cube), lightweight (~2.5 kg) modules incorporating a variety of sensors and low-power (~5 W) processing electronics. The LEO Environment Monitor Module (EMM) sensor complement consists of two passively called Quartz Crystal Microbalances and three calorimeters for contaminant detection/characterization, three actinometers for measuring AO flux, two RADFETs for total dose radiation measurement, a Sun position sensor, and a solar irradiance sensor. The EMM is designed as a remote terminal for MIL-STD-1553B communication with an experiment bus controller and for independent operation of its sensors. The present design can be modified to be fully autonomous, with module-based mass memory, onboard data processing, and software upload capability.

The SAMMES architecture concept can be extended to instrumentation for planetary exploration, both on spacecraft and *in situ*. The operating environment for planetary application will be substantially different, with temperature extremes and harsh solar wind and cosmic ray flux on lunar surfaces and temperature extremes and high winds on venusian and martian surfaces. Moreover, instruments for surface deployment, which will be packaged in a small lander/rover (as in MESUR, for example), must be extremely compact with ultralow power and weight. With these requirements in mind, we have extended the SAMMES concept to a sensor/instrumentation scheme for the lunar and martian surface environment, as illustrated in Fig. 1.

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OPTICAL TECHNOLOGIES FOR UV REMOTE SENSING INSTRUMENTS. R. A. M. Keski-Kuha, J. F. Osantowski, D. B. Leviton, T. T. Saha, D. A. Content, R. A. Boucarut, J. S. Gum, G. A. Wright, C. M. Fleetwood, and T. J. Madison, NASA Goddard Space Flight Center, Greenbelt MD 20771, USA.

Over the last decade significant advances in technology have made possible development of instruments with substantially improved efficiency in the UV spectral region. In the area of optical coatings and materials, we discuss the importance of recent developments in chemical vapor deposited (CVD) silicon carbide (SiC) mirrors, SiC films, and multilayer coatings in the context of ultraviolet instrumentation design. For example, the development of chemically vapor deposited (CVD) silicon carbide (SiC) mirrors, with high ultraviolet (UV) reflectance and low scatter surfaces, provides the opportunity to extend higher spectral/spatial resolution capability into the 50-nm region. Optical coatings for normal incidence diffraction gratings are particularly important for the evolution of efficient extreme ultraviolet (EUV) spectrographs. SiC films are important for optimizing the spectrograph performance in the 90-nm spectral region.

Diffraction grating technology has always played a pivotal role in the development of spectroscopic instrumentation for ultraviolet space flight instrumentation. An essential element in the successful diffraction grating development program is the ability to quantitatively evaluate the performance of test diffraction gratings in the early stages of the instrument development program. The Diffraction Grating Evaluation Facility (DGEF) at Goddard Space Flight Center was established to evaluate the performance of new technology diffraction gratings and other optical components for future spaceflight instrumentation especially in the vacuum ultraviolet. DGEF is a unique, world-class, extremely versatile facility with enormous evacuable optical set-up volume allowing mirrors and gratings to be evaluated in their design configurations with respect to design specifications, manufacturer's data, and optical analytical results.

We will discuss the performance evaluation of the flight optical components for the Solar Ultraviolet Measurements of Emitted Radiation (SUMER) instrument, a spectroscopic instrument to fly aboard the Solar and Heliospheric Observatory (SOHO) mission, designed to study dynamic processes, temperatures, and densities in the plasma of the upper atmosphere of the Sun in the wavelength range from 50 nm to 160 nm. The optical components were evaluated for imaging and scatter in the UV. We will also review the performance evaluation of SOHO/CDS (Coronal Diagnostic Spectrometer) flight gratings tested for spectral resolution and scatter in the DGEF and present preliminary results on resolution and scatter testing of Space Telescope Imaging Spectrograph (STIS) technology development diffraction gratings.

N93-28789

MULTISCALE MORPHOLOGICAL FILTERING FOR ANALYSIS OF NOISY AND COMPLEX IMAGES. A. Kher and S. Mitra, Computer Vision and Image Analysis Laboratory, Department of Electrical Engineering, Texas Tech University, Lubbock TX 79410, USA.

Images acquired with passive sensing techniques suffer from illumination variations and poor local contrasts that create major difficulties in interpretation and identification tasks. On the other hand, images acquired with active sensing techniques based on monochromatic illumination are degraded with speckle noise. Mathematical morphology offers elegant techniques to handle a wide range of image degradation problems. Unlike linear filters, morphological filters do not blur the edges and hence maintain higher image resolution. Their rich mathematical framework facilitates the design and analysis of these filters as well as their hardware implementation. Morphological filters are easier to implement and are more cost effective and efficient than several conventional linear filters. Morphological filters to remove speckle noise while maintaining high resolution and preserving thin image regions that are particularly vulnerable to speckle noise [1] have been developed and applied to SAR imagery. These filters used combination of linear (one-dimensional) structuring elements in different (typically four) orientations (the median operators by Maragos [2]). Although this approach preserves more details than the simple morphological filters using two-dimensional structuring elements, the limited orientations of one-dimensional elements approximate the fine details of the region boundaries. A more robust filter designed recently overcomes the limitation of the fixed orientations. This filter uses a combination of concave and convex structuring elements. Morphological operators are also useful in extracting features from visible and infrared imagery. A multiresolution image pyramid obtained with successive filtering and a subsampling process aids in the removal of the illumination variations and enhances local contrasts. A morphology-based interpolation scheme has also been introduced to reduce intensity discontinuities created in any morphological filtering task. The generality of morphological filtering techniques in extracting information from a wide variety of images obtained with active and passive sensing techniques will be discussed. Such techniques are particularly useful in obtaining more information from fusion of complex images acquired by different sensors such as SAR, visible, and infrared [3].

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A UNIQUE PHOTON BOMBARDMENT SYSTEM FOR SPACE APPLICATIONS. E. J. Klein, KET Canada Inc./Sol-RF Energy Systems Inc., Box 2550, Winnipeg, Canada, R3C 4B3.

The innovative (patents pending) Electromagnetic Radiation Collection and Concentration System (EMRCCS) described here is the foundation for the development of a multiplicity of space and terrestrial system formats. The system capability allows its use in the visual, infrared, and ultraviolet ranges of the spectrum for EM collection, concentration, source/receptor tracking, and targeting.

The nonimaging modular optical system uses a physically static position aperture for EM radiation collection. Folded optics provide the concentration of the radiation and source autotracking. The collected and concentrated electromagnetic radiation is utilized in many applications, e.g., solar spectrum in thermal and associative photon bombardment applications for hazardous waste management, water purification, metal hardening, hydrogen generation, photovoltaics, etc., in both space and terrestrial segment utilization. Additionally, at the high end of the concentration capability range, i.e., 60,000+, a solar-pulsed laser system is possible.

The system outputs the concentrated flux, orthogonal (normally incident) to the input plane of an output port. The orthogonality remains constant regardless of the radiation input angle to the collection aperture, allowing simplification of radiation receptor design and highly efficient utilization of the concentrated radiation. The system configuration is arrayed for extremely high levels of flux concentration in windowing and targeting applications. Other system design formats provide power generation and thermal processes for heating and absorption cooling.

Fixed portable and mobile (space and terrestrial) applications include designs that incorporate a phased RF and/or the system array for purposes of radiation source acquisition/tracking and data derivation. The data is utilized in source acquisition (array capture angle of ±75° in the orthogonal E and H planes), source autotracking in the same angular intervals, and, subsequent to source and receptor acquisition, control of direction and magnitude of the output concentrated radiation at a given target range. In addition, the phased array can provide EM channel voice or data capability.

N93-28791 160737 p. 1

DETECTION OF OTHER PLANETARY SYSTEMS USING PHOTOMETRY. D. Koch[1], W. Borucki[1], and H. Reitsema[2], [1]Mail Stop 245-6, NASA Ames Research Center, Moffett Field CA 94035, USA, [2]Ball Aerospace Systems Group, P.O. Box 1062, Boulder CO 80306, USA.

Detection of extrasolar short-period planets, particularly if they are in the liquid-water zone, would be one of the most exciting discoveries of our lifetime. A well-planned space mission has the capability of making this discovery using the photometric method. An Earth-sized planet transiting a Sun-like star will cause a decrease in the apparent luminosity of the star by one part in 10,000 with a duration of about 12 hours and a period of about one year. Given a random orientation of orbital plane alignments with the line-of-sight to a star, and assuming our solar system to be typical, one would expect 1% of the stars monitored to exhibit planetary transits. A null result would also be significant and indicate that Earth-sized planets are rare.

For the mission to be successful one needs a sensor system that can simultaneously monitor many thousands of stars (F, G, and K dwarfs) with a photometric precision of one part in 30,000 per hour of integration. The stellar magnitude, integration time, and desired photometric precision determine the aperture size. The field of view and limiting stellar magnitude determine the number of stars that can be monitored. A 1.5-m telescope is required to attain the photometric precision for 12.5 mag stars. An 8° field of view will yield many thousands of stars and several transit detections per month. Confirmation of a detection will involve detection of a second transit that will yield a period and predict the time for a third and subsequent transits.

The technology issues that need to be addressed are twofold: One is for an appropriate optical design; the other is for a detector system with the necessary photometric precision. Two candidates for the detector system are silicon diodes and CCDs. It has been demonstrated that discrete silicon diodes have the required precision. However, the technology for building them into arrays with readouts needs development. The other approach is to use silicon CCDs. These already exist as arrays. However, the required photometric precision technology has yet to be demonstrated. Data processing complexity can be reduced by using the local-area-readout technique to obtain the flux for a few hundred stars per CCD.

N93-28792 160738 p 2

AN INTEGRATED XRF/XRD INSTRUMENT FOR MARS EXOBIOLOGY AND GEOLOGY EXPERIMENTS. L. N. Koppel[1], E. D. Franco[1], J. A. Kerner[1], M. L. Fonda[2], D. E. Schwartz[2], and J. R. Marshall[2], [1]ARACOR, 425 Lakeside Drive, Sunnyvale CA 94086-4701, USA, [2]Mail Stop 239-12, NASA Ames Research Center, Moffett Field CA 94035-1000, USA.

By employing an integrated X-ray instrument on a future Mars mission, data obtained will greatly augment those returned by Viking; details characterizing the past and present environment on Mars and those relevant to the possibility of the origin and evolution of life will be acquired. A combined XRF/XRD instrument has been breadboarded and demonstrated to accommodate important exobiology and geology experiment objectives outlined for MESUR and future Mars missions. Among others, primary objectives for the exploration of Mars include the intense study of local areas on Mars to "establish the chemical, mineralogical, and petrological character of different components of the surface material; to determine the distribution, abundance, and sources and sinks of volatile materials, including an assessment of the biologic potential, now and during past epoches; and to establish the global chemical and physical characteristics of the martian surface" [1].

The XRF/XRD breadboard instrument identifies and quantifies soil surface elemental, mineralogical, and petrological characteristics and acquires data necessary to address questions on volatile abundance and distribution. Additionally, the breadboard is able to