positive strain at a certain direction without increasing the applied voltage. The difference of this innovation from the HYBAS is that all the elements can be made from one-of-a-kind materials.

Stacked HYBATS can provide an extremely effective piezoelectric constant at both resonance and off resonance frequencies. The effective piezoelectric constant can be alternated by varying the size of each component, the degree of the pre-curvature of the positive strain components, the thickness of each layer in the multilayer stacks, and the piezoelectric constant of the material used. Because all of the elements are piezoelectric components, Stacked HYBATS can serve as projector and receiver for underwater detection. The performance of this innovation can be enhanced by improving the piezoelectric properties.

This work was done by Ji Su of Langley Research Center, Xiaoning Jiang of TSR Technologies, and Tian-Bing Zu of the National Institute of Aerospace. Further information is contained in a TSP (see page 1). LAR-17671-1

Active Flow Effectors for Noise and Separation Control
These variable effectors provide enhanced vehicle and aeroelastic control.

Langley Research Center, Hampton, Virginia

New flow effector technology for separation control and enhanced mixing is based upon shape memory alloy hybrid composite (SMAHC) technology. The technology allows for variable shape control of aircraft structures through actively deformable surfaces. The flow effectors are made by embedding shape memory alloy actuator material in a composite structure. When thermally actuated, the flow effector def1ects into or out of the flow in a prescribed manner to enhance mixing or induce separation for a variety of applications, including aeroacoustic noise reduction, drag reduction, and f1ight control. The active flow effectors were developed for noise reduction as an alternative to fixed-configuration effectors, such as static chevrons, that cannot be optimized for airframe installation effects or variable operating conditions and cannot be retracted for off-design or fail-safe conditions.

Benefits include:
• Increased vehicle control, overall efficiency, and reduced noise throughout all f1ight regimes,
• Reduced flow noise,
• Reduced drag,
• Simplicity of design and fabrication,
• Simplicity of control through direct current stimulation, autonomous response to environmental heating, fast response, and a high degree of geometric stability.

The concept involves embedding prestrained SMA actuators on one side of the chevron neutral axis in order to generate a thermal moment and def1ect the structure out of plane when heated. The force developed in the host structure during def1ection and the aerodynamic load is used for returning the structure to the retracted position. The chevron design is highly scalable and versatile, and easily affords active and/or autonomous (environmental) control.

The technology offers wide-ranging market applications, including aerospace, automotive, and any application that requires flow separation or noise control.

This work was done by Travis L. Turner of Langley Research Center. For further information, contact the Langley Innovative Partnerships Office at (757) 864-8881. LAR-17332-1

Method and System for Temporal Filtering in Video Compression Systems
This filtering improvement increases efficiency for visual signal components for low-power applications.

Stennis Space Center, Mississippi

Three related innovations combine improved non-linear motion estimation, video coding, and video compression. The first system comprises a method in which side information is generated using an adaptive, non-linear motion model. This method enables extrapolating and interpolating a visual signal, including determining the first motion vector between the first pixel position in a first image to a second pixel position in a second image; determining a second motion vector between the second pixel position in the second image and a third pixel position in a third image; determining a third motion vector between the first pixel position in the first image and the second pixel position in the second image, the second pixel position in the second image, and the third pixel position in the third image using a non-linear model; and determining a position of the fourth pixel in a fourth image based upon the third motion vector.

For the video compression element, the video encoder has low computational complexity and high compression efficiency. The disclosed system comprises a video encoder and a decoder. The encoder converts the source frame into a space-frequency representation, estimates the conditional statistics of at least one vector of space-frequency coefficients with similar frequencies, and is conditioned on previously encoded data. It estimates an encoding rate based on the conditional statistics and applies a Slepian-Wolf code with the computed encoding rate. The method for decoding includes generating a side-information vector of frequency coefficients based on previously decoded source data and encoder statistics and previous reconstructions of the source frequency vector. It also performs Slepian-Wolf decoding of a source frequency vector based on the

generated side-information and the Slepian-Wolf code bits.

The video coding element includes receiving a first reference frame having a first pixel value at a first pixel position, a second reference frame having a second pixel value at a second pixel position, and a third reference frame having a third pixel value at a third pixel position. It determines a first motion vector between the first pixel position and the second pixel position, a second motion vector between the second pixel position and the third pixel position, and a fourth pixel value for a fourth frame based upon a linear or nonlinear combination of the first pixel value, the second pixel value, and the third pixel value. A stationary filtering process determines the estimated pixel values. The parameters of the filter may be predetermined constants.

This work was done by Ligang Lu, Drake He, Ashish Jagmohan, and Vadim Sheinin of IBM for Stennis Space Center.

Apparatus for Measuring Total Emissivity of Small, Low-Emissivity Samples

Goddard Space Flight Center, Greenbelt, Maryland

An apparatus was developed for measuring total emissivity of small, lightweight, low-emissivity samples at low temperatures. The entire apparatus fits inside a small laboratory cryostat. Sample installation and removal are relatively quick, allowing for faster testing.

The small chamber surrounding the sample is lined with black-painted aluminum honeycomb, which simplifies data analysis. This results in the sample viewing a very high-emissivity surface on all sides, an effect which would normally require a much larger chamber volume. The sample and chamber temperatures are individually controlled using off-the-shelf PID (proportional–integral–derivative) controllers, allowing flexibility in the test conditions. The chamber can be controlled at a higher temperature than the sample, allowing a direct absorptivity measurement.

The lightweight sample is suspended by its heater and thermometer leads from an isothermal bar external to the chamber. The wires run out of the chamber through small holes in its corners, and the wires do not contact the chamber itself. During a steady-state measurement, the thermometer and bar are individually controlled at the same temperature, so there is zero heat flow through the wires. Thus, all of sample-temperature-control heater power is radiated to the chamber.

Double-aluminized Kapton (DAK) emissivity was studied down to 10 K, which was about 25 K colder than any previously reported measurements. This verified a minimum in the emissivity at about 35 K and a rise as the temperature dropped to lower values.

This work was done by James Tuttle and Michael J. DiPirro of Goddard Space Flight Center. For further information, contact the Goddard Innovative Partnerships Office at (301) 286-5810. GSC-15697-1

Multiple-Zone Diffractive Optic Element for Laser Ranging Applications

This technology can be used on unmanned aerial vehicles, or in collision-avoidance and robotic control applications in cars, trains, and ships.

Goddard Space Flight Center, Greenbelt, Maryland

A diffractive optic element (DOE) can be used as a beam splitter to generate multiple laser beams from a single input laser beam. This technology has been recently used in LRO's Lunar Orbiter Laser Altimeter (LOLA) instrument to generate five laser beams that measure the lunar topography from a 50-km nominal mapping orbit (see figure). An extension of this approach is to use a multiple-zone DOE to allow a laser altimeter instrument to operate over a wider range of distances. In particular, a multiple-zone DOE could be used for applications that require both mapping and landing on a planetary body. In this case, the laser altimeter operating range would need to extend from several hundred kilometers down to a few meters.

The innovator was recently involved in an investigation how to modify the LOLA instrument for the OSIRIS asteroid mapping and sample return mission. One approach is to replace the DOE in the LOLA laser beam expander assembly with a multiple-zone DOE that would allow for the simultaneous illumination of the asteroid with mapping and landing laser beams. The proposed OSIRIS multiple-zone DOE would generate the same LOLA five-beam output pattern for high-altitude topographic mapping, but would simultaneously generate a wide divergence angle beam using a small portion of the total laser energy for the approach and landing portion of the mission. Only a few percent of the total laser energy is required for approach and landing operations as the return signal increases as the inverse square of the ranging height. A wide divergence beam could be implemented by making the center of the DOE a diffractive or refractive negative lens. The beam energy and beam divergence characteristics of a multiple-zone DOE could be easily tailored to meet the requirements of other missions that require laser ranging data.