

## Japanese Aerospace Literature This month: *Remote Sensing*

**A92-51465 Recent advances in 3D applications of remote sensing and GIS in Japan.** SHUNJI MURAI, MO XI, SUKIT VISESHIN, MASATAKA TAKAGI, YOSHIKI HONDA, SHIRO OCHI, MITSU HARU TOKUNAGA, (Workshop on 3D in Remote Sensing and GIS - Systems and Applications, Oberpfaffenhofen, Federal Republic of Germany, Sept. 16-22, 1991, Selected Papers. A92-51457 21-43) *ITC Journal* (ISSN 0303-2434), No. 1, 1992, pp. 55-58.

Three kinds of 3D applications of remote sensing and GIS in Japan are described: data acquisition for digital elevation models (DEMs), data processing and analysis, and 3D image output. The output from combinations of remote sensing images, DEMs, hill shading, drainage patterns, and other thematic variables is illustrated.

**A92-38970 Collective-processing correlator system for imaging radiometer of thinned arrays** K. KOMIYAMA, Y. KATO, T. IWASAKI, *Electronics Letters* (ISSN 0013-5194), Vol. 28, No. 8, April 9, 1992, pp. 779-781.

A correlation processor is proposed for interferometric microwave radiometers of thinned arrays. In this system, each antenna signal is frequency-shifted by local signals of different frequency. These signals are gathered and processed collectively to generate correlation signals between all pairs of antennas. A conceptual design of the collective-processing correlator for a six-antenna thinned array is shown.

**A92-35075 Change detection from remotely sensed multi-temporal images using spatial segmentation** HIROSHI HANAIZUMI, HIROSHI OKUMURA, SADA O FUJIMURA, *IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium*, Espoo, Finland, June 3-6, 1991. Vol. 2 (A92-34851 14-43). New York, Institute of Electrical and Electronics Engineers, Inc., 1991, pp. 1079-1082.

A new method is proposed for detection of temporal change between remotely sensed multispectral images. This method uses regression and segmentation techniques for reduction of apparent change due to noise and/or variation of recording gain and offset between two images. In the method, the images are normalized by fitting a line to the whole pixel scattergram between them. A description is presented of the principle and the procedures of this method. The validity of this method is confirmed by numerical simulation. A result obtained by application of this method to a pair of actual multitemporal multispectral images is also shown.

**A92-35480 Land cover monitoring in Asia by NOAA GVI data** RYUTARO, TATEISHI, KOTI KAJIWARA, *Geocarto International* (ISSN 1010-6049), Vol. 6, No. 4, Dec. 1991, pp. 53-64.

NOAA/AVHRR Global Vegetation Index (GVI) data of Asia in 1983 and 1987 were used to evaluate their usefulness for global land cover monitoring. Color composite images of monthly GVI data and color composite images of principal components from 12 successive monthly GVI data were found to be useful for visual interpretation of seasonal vegetation dynamics. The results of cluster analysis applied to monthly GVI data for a one-year period, indicate that unsupervised classification method is useful for global or continental land cover classification without ground truth. In order to detect land cover changes, the difference between the 1983 and 1987 12-month GVI data was calculated. The results show that it is difficult to detect land cover changes due to cloud contamination in monthly GVI data and poor registration of GVI products.

**A92-35128 Evaluati on of radiometric performance of MOS-1/MOS-1b** KOREHIRO MESSR MAEDA, MASAO NAKAI, *IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium*, Espoo, Finland, June 3-6, 1991. Vol. 3 (A92-34851 14-43). New York, Institute of Electrical and Electronics Engineers, Inc., 1991, pp. 1345-1347.

MOS-1 (Marine Observation Satellite-1) and MOS-1b were launched on February 19, 1987, and February 7, 1990, respectively. MOS-1 has four mission instruments: the MESSR (Multispectral Electronic Self-Scanning Radiometer), VTIR (Visible and Thermal-Infrared Radiometer), MSR (Microwave Scanning Radiometer), and the DCST (Data Collection System Transponder). The MESSR has two systems, and each system has two telescopes. The radiometric performance of the MESSR is evaluated by a uniform ocean-area and verification experiment. Some results on the radiometric characteristics of the MOS-1/MOS-1b MESSR are presented.

**A92-35164 Radar backscatters from vegetation - Review of a laboratory-based measurement technique** HARUTO HIROSAWA, *IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium*, Espoo, Finland, June 3-6, 1991. Vol. 3 (A92-34851 14-43). New York, Institute of Electrical and Electronics Engineers, Inc., 1991, pp. 1519-1522.

The author reviews a technique developed for studying the backscattering characteristics of vegetation. An extended target composed of vegetation is formed on a turntable, and backscattering is measured while the target is rotated. The technique has been applied to the study of backscattering from trees. It has also been used to study the polarimetric microwave signature of random media.

**A92-35158 C- and X-band polarimetric microwave signatures of artificial random media** OSAMU KOBAYASHI, HARUTO HIROSAWA, YUKIHIKO MATSUZAKA, *IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium*, Espoo, Finland, June 3-6, 1991. Vol. 3 (A92-34851 14-43). New York, Institute of Electrical and Electronics Engineers, Inc., 1991, pp. 1491-1494.

To reveal the microwave signatures of random media, full-polarimetric backscatter measurements are made using a multipolarization power-measuring-type indoor scatterometer at C-band and X-band. Measured polarimetric characteristics of artificially fabricated random media (ensembles of dielectric rods/disks) are presented. The polarization signatures of ensembles of dielectric disks were analyzed qualitatively, considering the backscattering characteristics of a single scatterer and the structure of the media. The differences due to the elevation angle distribution were most clearly observed at X-band. For the ensemble of dielectric rods, the measured and the calculated polarimetric backscattering characteristics were compared. Fairly good agreement was observed between the two.

**A92-35286 Texture analysis using a fractal matrix model (for terrain analysis)** SHOICHI MASUDA, *IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium*, Espoo, Finland, June 3-6, 1991. Vol. 4 (A92-34851 14-43). New York, Institute of Electrical and Electronics Engineers, Inc., 1991, pp. 2165-2168.

Seasat Synthetic Aperture Radar (SAR) images taken from satellites are fractals. Until now, fractal features have been treated as scalar quantities, making it difficult to treat images containing considerable variation. An attempt is made to generalize the fractal dimension  $F$  obtained by multidimensionalizing the fractal relation. A fractal matrix (F-matrix) model is used for the texture analysis of mountains and other areas having considerable topographical variation in Seasat SAR images. The effectiveness of this method in remote sensing image classification is demonstrated. It is shown that the F-matrix model is effective in classifying the textures of different types of mountainous topography in Seasat SAR remote-sensing images of natural landscapes. This proves that the F-matrix contains significant information of value in texture analysis of remote-sensing images.

**A92-35125 A new simplified method for the measurement of the atmospheric water vapor** SHINOBU HASHIMOTO, *IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium*, Espoo, Finland, June 3-6, 1991. Vol. 3 (A92-34851 14-43). New York, Institute of Electrical and Electronics Engineers, Inc., 1991, pp. 1329-1332.

A method is presented which is based on the measurement of the atmospheric extinction of solar radiation using a multifrequency Dicke radiometer and a set of two different beamwidth antennas. The relative intensity of the absorption spectrum is used as the measure of the water-vapor concentration. Problems associated with the conventional method, or cancellation of the thermal emission component of the atmosphere and the fluctuation of the solar radiation, can be removed automatically. Computer simulations for the estimation of the integrated water vapor and the altitude distribution are given in comparison with radiosonde data.

**A92-35017 MOS-1 multi-sensor data set for sea ice monitoring - Japanese contribution to ISY/PIE program** TAKEDA K. CHO, F. NISHIO, KODAMA K. MAEDA, T. YAMANOUCHI, *IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium*, Espoo, Finland, June 3-6, 1991. Vol. 2 (A92-34851 14-43). New York, Institute of Electrical and Electronics Engineers, Inc., 1991, pp. 811-814.

Japan's first polar orbiting earth observation satellite series, MOS-1 and MOS-1b, carry three different sensors, MESSR (Multispectral Electronic Self-Scanning Radiometer), VTIR (Visible Thermal Infrared Radiometer), and MSR (Microwave Scanning Radiometer). The advantage of MOS-1 is that it can observe the same phenomena using the three different sensors at the same time. In order to contribute to the ISY (International Space Year)/PIE (Polar Ice Extent) Program, NASDA and related agencies in Japan plan to produce an MOS-1 multisensor data set of the Antarctic region, Okhotsk Sea and the Arctic region. A description is given of the use of the data set for sea ice study and monitoring, and further plans to produce the MOS-1 data set for ISY/PIE.

**A92-12453 Study of Lunar Polar Orbiter** RYOICHI IMAI, TOSHIHIDE MAEDA, TAKAO ETO, KAZUO OHTA, YUTAKA KANEKO, TSUTOMU IWATA, *IAF, International Astronautical Congress*, 42nd, Montreal, Canada, Oct. 5-11, 1991. 11 p.

Two Lunar Polar Orbiter (LPO) systems and their sensors are described. One LSO is a two-ton-class remote sensing satellite which uses the high-resolution Lunar Mapping Imager (LMI), SAR, and the Laser Altimeter. The other LPO, a combination of the 1.5-ton class remote sensing satellite and a 0.5-ton class Landing Probe, employs the LMI, conventional RF radar altimeter, and ground-truth sensors. The designs of the subsystems are shown and operational scenarios are briefly addressed.

**A92-34996 Global remote sensing programs in Japan - Special emphasis on earth resources** YOSHINORI ISHII, IGARSS '91; *Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium*, Espoo, Finland, June 3-6, 1991. Vol. 2 (A92-34851 14-43). New York, Institute of Electrical and Electronics Engineers, Inc., 1991, pp. 709-712.

A discussion is presented of the (1) basic structures of Japanese governmental organizations for space remote sensing, (2) approved and planned projects and their objectives, and (3) related research activities. Two satellites, JERS-1 (1992 by H-1) and ASTER (1998 by NASA polar orbit platform, or NPOP), have also been planned. Their original objectives are for the exploration of nonrenewable natural resources such as petroleum and minerals. Sensor specifications are: (1) high ground resolution, especially for VNIR, (2) stereo imaging, (3) SAR (synthetic aperture radar), on JERS for topography mapping, (4) many-channels for SWIR and TIR. These features also have great potential for global land observation. From this viewpoint, basic ideas and geoscientific potentials are discussed.

**A92-34938 Measurements of soil backscatter with a 60 GHz scatterometer** HIROMICHI YAMASAKI, JUN AWAKA, AKIRA TAKAHASHI, KEN'ICHI OKAMOTO, TOSHIO IHARA, IGARSS '91; *Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium*, Espoo, Finland, June 3-6, 1991. Vol. 2 (A92-34851 14-43). New York, Institute of Electrical and Electronics Engineers, Inc., 1991, pp. 403-406.

Indoor experiments to measure the backscattering coefficient of a soil surface were performed using a 60-GHz scatterometer. The roughness of the soil surface was also measured by a laser profile meter to get the roughness parameters such as standard deviation and correlation length. Incidence angle dependence of the measured backscattering coefficient showed distinctive features according to the roughness of soil surface. These results were compared with estimates from a small perturbation theory.

**A92-34929 Analysis of green area change in and around metropolis using Landsat and census data** NOBUYUKI MIZUTANI, HIDEAKI MIYAMOTO, SIEJIRO HAYAKAWA, MASAO KATO, KENJI KAMIGAWARA, IGARSS '91; *Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium*, Espoo, Finland, June 3-6, 1991. Vol. 2 (A92-34851 14-43). New York, Institute of Electrical and Electronics Engineers, Inc., 1991, pp. 359-362.

A forecast is given pertinent to the green area in the Tokyo, Japan, metropolitan area up to the year 2000. These results will help to determine greenery policies and plan urban development projects for the future. The information is based on green area data obtained from Landsat data and statistical population data gathered from census data. This study shows the effectiveness of combining remote sensing data with other data to present an index for effective utilization of environmental resources.

**A92-34920 A proportion estimation of mixed pixel (mixel) with previously estimated proportions of neighboring mixels** KOHEI ARAI, YASUNORI TERAYAMA, KENBU TERAMOTO, IGARSS '91; *Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium*, Espoo, Finland, June 3-6, 1991. Vol. 1 (A92-34851 14-43). New York, Institute of Electrical and Electronics Engineers, Inc., 1991, pp. 313-316.

A proportion estimation of mixed pixels (mixels) based on the inversion problem solving technique with a previously estimated proportion of neighboring mixels is proposed. First, homogeneous areas are extracted and classified. Then spatial features such as line-likeness, area-likeness, etc. and properties such as directionality, length, width, etc. of heterogeneous areas are calculated. This is followed by referencing of contextual information with rotational information. Experimental results with simulation data show that the proposed method is superior to the previously proposed conventional method with a generalized inverse matrix by 81 times in terms of root-mean-square error.

**A91-38262 Polarimetric investigation of the atmospheric aerosols over the Pacific Ocean** Y. TAKAYAMA, K. MASUDA, T. TAKASHIMA, *International Journal of Remote Sensing* (ISSN 0143-1161), Vol. 12, May 1991, pp. 969-983.

For a feasibility study setting up the maritime aerosol model, measurements of the radiance and degree of polarization of the skylight radiation were carried out over the Pacific Ocean during the cruise of the Hakuho Maru KH-88-2. The wavelengths 0.4, 0.6 and 0.9 micron were considered using the portable spectroradiometer (resolution about 30 nm). The derived visibility is in good agreement with that reported from ships. Furthermore, the optical thickness and the mixing ratio of aerosol constituents are shown to be derived from the measurements of maximum degree of polarization for moderate solar elevations, provided that the maritime aerosol is a mixture of oceanic and water-soluble aerosols.

**A91-41034 Hierarchical algorithms for the classification of remotely sensed multi-spectral images** SADA O FUJIMURA, HIROSHI HANAIZUMI, *IEEE Transactions on Communications, Electronics, Information and Systems* (ISSN 0917-1673), Vol. E74, Feb. 1991, pp. 295-301.

Classification algorithms with hierarchical structure are quite effective for the classification of remotely sensed multispectral images because the data are vast in volume and have redundancy in spatial, spectral and/or, in some sense, temporal structure. The algorithms bring high speed and high accuracy in the classification. A couple of hierarchical algorithms developed with spectral and spatial meaning are described with experimental results.

**A92-34886 Error characteristics of split window function for sea surface temperature estimation** RYUZO YOKOYAMA, SUMIO TANBA, IGARSS '91; *Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium*, Espoo, Finland, June 3-6, 1991. Vol. 1 (A92-34851 14-43). New York, Institute of Electrical and Electronics Engineers, Inc., 1991, pp. 167-170.

Error statistics in the sea surface temperature (SST) estimation functions by the NOAA AVHRR (advanced very-high-resolution radiometer) brightness temperatures were investigated for two types of split window functions and a single variable function. The mean and the variance of the errors were described by the coefficients of the SST estimation function of the object and the statistics of the specified match-up data set used in the validation test. The authors investigate the statistics of the estimation error with regard to the coefficients of the estimation function and the match-up data statistics. The mean and the variance of errors in SST estimation functions are described in a unified manner.

**A92-15334 Stratospheric lighter-than-air powered platform** M. ONDA, *Chinese Journal of Aeronautics* (ISSN 1000-9361), Vol. 4, May 1991, pp. 156-162.

A feasibility study has been carried out on a high altitude (20 km) superpressured PLTA (powered lighter-than-air) platform, which has a long service life and larger payload than that of a large artificial satellite. This PLTA platform has an electric propulsion system to cope with wind flow for position keeping and its thruster is driven by solar power acquired through solar cells. Solar energy is to be stored for night use in regenerative fuel cells. The study is focused on energy balance and hull structure analysis of the platform. This platform is particularly capable of conducting high resolution remote sensing and telecommunications relay. This platform can replace a number of ground-based telecommunications relay facilities and can guarantee reasonable radio frequency intensity enough to secure good telecommunications quality. The altitude where the platform resides is the least windy area in the lower stratosphere at a height from which one can have a direct line of sight on the ground within a 1,000 km diameter range. The platform can also be useful to chase typhoons and to observe them from their births in the tropical regions.

**A92-12240 GCP acquisition using simulated SAR and evaluation of GCP matching accuracy with texture features** KOHEI ARAI, *International Journal of Remote Sensing* (ISSN 0143-1161), Vol. 12, Nov. 1991, pp. 2389-2397.

A method is proposed for ground control-point (GCP) acquisition using a simulated synthetic-aperture radar (SAR) image derived from a digital-elevation model (DEM). Also proposed is a method for the evaluation of the accuracy of GCP matching with texture features from a reference GCP-chip image. Results from experiments with simulated GCP-chip images as reference images and geometrically distorted GCP-chip images, derived using simulated SAR images as current images, show good coincidence with GCP matching accuracy in terms of pixel distances between matched GCP points in reference and current chip images and texture features. Based on the proposed methods, GCP-chip images can be generated from a DEM, and GCP-matching accuracy can be evaluated with texture features of simulated SAR from a GCP-chip image.

**A91-56698 Dual-parameter radar rainfall measurement from space - A test result from an aircraft experiment** TOSHIKI KOZU, KENTJI NAKAMURA, ROBERT MENEGHINI, WAYNE C. BONGYK, Ministry of Posts and Telecommunications, Tokyo (Japan). *IEEE Transactions on Geoscience and Remote Sensing* (ISSN 0196-2892), Vol. 29, Sept. 1991, pp. 690-703.

An aircraft experiment has been conducted with a dual-frequency (X/Ka-bands) radar to test various rainfall retrieval methods from space. The authors test a method to derive raindrop size distribution (DSD) parameters from the combination of a radar reflectivity profile and a path-integrated attenuation derived from surface return, which may be available from most spaceborne radars. The estimated DSD parameters are reasonable in that the values generally fall within the range of commonly measured ones and that shifts in DSD parameters appear to be correlated with changes in storm type. The validity of the estimation result is also demonstrated by a consistency check using the Ka-band reflectivity profile which is independent of the DSD estimation process. Although errors may occur in the cases of nonuniform beam filling, these test results indicate the feasibility of the dual-parameter radar measurement from space in achieving a better accuracy in quantitative rainfall remote measurements.

**A92-22480 Japanese status of commercial space activities** JIRO KOCHIYAMA, HIROSHI IMAMURA, IAF, *International Astronautical Congress*, 42nd, Montreal, Canada, Oct. 5-11, 1991. 9 pp.

The Japanese space industry is described in terms of its nonmilitary basis and commercial developments to evaluate prospects for the near future. The industry is based on the interconnections between space-related service businesses, manufacturing businesses, and businesses based on the utilization of space. Descriptions are given of the country's current launch services, the manufacturing of vehicles, and developments in the areas of satellite communications and broadcasting. Remote sensing and materials processing are given as examples of space-environment utilization and establish the basis for areas of expansion. Space-related commerce is not considered to be economically significant although the activities of the industry are broadening at present.