space applications. Some damping technologies have been experimented with to reduce the impact, but they increased the risks of an unsuccessful deployment.

Coalescing strain energy components with shape memory composite (SMC) components to form a hybrid hinge is the solution. SMCs are well suited for deployable structures. A SMC is created from a high-performance fiber and a shape memory polymer resin. When the resin is heated to above its glass transition temperature, the composite becomes flexible and can be folded or packed. Once cooled to below the glass transition temperature, the composite remains in the packed state. When the structure is ready to be deployed, the SMC component is reheated to above the glass transition temperature, and it returns to its as-fabricated shape.

A hybrid hinge is composed of two strain energy flanges (also called tape-springs) and one SMC tube. Two folding lines are placed on the SMC tube to avoid excessive strain on the SMC during folding. Two adapters are used to connect the hybrid hinge to its adjacent structural components. While the SMC tube is heated to above its glass transition temperature, a hybrid hinge can be folded and stays at folded status after the temperature is reduced to below its glass transition temperature. After the deployable structure is launched in space, the SMC tube is reheated and the hinge is unfolded to deploy the structure. Based on test results, the hybrid hinge can achieve higher than 99.999% shape recovery.

The hybrid hinge inherits all of the good characteristics of a tape-spring hinge such as simplicity, light weight, high deployment reliability, and high deployment precision. Conversely, it eliminates the deployment impact that has significantly limited the applications of a tape-spring hinge. The deployment dynamics of a hybrid hinge are in a slow and controllable fashion. The SMC tube of a hybrid hinge is a multifunctional component. It serves as a deployment mechanism during the deployment process, and also serves as a structural component after the hinge is fully deployed, which makes a hybrid hinge much stronger and stiffer than a tape-spring hinge. Unlike a mechanically deploying hinge that uses relatively moving components, a hybrid hinge depends on material deformation for its packing and deployment. It naturally eliminates the microdynamic phenomenon.

Binding Causes of Printed Wiring Assemblies With Card-Loks

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A document discusses a study that presents the first documented extraction loads, both nominal and worst-case, and presents the first comprehensive evaluation of extraction techniques, methodologies, and tool requirements relating to extracting printed wiring assemblies (PWAs) with Card-Loks during EVA (extra vehicular activity). This task was performed for the first time during HST (Hubble Space Telescope) Servicing Mission 4.

With impending missions to Mars and to the Moon relying on an astronaut's abilities to perform repair and servicing tasks during EVAs, this study provides some insight into what challenges may be encountered during a repair/replacement of a PWA with Card-Loks. Extraction techniques presented in this study could be applicable to other PWA geometries with similar locking devices. Ground-based extractions also benefit from the techniques and extraction tool requirements presented in the study. The findings highlight techniques that work reliably, efficiently, and provide design requirements for tools necessary for extracting PWAs with Card-Loks on ground.

Coring Sample Acquisition Tool

NASA's Jet Propulsion Laboratory, Pasadena, California

A sample acquisition tool (SAT) has been developed that can be used autonomously to sample drill and capture rock cores. The tool is designed to accommodate core transfer using a sample tube to the IMSAH (integrated Mars sample acquisition and handling) SHEC (sample handling, encapsulation, and containerization) without ever touching the pristine core sample in the transfer process.

The SAT can be divided into four subelements termed the spindle/percussion assembly (SPA), magnetic chuck assembly (MCA), core bit assembly (CBA), and the core break-off assembly (CBO).

The SPA is used to impart the necessary rotational degree of freedom to the CBA to clear cuttings and impart the required impact energy to facilitate rock fracture. The percussive nature of the tool is imparted through the use of an eccentric CAM/lever mechanism. The MCA is designed to actively release the CBA to the SHEC and in air (no load), and passively under large enough side loads, and in air (no load). The magnetic chuck uses two diametrically polarized rings (permanent magnet) stacked one on top of the other. A low-torque actuator is then used to engage or disengage the chuck by aligning or de-aligning the polarized ring poles. The CBA accepts the rotational degree of freedom from the SPA and is used to clear the rock cuttings using a two-lead flute-coring bit. The CBA also transfers the impacts of a striker inside the SPA to the rock being drilled. Furthermore, the coring bit shapes and defines the geometric constraints of the core sample.

Lastly, the CBO is housed inside the CBA and is used to create break-off and capture the core sample. It is actuated through the use of a torque nut that axially retracts an outer tube using an

Acme thread. The outer tube has a series of ramps that drives a set of teeth into the shaped core, fracturing the base of the core and effectively capturing the core within a sample tube. The tool is designed to allow the captured core to be transferred out of the aft portion of the CBA and CBO without ever having to handle the core after capture.