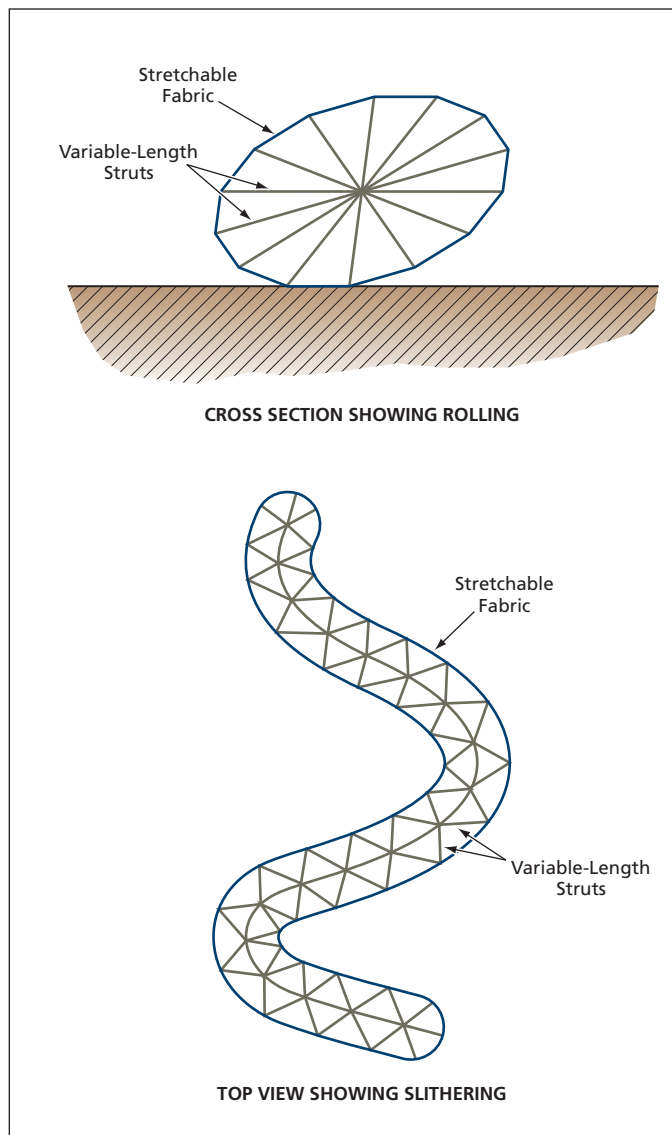


Figure 1. A Tetrahedral Mesh of Variable-Length Struts would be enclosed by a stretchable fabric. Struts would be lengthened and/or shortened in coordination to effect rolling and/or slithering.

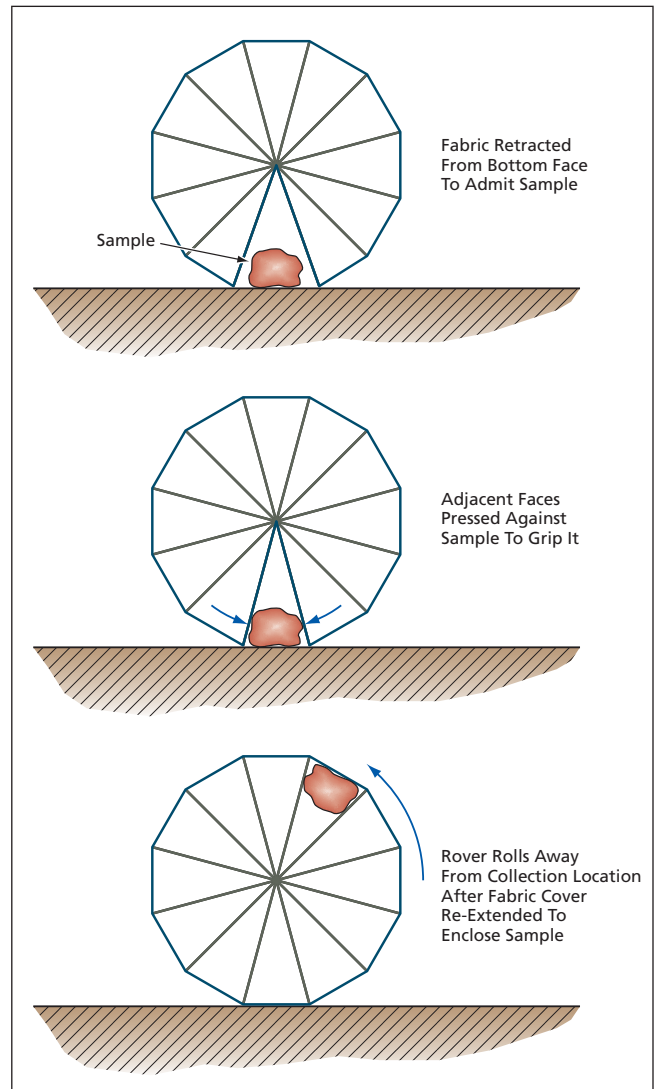


Figure 2. A Sample Would Be Collected by momentarily retracting the fabric from one of the outer faces, rotating so that a tetrahedral compartment that includes the open face contains the sample, re-extending the fabric to cover the outer face and trap the sample inside, then rolling away from the collection position.

action would be effected through coordinated lengthening and shorting of the struts. Inasmuch as there would be no head, visual and/or other data needed for navigation would be obtained by means of a distributed sensor network inside the structure. A sample for return could be collected by a process, illustrated in Figure 2, that would lead to retention of the sample in a tetrahedral

compartment defined by stretchable fabric covering all its faces.

The amorphous rover could, in principle, be designed and built using currently available macroscopic electromechanical components. In addition, the basic amorphous-rover concept admits of a numerous design variations, including ones involving extreme miniaturization through exploitation of microelectromechanical systems

(MEMS), nanoelectromechanical systems (NEMS), and perhaps even the use of carbon nanotubes. Any or all of these variations could include control systems based on evolvable neural software systems.

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## ⚙️ Space-Frame Antenna

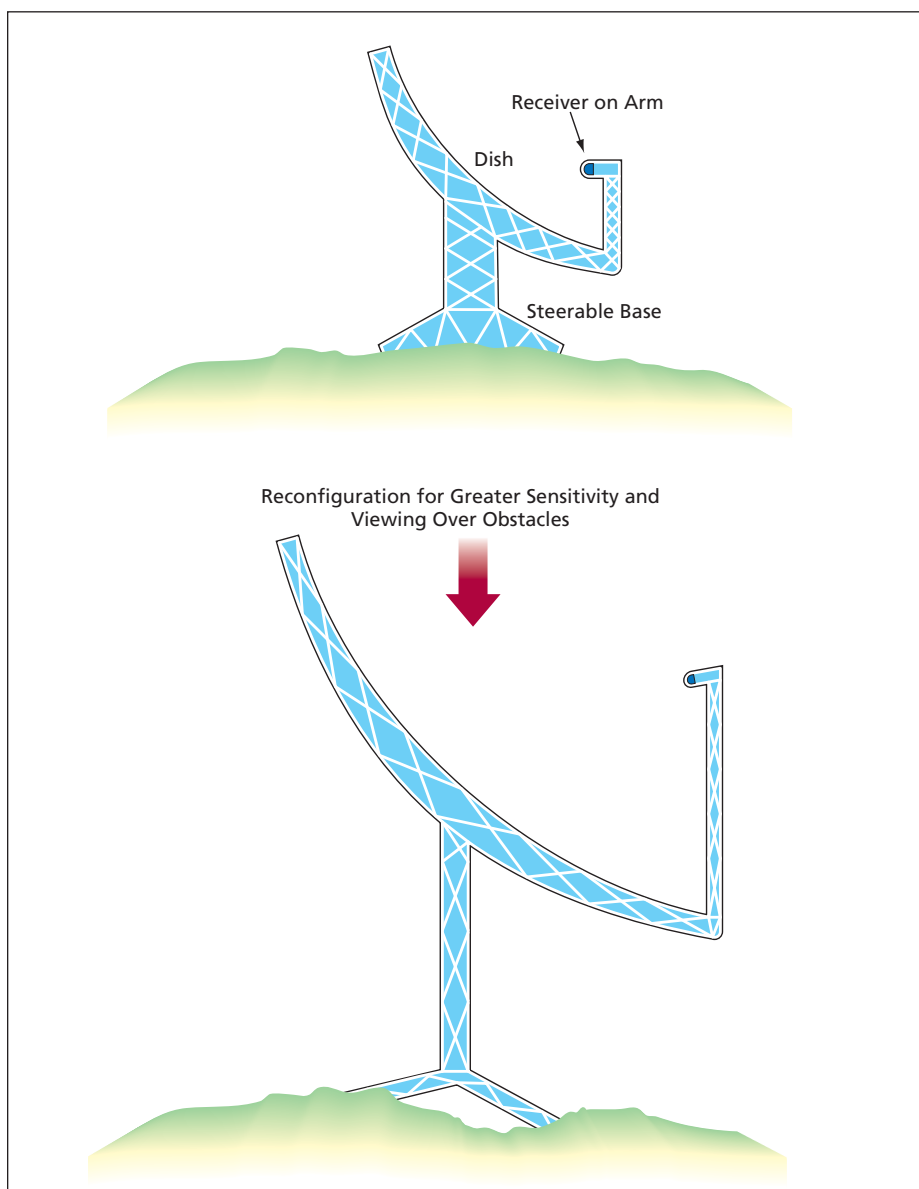
**The structure could be deformed to a desired size, shape, and orientation.**

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The space-frame antenna is a conceptual antenna structure that would be lightweight, deployable from compact stowage, and capable of deforming itself to a size, shape, and orientation required for a specific use. The underlying mechanical principle is the same as that of the amorphous rover described in the immediately preceding article: The space-frame antenna would be a trusslike structure consisting mostly of a tetrahedral mesh of nodes connected by variable-length struts. (The name of the antenna reflects the fact that such a structure has been called a “space frame.”) The deformation of the antenna to a desired size, shape, and orientation would be effected through coordinated lengthening and shorting of the struts. In principle, it would even be possible to form the space-frame antenna by deforming another space-frame structure (e.g., the amorphous rover) in this manner.

Typically, the space-frame antenna would be configured as a dish-type reflector with an arm holding a receiver, all on a steerable base. Examples of exploiting the space-frame concept to reconfigure the antenna for a specific use include making the base taller (for viewing over obstructions) and making the dish wider (for greater sensitivity), as illustrated in the figure.

Like the amorphous rover, the space-frame antenna could be designed and built using currently available macroscopic electromechanical components or by exploiting microelectromechanical systems (MEMS), nanoelectromechanical systems (NEMS), or perhaps even carbon



The Antenna Could Be Widened and Heightened as shown here for better viewing and greater sensitivity. It could also be twisted, reoriented, and/or otherwise deformed to aim it in one or more different direction(s).