than the two or more sensors conventionally used to sense and control winding currents. An unexpected benefit of using only one current sensor is that it actually improves the precision of current control by using the "same" sensors to read each of the three phases. Folding the encoder directly into the controller electronics eliminates a great deal of redundant electronics, packaging, connectors, and hook-up wiring. The reduction of wires and connectors subtracts substantial bulk and eliminates their role in behaving as EMI (electro-magnetic interference) antennas.

A shared knowledge by each motor controller of the state of all the motors in the system at 500 Hz also allows parallel processing of higher-level kinematic matrix calculations.

This work was done by William T. Townsend, Adam Crowell, and Traveler Hauptman of Barrett Technology, Inc., and Gill Andrews Pratt of Olin College for Johnson Space Center. For further information, contact the JSC Innovation Partnerships Office at (281) 483-3809.

In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to:

Barrett Technology, Inc.
625 Mount Auburn Street
Cambridge, MA 02138-4555
Phone No.: (617) 252-9000
Web site: www.barrett.com

Refer to MSC-23930-1, volume and number of this NASA Tech Briefs *issue, and the page number.*

A Reversible Thermally Driven Pump for Use in a Sub-Kelvin Magnetic Refrigerator

Goddard Space Flight Center, Greenbelt, Maryland

A document describes a continuous magnetic refrigerator that is suited for cooling astrophysics detectors. This refrigerator has the potential to provide efficient, continuous cooling to temperatures below 50 mK for detectors, and has the benefits over existing magnetic coolers of reduced mass because of faster cycle times, the ability to pump the cooled fluid to remote cooling locations away from the magnetic field created by the superconducting magnet, elimination of the added complexity and mass of heat switches, and elimination of the need for a thermal bus and single crystal paramagnetic materials due to the good thermal contact between the fluid and the paramagnetic material.

A reliable, thermodynamically efficient pump that will work at 1.8 K was needed to enable development of the new magnetic refrigerator. The pump consists of two canisters packed with pieces of gadolinium gallium garnet (GGG). The canisters are connected by a superleak (a porous piece of VYCOR® glass). A superconducting magnetic coil surrounds each of the canisters. The configuration enables driving of cyclic thermodynamic cycles (such as the sub-Kelvin Active Magnetic Regenerative Refrigerator) without using pistons or moving parts.

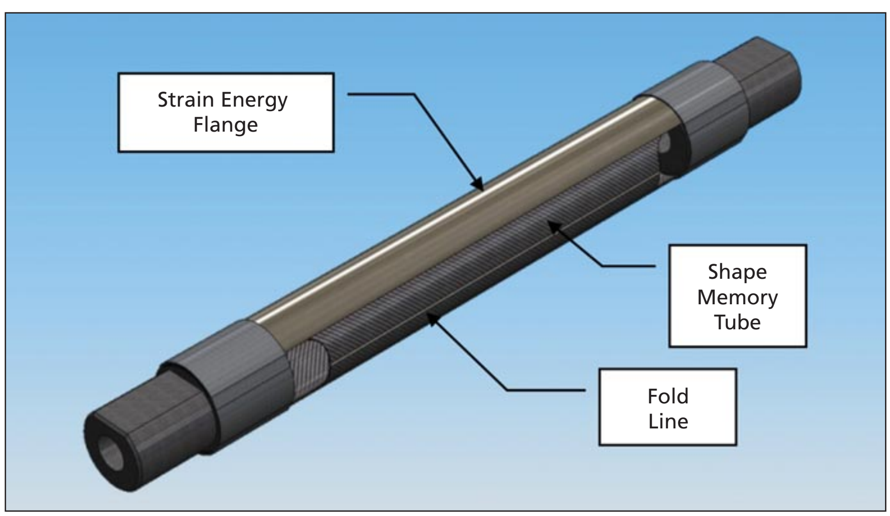
This work was done by Franklin K. Miller of Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC-15573-1

Shape Memory Composite Hybrid Hinge

The hinge can be used for in-space deployment of antennas, reflectors, cameras, solar panels, and sunshields, as well as in any structure requiring hinges.

NASA's Jet Propulsion Laboratory, Pasadena, California

There are two conventional types of hinges for in-space deployment applications. The first type is mechanically deploying hinges. A typical mechanically deploying hinge is usually composed of several tens of components. It is complicated, heavy, and bulky. More components imply higher deployment failure probability. Due to the existence of relatively moving components among a mechanically deploying hinge, it unavoidably has microdynamic problems. The second type of conventional hinge relies on strain energy for deployment. A tape-spring hinge is a typical strain energy hinge. A fundamental problem of a strain energy hinge is that its deployment dynamic is uncontrollable. Usually, its deployment is associated with a large impact, which is unacceptable for many



The **Shape Memory Composite Hybrid Hinge** is composed of two strain energy flanges and one shape memory composite tube.