

Japanese Aerospace Literature This month: *Image Processing*

A95-25653 Optical tracking of geostationary satellites and space debris using a sensitive CCD camera. Y. ARIMOTO, H. TAKAMI, N. HIROMOTO, N. SAWADA, and T. ARUGA, *Communications Research Laboratory, Journal* (ISSN 0914-9260), Vol. 41, No. 3, Nov. 1994, pp. 195-207. 7 Refs. Documents available from Aeroplus Dispatch.

This paper shows the results of a Communications Research Laboratory optical tracking experiment targeting geostationary satellites and space debris. This experiment used an optical tracking system consisting of a telescope 1.5 m in diameter and a sensitive CCD camera. Although tracking is presently limited to operational geostationary satellites, the technical feasibility of an operational debris tracking system is demonstrated by the geostationary satellite tracking experiment. The limiting magnitude of the experimental system is about 19 m when the integration time is 10 seconds and the tracking accuracy is 3-5 arc-seconds. These results are used to estimate the accuracy with which the orbit of the debris in a nearly geostationary orbit can be estimated, and it is shown that one night observation provides enough accuracy to continue the tracking of the debris. An operational system using a small aperture telescope and a highly sensitive CCD camera with a large format is also presented. (Author)

A95-25650 Oil pollution detection experiments by the synthetic aperture radar on the European Remote Sensing Satellite-1. K. OKAMOTO, T. KOBAYASHI, H. MASUKO, and M. SHIMADA (NASDA, Tokyo, Japan), *Communications Research Laboratory, Journal* (ISSN 0914-9260), Vol. 41, No. 3, Nov. 1994, pp. 161-166. 3 Refs. Documents available from Aeroplus Dispatch.

We conducted experiments on detecting artificial oil pollution areas using the C-band Synthetic Aperture Radar on the European Remote Sensing Satellite-1 in November 1991 and in October and November 1992. Artificial oil pollution areas were produced by spilling oleyl alcohol from a small ship in the Pacific ocean about 100 km off the coast of Japan. Sea truth data were collected by the research vessel and the small ship used to spill the alcohol. The ERS-1 SAR images were processed by NASDA. The artificial oil pollution areas were clearly detected by ERS-1 SAR under various wind speeds of less than 11 m/s. The maximum damping of the scattered power was nearly the same (4 to 5 dB) for the wind speeds of less than 11 m/s. However, the ERS-1 SAR did not detect the artificial oil pollution areas when the wind speed was 13.7 m/s. (Author)

N95-14836 Survey of the 1991 geothermal exploration promotion. New Energy and Industrial Technology Development Organization, Tokyo (Japan). Documents available from Aeroplus Dispatch.

The paper reports development of a geothermal reservoir evaluation method. This method includes development of a simulator, a model field survey and simulation. Simulators to be developed are a geothermal reservoir simulator (SING) and a geothermal well two-phase flow simulator (WENG). The following are conducted for SING-III: improvement/problem analysis of the simulator, exercise analysis of the tracer analytical function, arrangement of the graphic output feature. As to WENG, simulator development is made based on a modeling of the fluid including NaCl. A model field survey based on the development of this method is made. In the Mori area, made is a geothermal reservoir concept model which well reproduces the natural condition. From the simulation conducted using this model, it is confirmed that the pressure history is well reproduced. In the Oguni area, a geothermal reservoir concept model is also made and used for simulation. The simulation confirms that the natural condition is well reproduced and that the obtained pressure interference data agree with the measured data.

A94-28489 Data-driven segmentation of degraded images based on Markov random field models. N. M. SHIRAZI (Kyoto Univ., Japan), T. YAMAZAKI, and H. NODA, *Communications Research Laboratory, Journal* (ISSN 0914-9260), Vol. 41, No. 1, March 1994, pp. 19-36. 15 Refs. Documents available from Aeroplus Dispatch.

A data-driven segmentation algorithm is developed for images consisting of a known number of distinct regions corrupted by region-dependent white-Gaussian noises with unknown parameters. A recursive algorithm based on the expectation and maximization method is developed to estimate the parameters of the regional noises. Using these estimates, the initially segmented image is estimated by the conventional maximum likelihood (ML) method. The region process (true image) is modeled by a Markov random field; then the estimation of the parameters of the model and the segmentation of the true image are alternated using the maximum pseudo-likelihood and iterated conditional modes methods, respectively. The performance of the algorithm is shown through typical simulation results. (Author)

N95-10753 The relationship between satellite-derived cloud parameters and measured maximum wind speed in the typhoon genesis stage. Technical Note No. 28. Meteorological Satellite Center, Tokyo (Japan). Documents available from Aeroplus Dispatch.

This technical note contains articles on: (1) satellite derived cloud parameters of tropical cyclones in the western North-Pacific at the genesis stage, (2) improved software programs for producing and using VISSR image data sets, (3) the production of sea surface temperature grid point values covering the western North Pacific from NOAA/AVHRR data, (4) a description of the NOAA/NESDIS data collection system, and (5) the use of new sensors on GMS-5 for weather analysis and forecasting.

N94-29239 Initial observation results with imaging riometer at NY-Alesund (L is equal to 16). M. NISHINO, Y. TANAKA, T. OGUTI, H. YAMAGISHI, and J. A. HOLTET, in *National Inst. of Polar Research, Proceedings of the NIPR Symposium on Upper Atmosphere Physics*, No. 6, pp. 47-61 (SEE N94-29233 08-46). Documents available from Aeroplus Dispatch.

An imaging riometer was installed at Ny-Alesund (invariant latitude, 75.6 deg) for observations of spatial structure and motion of auroral absorption regions. The antenna consists of a two-dimensional dipole array with 64 elements, and a phasing matrix that produces 64 pencil beams viewing an ionospheric area of about 200 km square at 0 km altitude. The instrument provides with a two-dimensional image of enhanced absorption at 30 MHz with spatial resolution of 20 km and time resolution of 1 s by using an eight-channel radio receiver. With the aid of a personal computer, the absorption images are able to be monitored in real time by using a quiet day curve produced from daily variations of cosmic radio noise intensity during initial 10 days. Three examples of the absorption images are presented for events that occurred in daytime, evening, and night time. (Author)

N94-29233 Proceedings of the NIPR Symposium on Upper Atmosphere Physics, No. 6. H. YAMAGISHI, M. EJIRI, T. HIRASAWA, S. KOKUBUN, N. SATO, et al. Documents available from Aeroplus Dispatch.

The following topics were discussed: earth atmosphere, upper atmosphere, stratosphere, earth ionosphere, earth magnetosphere, earth magnetosphere-ionosphere coupling, geomagnetic fields, auroras, auroral irradiation, ionospheric radiation, radio emission, Very Low Frequencies (VLF), Extremely Low Frequencies (ULF), electric current, electric potential, plasmas, magnetohydrodynamic stability, magnetohydrodynamic waves, magnetohydrodynamic oscillation, magnetohydrodynamic flow, Hall effects, stereoscopic observation, Polar Patrol Balloon (PPB), solar wind, solar activity effects, polar regions, Antarctic regions, polar cusps, numerical analysis, finite element method, mathematical models, HF (High Frequency) radar, doppler radar, riometers, magnetometer, and computerized simulation. For individual titles, see N94-29234 through N94-29245. (Author)

N94-28851 Image technology and information analysis of bone change with gravitational exposure. K. NISHIMURA, in *Japan Society of Aerospace and Environmental Medicine, Japanese Journal of Aerospace and Environmental Medicine*, Vol. 30, No. 1, pp. 1-10 (SEE N94-28850 08-52). Documents available from Aeroplus Dispatch.

The influences of gravitational changes (microgravity approximately equals 0 G, control; 1 G, hypergravity; 2 G) on the bone were analyzed from the point of view of imaging technology using a microfocus tube and a highly sensitive x-ray image sensor with the photostimulable phosphor. Gravitational changes markedly affected the spongy bone of the posterior vertebral joint, with bone resorption occurring at approximately equals 0 G and enhancement of bone formation at 2 G. Such changes were larger in the posterior vertebral joints that bear more weight. In the seventh posterior vertebral joint, which showed the largest bone changes, the photostimulated luminescence level increased by about 19 percent and decreased by about 4 percent at approximately equals 0 G and 2 G, respectively, compared with 1 G. These bone changes resemble those occurring during the aging process of mandibular bone trabeculae on earth. (Author)

A95-15588 New development of laser speckle strain/displacement gage for the measurement of fracture mechanics parameters. I. NISHIKAWA, K. OGURA (Osaka Univ., Toyonaka, Japan), M. YAMAGAMI (Gunze, Ltd., Morioka, Japan), and K. Kuwayama (Horiba, Ltd., Kyoto, Japan), *Japan Society of Materials Science, Journal* (ISSN 0514-5163), Vol. 43, No. 493, Oct. 1994, pp. 1290-1296. In Japanese. 17 Refs. Documents available from Aeroplus Dispatch.

The paper describes a new strain/displacement measuring SSDG system by using laser speckles. Emphasis was put on the development of a real time noncontact system which could be applicable to the measurements of a local strain and a crack opening displacement (COD) around crack tips both at room- and elevated temperatures. A conventional double sensor SSDG system, in which two image sensors are required to eliminate the rigid motion of samples, is discussed. A single sensor SSDG system was newly proposed which was applicable to the COD measurements. A real time processing of speckle movements was realized by an originally developed software. The applicability of the single sensor system was successfully tested in the COD measurements of cracks in ceramics and in the closure measurements of small cracks in steels under cyclic thermal stressing at elevated temperatures. An application of this system to a crack tip deformation measurement under mixed loading of Mode I and II is described. (Author)

A95-11793 Microscopic structures in turbulent diffusion flames. T. IDA (Kumano Technical College, Mie, Japan) and K. OHTAKE (Toyoohashi Univ. of Technology, Aichi, Japan), *JSMI International Journal, Series B: Fluids and Thermal Engineering* (ISSN 0914-8817), Vol. 37, No. 3, Aug. 1994, pp. 629-635. 14 Refs. Documents available from Aeroplus Dispatch.

The paper studies microscopic structures in turbulent diffusion flames via time-resolved temperature distributions measured by a laser-sheet-illuminated Rayleigh scattering (LRS) method recorded by a high-speed VTR system, and one-point LRS measurement. The microscopic structures of temperature distribution are measured by analyzing the 2D LRS pictures by image processing. It is found that the flame can be divided into four characteristic

regions based on the distributions of macroscale temperature fluctuations. The turbulent heat-transfer mechanisms in these four regions are discussed in terms of the 2D LRS and the power spectral density of temperature fluctuations measured by one-point LRS. Different structures of microscopic temperature inhomogeneity are found to exist within Taylor's dissipation length scale defined by velocity fluctuations.

A95-11784 Application of infrared thermography to detection of flaws in honeycomb sandwich constructions. M. SHIRATORI, Y. QIANG, Y. TAKAHASHI, and N. OGASAWARA (Yokohama National Univ., Tokyo Electric Power Co., Japan), *JSMI International Journal, Series A: Mechanics and Material Engineering* (ISSN 1340-8046), Vol. 37, No. 4, Oct. 1994, pp. 396-402. 4 Refs. Documents available from Aeroplus Dispatch.

We have developed an experimental and computational hybrid system which can be applied to the detection of flaws in structural members. The system consists of an IR thermal video system by which the temperature distribution of the body surface can be measured, and an engineering work station which carries out image processing of the thermograms. We have applied the developed system to the detection of flaws embedded in honeycomb sandwich constructions. Various types of flaws lying between the honeycomb core and the surface sheet have been examined, and the effects of the thickness of the surface sheet and the combination of materials have been studied. We have found that the method is useful to detect flaws in the honeycomb sandwich structures. (Author)

A95-10612 Simultaneous 3-D imaging using chirped ultrashort optical pulses. K. MINOSHIMA, H. MATSUMOTO (National Research Lab. of Metrology, Tsukuba, Japan), Z. ZHANG, and T. YAGI (Inst. of Research and Innovation Laser Lab., Kashiwa, Japan), *Japanese Journal of Applied Physics, Part 2* (ISSN 0021-4922), Vol. 33, No. 9B, Sept. 15, 1994, pp. L1348-L1351. 7 Refs. Documents available from Aeroplus Dispatch.

A novel method for simultaneous 3D imaging using chirped ultrashort light pulses is proposed. Simultaneous imaging without scanning is possible by means of the conversion between the time and the color axes mediated by the chirped pulse. The theoretical limitation of the spatial resolution is discussed. We prove the efficacy of this method by measuring an area composed of three flat steps made of three gauge blocks of different lengths with an accuracy of better than 0.3 mm. This technique is applicable for imaging the shape of moving objects, or for surface testing or inspection. (Author)

A94-34372 Thermal wave tomography with ray-optic reconstruction. R. TAKAUE, K. HIRATA, S. KOGA, M. MATSUNAGA, and K. HOSOKAWA (Kyushu Inst. of Technology, Kitakyushu, Japan), *Japanese Journal of Applied Physics, Part 1* (ISSN 0021-4922), Vol. 33, No. 5B, May 1994, pp. 3265-3272. 17 Refs. Documents available from Aeroplus Dispatch.

Thermal wave tomographic imaging of an aluminum sample with a new photopyroelectric detector is reported. The new detector can detect the local ac temperature field when it comes into contact with the back surface of a sample. Compared to the capacitively coupled detector, this detector is easier to handle and has increased sensitivity to the photopyroelectric signal. The effects of the laser beam modulation frequency and subsurface defects in the sample on the tomographic image have also been studied. It is revealed that the resolution of the tomograph increases with increasing modulation frequency and decreasing metal-tip diameter of the detector. (Author)

A94-34370 High signal-to-noise ratio and high resolution detection techniques for photopyroelectric thermal wave imaging reconstruction. A. YARAI, K. SAKAMOTO, and T. NAKANISHI (Osaka Sangyo Univ., Daito, Japan), *Japanese Journal of Applied Physics, Part 1* (ISSN 0021-4922), Vol. 33, No. 5B, May 1994, pp. 3255-3259. 8 Refs. Documents available from Aeroplus Dispatch.

High SNR and high resolution detection techniques for photopyroelectric thermal wave imaging equipment are described. A high SNR technique is mainly achieved by realizing a very low-noise first stage preamplifier and its assembling technique and by the use of a very low noise second stage amplifier. High resolution detection is achieved by using a metal probe tip with a very small diameter. This equipment could be achieved mainly due to the high SNR technique and FEM analysis. A high-fidelity tomographic image reconstructed by these techniques is also shown. This work can be expected to yield significant tomographic reconstruction capabilities, even for thin solid materials with near-surface defects.

A94-34369 Generation of electron-acoustic signals and distribution of potential in transistor chip under applied of bias. H. TAKENOSHITA (Osaka Prefecture, Univ., Sakai, Japan), *Japanese Journal of Applied Physics, Part 1* (ISSN 0021-4922), Vol. 33, No. 5B, May 1994, pp. 3204-3207. 13 Refs. Documents available from Aeroplus Dispatch.

The study reports observations of a V(b)-applied Si Tr-chip performed to examine the change in the contrast of electron-acoustic microscopy (EAM) and to evaluate the applicability of EAM to nondestructive internal observations of semiconductor devices during operations. The observation area was selected using SEM images, and then, after a switch to the EAM mode, the fixed area selected using SEM images is studied by both SEM and EAM modes. It is found that the distribution of potential in the device could be determined from the contrast of electron acoustic images nondestructively, and that nondestructive internal observation of application of V(b) was possible. EAM is found to be a technique for nondestructive internal in situ observation which is possible under application of V(b) during operation of the device for a fixed area selected at first using the SEM mode.

A94-27745 Breakdown and rearrangement of a vortex street in the far wake of a cylinder. T. KARASUDANI and M. FUNAKOSHI (Kyushu Univ., Japan), *Kyushu University, Research Institute for Applied Mechanics,*

Reports, Vol. 39, No. 110, Feb. 1994, pp. 1-27. 31 Refs. Documents available from Aeroplus Dispatch.

The breakdown and rearrangement of a primary vortex street shed from a circular cylinder in the far wake are experimentally examined for R (the Reynolds number based on the diameter of the cylinder) in the range 70-154. According to the vorticity fields obtained using digital image processing for visualized flow fields, the primary vortex street breaks down into a nearly parallel shear flow of Gaussian profile at a certain downstream distance, before a secondary vortex street of large scale appears further downstream. The process leading to the nearly parallel flow can be explained as the evolution of the vortex regions of an inviscid fluid if we invoke the observation that the distance between the two rows in the primary vortex street increases with the downstream distance. Numerical computations with the discrete vortex method also support this explanation. (Author)

N94-27282 Bulletin of Precision and Intelligence Laboratory, No. 68 Tokyo Inst. of Tech., Yokohama (Japan). Precision and Intelligence Lab. Documents available from Aeroplus Dispatch.

The following topics were discussed; silence amenity engineering, historical review, philosophy, silence amenity, noise, noise reduction, noise control, noise quality, environmental quality, habitability, noise propagation, aerodynamic noise, vibration noise, and noise source. This material also contains bibliographies which lists 163 abstracts. In these abstracts, the following topics were discussed: speech recognition, sound propagation, molecular beam epitaxy, artificial reality, image processing, image analysis, crystal structure, crystal growth, laser devices, semiconductor devices, ultrasonic motors, accurate control techniques, materials processing, alloys, and materials properties. For individual titles, see N94-27283 through N94-27283. (Author)

N94-25568 Study on knowledge extraction and systematization for material design (Zairyo sekkei no tame no chishiki no chushutsu to taikaika ni kansuru kenkyu). K. HOSHIMOTO, Y. KURIHARA, A. MIYAZAKI, R. KANEKO, T. YOKOKAWA, S. IWATA, and M. FUJITA. In its *Bulletin of National Research Institute for Metals in Fiscal Year 1993*, No. 14, pp. 219-230, (see N94-25544 07-26). Documents available from Aeroplus Dispatch.

Investigation was conducted on knowledge extraction from published data as well as from visual information which is difficult to computerize, and filing of comprehensive material information which includes images and graphics. Functional inspection was studied for image data processing. Similarities in microscopic photographs of alloy texture were studied by both professionals and nonprofessionals, and their results were analyzed statistically by multi-dimensional scaling. Alloy texture was expressed roughly in three factors: crystal shapes, anisotropy, and fineness. Quantization of texture characteristics expresses the relationship between texture characteristics and characteristic values regressively and clearly. Next, data collection and data base development regarding binary alloy phase were researched, and software programs were developed accordingly. The image was quantized with an image scanner, and was classified into nodes, lines, and domains to be expressed in a graphic table. Search function was facilitated by search user interface which did not require specific languages for data search on the data base. (Author)

N94-19384 Development of ISY data set, part 2 (Isy data setto no seibi). Remote Sensing Technology Center, Tokyo (Japan). Documents available from Aeroplus Dispatch.

This report describes the study for the data set preparation of the sea surface temperature (SST) and the polar region ice zone, and the data set preparation algorithms developed for ISY (International Space Year) activities. Preparation process of the SST data set (including the VTIR (visible and thermal infrared radiometer) data set, comparison of the data by different kinds of sensors and production of marginal data set, production of data set for evaluating the algorithm, and evaluation of the algorithms) and the polar region ice zone data set (including superposition of the MSR (microwave scanning radiometer) and VTIR images, MESSR (multispectral electronic self-scanning radiometer) and VTIR images, production of MSR mosaic images, superposition of MSR and MSS (multi-spectral scanner) images, study on superposition of MESSR and SAR (synthetic aperture radar) images, and auxiliary information overlays), and the development of algorithms for polar region ice zone data set (including the development of the algorithm for the MOS-1 (Marine Observation Satellite-1) data set, comparison evaluation of MSR data set and MSS data, and study on integrated use of SAR data and visible and near infrared data) are outlined. (Author)

A94-11616 Melting and solidification of Y-Ba-Cu-O ceramics in microgravity by utilizing TR-IA sounding rocket. H. KITAGUCHI, K. TOGANO (National Research Inst. for Metals, Tsukuba, Japan), S.-i. YODA (NASDA, Tokyo, Japan), T. MACHIDA (NEC Corp., Yokohama, Japan), and H. NISHIMURA (Nichiden Machinery, Ltd., Kusatsu, Japan), *JASMA-Japan Society of Microgravity Application, Journal* (ISSN 0915-3616), Vol. 10, No. 1, 1993, pp. 15-25. 7 Refs. Documents available from Aeroplus Dispatch.

Melting and solidification phenomena of polycrystalline YBa₂Cu₃O_{7-x} bulk sample in microgravity were studied by utilizing TR-IA sounding rocket. Microgravitational experiment and the terrestrial one were carried out by using HTF apparatus to improve the fundamental understanding of these phenomena in microgravity. Video image observation reveals that oxygen gas bubbles were released at the liquid surface of the specimen more frequently in the terrestrial than in microgravity. Macroscopically, major difference between both samples is confirmed in the molten region. This can be explained by the difference in the conditions of thermal conduction and heat flow between both environments. No superconductivity is observed in both samples at the 'as melt-solidified' state. After the post annealing, the micro-G sample shows steeper superconducting transition than the terrestrial one. (Author (revised))