INFRARED RUGATES BY MOLECULAR BEAM EPITAXY. M. Rona, Arthur D. Little, Inc., Cambridge MA 02140, USA.

Rugates are optical structures that have a sinusoidal index of refraction (harmonic gradient-index field). As their discrete high/low index filter counterparts, they can be used as narrow rejection band filters. However, since rugates do not have abrupt interfaces, they tend to have a smaller absorption, hence deliver a higher in-band reflectivity. The absence of sharp interfaces makes rugates even more desirable for high-energy narrowband reflectors. In this application, the lack of a sharp interface at the maximum internal standing wave electric field results in higher breakdown strengths.

Our method involves fabricating rugates, with molecular beam epitaxy [1]; on GaAs wafers as an Al(x)Ga(1-x)As single-crystal film in which x, the alloying ratio, changes in a periodic fashion between 0 < x < 0.5 [2]. The single-crystal material improves the rugate performance even further by eliminating the enhanced optical absorption associated with the grain boundaries. Salient features of our single-crystal rugate fabrication program, including the process control system and methodology and some representative results, are shown [3].


PLASMA, MAGNETIC, AND ELECTROMAGNETIC MEASUREMENTS AT NONMAGNETIC BODIES. C. T. Russell and J. G. Luhmann, Institute of Geophysics and Planetary Physics, University of California, Los Angeles CA 90024-1567, USA.

The need to explore the magnetospheres of the Earth and the giant planets is widely recognized and is an integral part of our planetary exploration program. The equal need to explore the plasma, magnetic, and electromagnetic environments of the nonmagnetic bodies is not so widely appreciated. The previous, albeit incomplete, magnetic and electric field measurements at Venus, Mars, and comets have proven critical to our understanding of their atmospheres and ionospheres in areas ranging from planetary lightning to solar wind scavenging and accretion. In the cases of Venus and Mars, the ionospheres can provide communication paths over the horizon for low-altitude probes and landers, but we know little about their lower boundaries. The expected varying magnetic fields below these planetary ionospheres penetrates the planetary crusts and can be used to sound the electrical conductivity and hence the thermal profiles of the interiors. However, we have no knowledge of the levels of such fields, let alone their morphology. Finally, we note that the absence of an atmosphere and an ionosphere does not make an object any less interesting for the purposes of electromagnetic exploration. Even weak remnant magnetism such as that found on the Moon during the Apollo program provides insight into the present and past states of planetary interiors. We have very intriguing data from our space probes during times of both close and distant passages of asteroids that suggest they may have coherent magnetization. If true, this observation will put important constraints on how the asteroids formed and have evolved. Our planetary exploration program must exploit its full range of exploration tools if it is to characterize the bodies of the solar system thoroughly. We should especially take advantage of those techniques that are proven and require low mass, low power, and low telemetry rates to undertake.

DIGITAL IMAGE COMPRESSION USING ARTIFICIAL NEURAL NETWORKS. M. Serra-Ricart1, Ll. Garrido2, V. Gaitán2, and A. Aloy2, 1Instituto de Astrofisica de Canarias, E-38200 La Laguna (Tenerife), Spain, 2Departament d'Estructura i Constituents de la Materia, Universitat de Barcelona, Diagonal 647, E-08028 Barcelona, Spain, 3Institut de Física d'Altes Energies, Universitat Autònoma de Barcelona, E-08193 Bellaterra (Barcelona), Spain, 4Digital Equipment Enterprise Espana SA., Provenza, 204-208, 08036 Barcelona, Spain.

The problem of storing, transmitting, and manipulating digital images is considered. Because of the file sizes involved, large amounts of digitized image information are becoming common in
modern projects. Transmitting images will always consume large amounts of bandwidth, and storing images will always require special devices. Our goal is to describe an image compression transform coder based on artificial neural networks techniques (hereafter Neural Network Compression Transform Coder or NNCTC). Like all generic image compression transform coders, the NNCTC embodies a three-step algorithm: invertible transformation to the image (transform), lossy quantization (quantize), and entropy coding (remove redundancy). Efficient algorithms have already been developed to achieve the two last steps, quantize and remove redundancy [4]. The NNCTC offers an alternative invertible transformation based on neural network analysis [3].

A comparison of the compression results obtained from digital astronomical images by the NNCTC and the method used in the compression of the digitized sky survey from the Space Telescope Science Institute based on the H-transform [3] is performed in order to assess the reliability of the NNCTC.

Artificial neural network techniques are based on the dot-product calculation, which is very simple to perform in hardware [4]. It is in this sense that the NNCTC can be useful when high compression and/or decompression rates are required (e.g., space applications, remote observing, remote database access).


PROTOTYPE BACKSCATTER MÖSSBAUER SPECTROMETER FOR MESURment OF MARTIAN SURFACE MINERALOGY. T. D. Sheller1, R.V. Morris1, D.G. Agresti2, T. Nguyen3, E.L. Wills4, and M.H. Shen5, 1Code SN4, NASA Johnson Space Center, Houston TX 77058, USA, 2Physics Department, University of Alabama at Birmingham, Birmingham AL 35294, USA, 3Lockheed Engineering and Sciences Co., Houston TX 77058, USA.

We have designed and successfully tested a prototype of a backscatter Mössbauer spectrometer (BaMS) targeted for use on the martian surface to (1) determine oxidation states of iron and (2) identify and determine relative abundances of iron-bearing mineralogies. No sample preparation is required to perform measurements; it is only necessary to bring sample and instrument into physical contact. The prototype meets our projected specifications for a flight instrument in terms of mass (<500 g), power (<2 W), and volume (<300 cm³).

A Mössbauer spectrometer on the martian surface would provide a wide variety of information about the current state of the martian surface:

1. Oxidation state: Iron Mössbauer spectroscopy (FeMS) can determine the distribution of iron among its oxidation states. Is soil oxidized relative to rocks?

2. Mineralogy: FeMS can identify iron-bearing mineralogies (e.g., olivine, pyroxene, magnetite, hematite, ilmenite, clay, and amorphous phases) and their relative abundances. FeMS is not blind to opaque phases (e.g., ilmenite and magnetite), as are visible and near-IR spectroscopy.

3. Magnetic properties: FeMS can distinguish between magnetic and magnetite, which are putative mineralogies to explain the magnetic nature of martian soil.

4. Water: FeMS can distinguish between anhydrous phases such as hematite, olivine, pyroxene, and hydrous phases such as clay, ferrhydrite, goethite, and lepidocrocite. What are the relative proportions of hydrous and anhydrous iron-bearing mineralogies?

In summary, a BaMS instrument on MESUR would provide a very high return of scientific information about the martian surface (with no sample preparation) and would place a very low resource demand (weight, power, mass, data rate) on spacecraft and lander. Our BaMS instrument can be flight-qualified within two years and is also suitable for lander missions to the Moon, comets, and asteroids.


THE BACKGROUNDS DATA CENTER. W. A. Snyder1, H. Gursky1, H. M. Heckathorn1, R. L. Lucke1, S. L. Berg2, E. G. Dombrowski2, and R. A. Kessep3, 1Code 7604, Naval Research Laboratory, Washington DC 20375-5352, USA, 2Computational Physics, Inc., Suite 600, 2750 Prosperity Avenue, Fairfax VA 22031, USA, 3Sachs-Freeman Associates, 1401 McCormick Drive, Landover MD 20785, USA.

The Strategic Defense Initiative Organization (SDIO) has created data centers for midcourse, plumes, and backgrounds