and meteoroids, and will determine their velocity and size distributions around the spacecraft environment. With two different color diode lasers, the contaminant and meteoroid composition will also be determined based on laboratory calibration with different materials. Secondary particles dislodged from the top aluminum surface of the MOS detector will also be measured to determine the kinetic energy losses during energetic meteoroid impacts. The velocity range of this instrument is 0.1 m/s to more than 14 km/s, while its size sensitivity is from 0.2 μm to millimeter-sized particles.

The particulate measurements in space of the kind proposed here will be the first simultaneous multipurpose particulate experiment that includes velocities from very slow to hypervelocities, sizes from submicrometer- to pellet-sized diameters, chemical analysis of the particulate composition, and measurements of the kinetic energy losses after energetic impacts of meteoroids.

This experiment will provide contamination particles and orbital debris data that are critically needed for our present understanding of the space environment. The data will also be used to validate contamination and orbital debris models for predicting optimal configurations of future space sensors and for understanding their effects on sensitive surfaces such as mirrors, lenses, paints and thermal blankets.

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OPTIMISM EXPERIMENT AND DEVELOPMENT OF SPACE-QUALIFIED SEISMOMETERS IN FRANCE. P. Lognonné[1], J. F. Karczewski[2], and DT/INSU-CRG Garchy Team[2], [1]IPGP, 4 Place Jussieu, 75252 Paris Cedex 05, France, [2]INSU, 4 Avenue de Neptune, 94107 Saint Maur des Fosses Cedex, France.

The OPTIMISM experiment will put two magnetometers and two seismometers on the martian floor in 1995, within the framework of the Mars '94 mission. The seismometers are put within the two small surface stations.

The seismometer sensitivity will be better than 10^{-9} g at 1 Hz, 2 orders of magnitude higher than the Viking seismometer sensitivity. *A priori* waveform modeling for seismic signals on Mars [1] shows that it will be sufficient to detect quakes with a seismic moment greater than 10^{15} Nm everywhere on Mars. Such events, according to the hypothesis of a thermoelastic cooling of the martian lithosphere, are expected to occur at a rate close to one per week [2] and may therefore be observed within the 1-year lifetime of the experiment.

Due to severe constraints on the available power, mass budget, *g* load, and size of the small stations, it was necessary to completely redesign the seismometer sensors and electronic. The sensor has been developed in order to support a high *g* load of 200 *g*/10 ms without reducing its sensitivity. It consists of a new leaf-spring vertical seismometer, with a free period close to 0.5 s and an inertial mass of 50 *g*. The seismometer has two modes, working either with a velocity transducer, for high-frequency seismic measurements, or with a displacement transducer, for long-period seismic measurements. The seismometer's mass is 340 *g*, and its size is 9 cm^3.

Along the same lines, a low-power, hybrid technology has been used for the electronic. The velocity transducer and displacement transducer need a power of a few milliwatts, with a sensitivity of 10^{-10} for the displacement transducer.

This seismometer will be the first space-qualified or automatic very-broad-band seismometer to be developed in France. The next generation will consist of a triaxial seismometer, with performances at least 1 order of magnitude better than the OPTIMISM seismometer.

References: [1] Lognonné and Mosser (1992). [2] Solomon et al. (1991).

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FILTERING INTERPOLATORS FOR IMAGE COMPARISON ALGORITHMS. R. L. Lucke[1] and A. D. Stocker[2], [1]Code 7604, Naval Research Laboratory, Washington DC 20375-5352, USA, [2]Space Computer Corporation, Suite 104, 2800 Olympic Boulevard, Santa Monica CA 90404-4119, USA.

Comparing two or more images, either by differencing or ratioing, is important to many remote sensing problems. Because the pixel sample points for the images are (almost) always separated by some nonzero shift, a resampling, or interpolation, process must be performed if one image is to be accurately compared to another. Considered in Fourier space, an interpolator acts as a filter that attenuates some frequencies (usually high) of the image. Thus, when the shifted and unshifted images are compared, the former has been filtered, while the latter has not; the effect of this difference is called interpolation error. The key idea of this paper is to apply a filter to the unshifted image that matches the filtering effect of applying the interpolator to the shifted image, thereby drastically reducing interpolation error. The resulting interpolators, called filtering interpolators, are derived and discussed in detail elsewhere [1]. Basic results will be given in this presentation.

The cost of reducing interpolation error is some loss of high-frequency information. This paper presents parameterized families of local convolutional interpolators (polynomial and trigonometric) that can be adjusted to the desired trade-off between interpolation error reduction and high-frequency information retention. These interpolators allow as many images as desired, all with different shifts, to be compared on an equal footing.

The method is derived for images with the same pixel spacing and purely translational shifts. Performance suffers if these conditions are not met, but is still better than ordinary interpolation. Four-point interpolators are probably the most useful because they give good interpolation performance with reasonable computational efficiency. One-dimensional formulas are given; for two dimensions, the interpolators are applied to each dimension separately. In tests on simulated imagery, the filtering interpolators reduced interpolation error to below the level of sensor noise for 13-bit data (LSB = rms noise) on highly structured scenes.

References: [1] Lucke R. L. and Stocker A. D. (1993) *IEEE Trans. Signal Processing*, in press.

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MASS SPECTROMETRIC MEASUREMENT OF MARTIAN KRYPTON AND XENON ISOTOPIC ABUNDANCE. P. Mahaffy[1] and K. Mauersberger[2], [1]Laboratory for Atmospheres, NASA/Goddard Space Flight Center, Greenbelt MD 20771, USA, [2]University of Minnesota, School of Astronomy and Physics, Minneapolis MN 55455, USA.

The Viking gas chromatograph mass spectrometer experiment provided significant data on the atmospheric composition at the surface of Mars, including measurements of several isotope ratios. However, the limited dynamic range of this mass spectrometer resulted in marginal measurements for the important Kr and Xe