Self-Deployable Spring-Strip Booms

These structures can be stowed compactly with small forces and become rigid once deployed.

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Booms and other structures consisting mainly of thin spring strips are undergoing development. These structures are designed to be lightweight, to be compactly stowable, and to be capable of springing to stable configurations at full extension once released from stowage. Conceived for use as self-deploying structures in outer space, portable structures of this type may also be useful on Earth in applications in which there are requirements for light weight and small transportation volume.

The elements common to these structures are spring strips with curved cross sections — similar to spring strips of the type commonly used as compactly stowable carpenters' measuring tapes. These structures exploit the nonlinear mechanical properties of such tapes, namely (1) strong resistance to axial buckling while they are straight and (2) ease with which they can be wound into compact rolls once they have been initially bent. For a structure that contains multiple such strips, the net effect of the combined nonlinear characteristics is the following:

- When at full extension, the structure is in a stable state, in which it is rigid and strong.
- When stowed compactly, the structure is in a state that is semistable in the sense that only a small force is needed to restrain the structure against deployment.
- The strain energy stored in the spring strips during compaction is sufficient to deploy the structure to full extension when the restraint is removed.

The figure depicts two of several boom designs that have been investigated thus far. One design calls for several longitudinal spring strips with curved cross sections as described above, connected at intervals by semicircular circumferential spring strips with flat extensions. The main advantage of this design is relative strength; the main disadvantages are the additional weight and volume of the flat extensions and the potential for motion of the flat extensions to cause damage during deployment.

Another design features semicircular circumferential spring strips joined by fibrous hinges. The main disadvantage of this design is less strength, relative to the design described above; the main advantages are less weight and volume as well as greater safety during deployment. Still other designs feature, variously, circumferential spring strips with self-locking hinges, and deployment control devices to reduce deployment speeds.

This work was done by Houfei Fang, Michael Lou, and Nathan Palmer of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1).*

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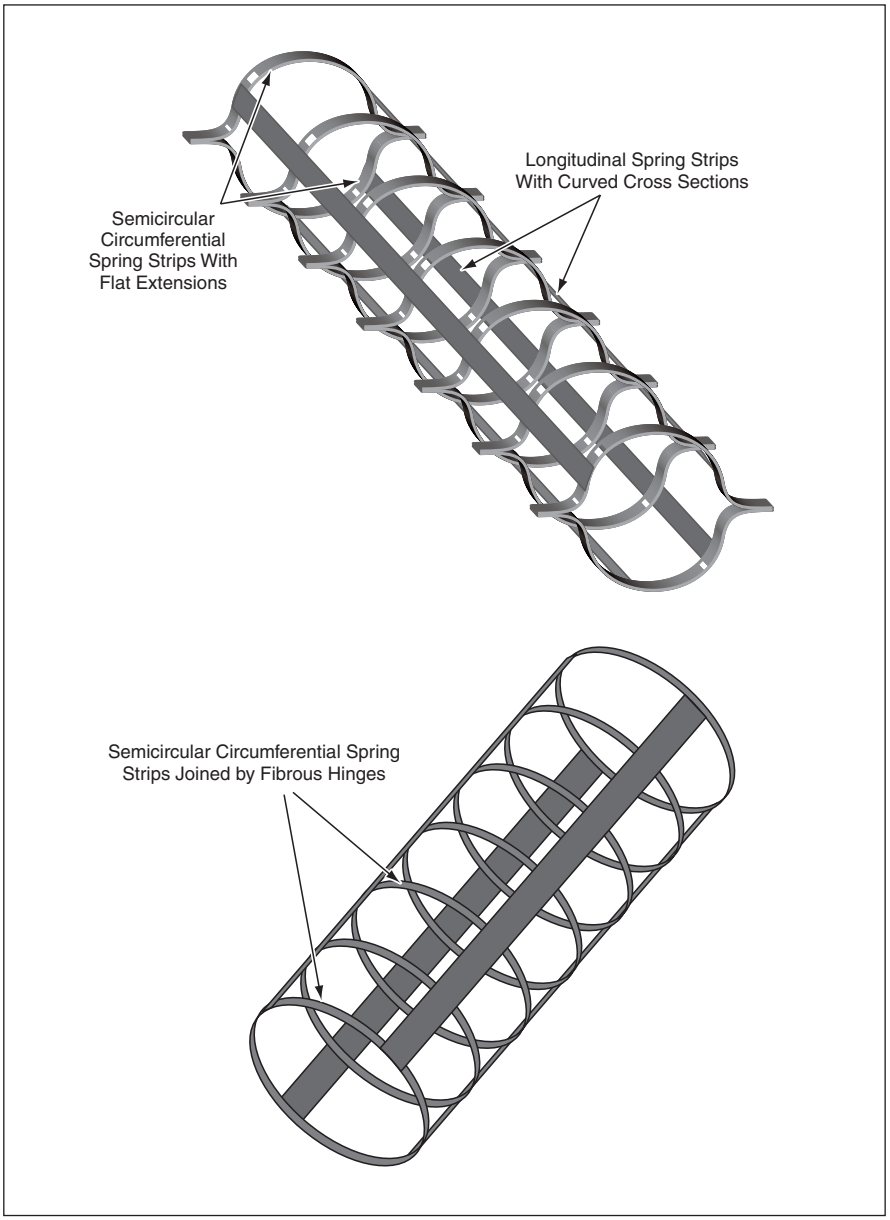

Spring-Strip Booms are made of longitudinal spring strips with curved cross sections (similar to carpenters' measuring tapes) connected with circumferential spring strips.