beam curvature equation in closed forms to yield slope and deflection equations for each domain in recursion formats. The final deflection equations in summation forms (called Ko displacement transfer functions), which contain no structural properties (such as bending stiffness), were then expressed in terms of domain length, beam depth factor, and surface bending strains at the domain junctures. In fact, the effect of the structural properties is absorbed by surface strains.

For flying wing structures, the two-line strain-sensing system is a powerful method for simultaneously monitoring the bending and cross sectional rotations. The two-line strain-sensing system eliminates the need for installing the shear strain sensors to measure the surface distortions through which the wing structure cross sectional rotations could be determined.

The Ko displacement theory combined with onboard fiber-optic strain-sensing system forms a powerful tool for in-flight deformed shape monitoring of flexible wings and tails, such as those often employed on unmanned flight vehicles by the ground-based pilot for maintaining safe flights. In addition, the real-time wing shape monitored could then be input to the aircraft control system for aero-elastic wing-shape control.

This work was done by William L. Ko of Dryden Flight Research Center. Further information is contained in a TSP (see page 1).
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Pyrotechnic Actuator for Retracting Tubes Between MSL Subsystems

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An apparatus, denoted the "retractuator" (a contraction of "retracting actuator"), was designed to help ensure clean separation between the cruise stage and the entry-vehicle subsystem of the Mars Science Laboratory (MSL) mission. The retractuator or an equivalent mechanism is needed because of tubes that (1) transport a heat-transfer fluid between the stages during flight and (2) are cut immediately prior to separation of the stages retractuator. The role of the retractuator is to retract the tubes, after they are cut and before separation of the subsystem, so that cut ends of the tubes do not damage thermal-protection coats on the entry vehicle and do not contribute to uncertainty of drag and consequent uncertainty in separation velocity.

The retractuator was conceived as a less massive, less bulky, and more powerful alternative to a traditional spring-actuated retractor. The retractuator is a modified version of a prior pyrotechnically actuated cutter. The modifications include alterations of the geometries of pyrotechnic charges, piston, and cylinder; replacing the cutter blade with a push rod; and other changes to reduce weight, arrest the piston at the end of its stroke, and facilitate installation.

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