Japanese Aerospace Literature This month: *Synthetic Aperture Radar*

A92-47761 Thermal deformation of a large space panel caused by temperature difference between front and rear sides. NAOKI ICHIKAWA, HARUHISA KUROKAWA, NOBUYUKI YAJIMA, SHIGERU KOKAJI, and AKIO SUZUKI, *Japan Society for Aeronautical and Space Sciences Journal* (ISSN 0021-4663), Vol. 40, No. 461, 1992, pp. 346–353. 7 Refs.

This paper describes the development of a ground test system for determining the thermal deformation of large antenna panels to be used in space. The system is designed to measure the deformation occurring as a result of temperature differences between the front and rear surfaces of the panel. In the experimental set-up, a symmetric honeycomb panel was used. The front surface of the panel was heated by IR radiation, and the deformation was determined using a fringe scanning moire system which measured the shape of the rear surface. It was found that the temperature difference realized by the system was of the same order as was estimated on the orbit. The variations in the temperature difference were less than 15 percent of the average value. The effects of temperature distribution on the deformation were evaluated to be negligible by an FEM calculation. (Author)

N92-26743 Japanese Earth Observation Program. YUKIO HARUYAMA, *International Conference on Japanese Earth Observation Programs: Plenary Session,* National Space Development Agency, Tokyo (Japan). pp. 1–30 (SEE N92-26742 17-43).

Presented in viewgraph format, NASDA's (National Space Development Agency of Japan) earth observation program was outlined. Objectives, current status, characteristics, and operation schedules of Japanese satellites such as GMS (Geostationary Meteorological Satellite), MOS-1 (Marine Observation Satellite-1), MOS-1b, JERS-1 (Japan Earth Resources Satellite-1), ADEOS (Advanced Earth Observing Satellite), TRMM (Tropical Rainfall Measuring Mission) satellite, and JPOP (Japanese Polar Orbiting Platform) were presented.

N92-25634 Utilization of SAR data for resources exploration. ATSUSHI IWASHITA, *NASDA, International Conference on Japanese Earth Observation Programs: JERS-1 Workshop*, Earth Resources Satellite Data Analysis Center, Tokyo (Japan). pp. 141–151 (SEE N92-25620 16-43).

Presented in viewgraph format, utilization of Synthetic Aperture Radar (SAR) data for geological survey is outlined. Topics addressed include: analysis of SAR image over the tropical forest; edge density image; terrain detection; and rock type discrimination.

N92-25633 JERS-1 application for sea ice, glacier, and ice sheet. FUMIHIKO NISHIO, *NASDA, International Conference on Japanese Earth Observation Programs: JERS-1 Workshop*, National Inst. of Polar Research, Tokyo (Japan). pp. 119–140 (SEE N92-25620 16-43).

Presented in viewgraph format, application of JERS-1 (Japan Earth Resources Satellite-1) and ERS-1 data to observe sea ice, glacier and ice sheet is presented. Topics addressed include: operational status of world earth observation satellites; SAR (Synthetic Aperture Radar) data requirement; characteristics of Optical Sensor (OPS) and SAR on the JERS-1; usefulness of SAR and other sensors compared under the glaciological regime; and sensor images of ice environment.

N92-25626 Verification project. KOREHIRO MAEDA, *International Conference on Japanese Earth Observation Programs: JERS-1 Workshop*, National Space Development Agency, Ohashi (Japan). pp. 55–70 (SEE N92-25620 16-43).

Presented in viewgraph format, verification activities of JERS-1 (Japan Earth Resources Satellite-1) in NASDA (National Space Development Agency of Japan) are outlined. Topics addressed include: mission objectives of JERS-1 system; purpose of JERS-1 verification program; schedule of verification program; verification items; calibration of SAR (Synthetic Aperture Radar) on the JERS-1; and calibration of OPS (Optical Sensor) system on the JERS-1.

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. 2 Refs.

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.

N92-25632 Utilization of JERS-1 data. HARUHISA SHIMODA, *NASDA, International Conference on Japanese Earth Observation Programs: JERS-1 Workshop*, Research and Information Center, Tokai Univ., Tokyo (Japan). pp. 113–118 (SEE N92-25620 16-43).

Presented in viewgraph format, the reception and use of JERS-1 (Japan Earth Resources Satellite-1) and ERS-1 data is outlined. Topics addressed include: performance of JERS-1 and its sensor units; utilization of JERS-1 and ERS-1 data; land cover classification; vegetation classification; change detection; ocean observation; soil moisture detection; natural hazard detection; stereo image; and Synthetic Aperture Radar (SAR).

N92-25624 ERS-1 facility at Earth Observation Center. HIROYUKI WAKABAYASHI, *International Conference on Japanese Earth Observation Programs: JERS-1 Workshop,* ERS-1 Payload Ground Segment Office, National Space Development Agency, Ohashi (Japan). pp. 29–40 (SEE N92-25620 16-43).

Presented in viewgraph format, the status and overview of JERS-1 (Japan Earth Resources Satellite-1) ground system are outlined. Topics addressed include: purposes and functions of JERS-1 ground system; system overview; development schedule; functional block diagram of JERS-1 ground system; ground station; data receiving system; data recording system; data processing system; quality of JERS-1 data; and flow of SAR (Synthetic Aperture Radar) data processing.

N92-25622 SAR development status. YUKIAKI NEMOTO, *NASDA, International Conference on Japanese Earth Observation Programs: JERS-1 Workshop,* Japan Resources Observation System Organization. pp. 7–18 (SEE N92-25620 16-43).

Presented in viewgraph format, the status of SAR (Synthetic Aperture Radar) development on the JERS-1 (Japan Earth Resources Satellite-1) are described. Topics addressed include: block diagram of SAR; functional block diagram of signal processor; specification of SAR; SAR data sequence; radar calibration; SAR raw data format at observation mode and calibration mode; and schedules of SAR development.

N92-25621 Development status of space craft. CHU ISHIDA, *International Conference on Japanese Earth Observation Programs: JERS-1 Workshop,* Earth Observation Satellite Group, National Space Development Agency, Tokyo (Japan). pp. 1–6 (SEE N92-25620 16-43).

Presented in viewgraph format, the status of JERS-1 (Japan Earth Resources Satellite-1) development is outlined. Topics addressed include: JERS-1 project organization; JERS-1 development schedule; design parameters such as orbit category, altitude, inclination, period, recurrent period, local mean time; on orbit configuration of JERS-1; and satellite components such as mission instrument system and satellite bus system e.g., Synthetic Aperture Radar (SAR) , and Communications and Data Handling Subsystem (C&DH).

N92-25620 International Conference on Japanese Earth Observation Programs: JERS-1 Workshop. National Space Development Agency, Tokyo (Japan). Page: 158P.

The following topics were discussed: JERS-1 (Japanese Earth Resources Satellite-1), JERS-1 satellite verification program, remote sensing, remote sensors, earth resources survey, ice observation, SAR (Synthetic Aperture Radar), optical sensors, radiometers, ground stations, mission planning procedure, data acquisition, data reception, data processing, data transfer network, data distribution, JERS-1 data cataloging and archiving, JERS-1 project organization, and schedule of project. For individual titles, see N92-25621 through N92-25635.

A92-40247 Recent activities in antennas and propagation in Japan. KENICHI KAGOSHIMA and TAKAYASU SHIOKAWA, *IEEE Antennas and Propagation Magazine* (ISSN 1045-9243), Vol. 34, No. 2, April 1992, pp. 18–26. 24 Refs.

Recent Japanese activities in the fields of antennas and propagation are discussed. In the realm of antennas, developments in the areas of mobile communications antennas, multibeam earth station antennas, satellite-borne antennas for ETS-VI, and the shaped-beam antenna for the Superbird commercial domestic communications satellites are examined. In addition, antennas for the Japanese Earth Resources Satellite-1 SAR, the Japanese operational DBS, and for microwave radio-relay system are briefly discussed. In the field of propagation, developments in land-mobile radio systems, mobile satellite systems, fixed-satellite communication systems, and terrestrial radio systems are examined.

A91-37150 Analysis of topographic effects on SIR-B imagery. MAKOTO SATAKE, MASAHARU FUJITA, *Noise and clutter rejection in radars and imaging sensors; Proceedings of the 2nd International Symposium,* Kyoto, Japan, Nov. 14–16, 1989 (A91-37076 15-32). Amsterdam, Elsevier Science Publishers, 1990, pp. 728–731.

The topographic effects on spaceborne SAR imagery are investigated using two SIR-B images which were obtained for the same hilly area of the Sarobetsu test site from mutually orthogonal orbits. Slope images, images showing the inclination of each local surface, are constructed from a geographical contour map and used for comparison with the SIR-B images.

A92-35062 Development of a frequency offsetting ARC (Active Radar Calibrator). MASAHARU FUJITA, *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. 1023–1025. 5 Refs.

An ARC (active radar calibrator) is proposed for SAR (synthetic aperture radar) in which the frequency of a received SAR signal is shifted by a certain amount. The frequency shift causes a shift of the ARC image in an azimuth direction relative to its background. This function allows to enhance a signal-to-clutter ratio of the ARC image by moving it onto a dark background, and hence it would be of value for SAR calibration even at a narrow test site. The theory, design and development are described.

A92-35056 SAR antenna pattern and microwave penetration measurement using spectrum analyzers. HIROSHI KIMURA, MITSUNORI YOSHIMURA, and NOBUHIKO KODAIRA, *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. 997–1000. Research supported by Japan Resources Observation System Organization. 4 Refs.

A convenient method to measure SAR (synthetic aperture radar) antenna patterns and microwave penetration of soil or trees using spectrum analyzers, which are popular instruments for high performance microwave measurements, and amateur use antennas is discussed. First, the received power by ground receiver is estimated for several SARs. This estimation suggests that spectrum analyzers can be used for ground measurement during SAR observation. In situ experimental measurements are presented. The application for the J-ERS-1 SAR is discussed.

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.

N92-22094 Research and development on large deployable antenna. YASUMASA HISADA, *Preprints of NASDA's 5th Technical Symposium,* Tsukuba Space Center, National Space Development Agency, Tokyo (Japan). pp. 123–157 (SEE N92-22089 12-12).

This paper describes the ground deployment test of a synthetic aperture radar (SAR) antenna and a five meter diameter petal deployable antenna under research and development by the National Space Development Agency of Japan (NASDA). The SAR antenna will be mounted on Earth Resources Satellite-1 (ERS-1) and the five meter diameter petal deployment antenna will be mounted on a Tracking and Data Relay (TDRS) Satellite. This paper especially describes the policy on research and development of a large deployable antenna in NASDA, and the ground deployment test results of these two antennas are also introduced.

A91-15814 High-speed SAR processing system. K. UTSUNOMIYA, K. HORIGUCHI, Y. KUNIYASU, and T. KOBAYASHI, *Quantitative remote sensing: An economic tool for the Nineties; Proceedings of 12th IGARSS '89 and Canadian Symposium on Remote Sensing,* Vol. 3, Vancouver, Canada, July 10–14, 1989. (A91-15476 04-43). New York, Institute of Electrical and Electronics Engineers, 1989, pp. 1715–1718. 6 Refs.

A breadboard model of the SAR (synthetic aperture radar) processing system has been developed by using the 32-bit high-speed image processor T9506 and the special high-speed bus. The design concept of the T9506 and an examination of the SAR processor system using the T9506 was presented at IGARSS'85, and '86. The small image processing system for remote sensing utilizing the processor-board-mounted T9506 was presented at IGARSS'87. This SAR processing system is composed of the host computer, several image-processor-mounted T9506s, work memories, and a special high-speed bus without a bus neck. Features of this SAR processor system are very high speed, expandability, and low cost. The image-processor-mounted T9506 can perform a FFT (fast Fourier transform) very quickly (1024 point complex FFT: 2 ms). The special high-speed bus has several ports, and can be used without a bus neck by several image processors at the same time. This bus has a data transmission capacity of 320 Mb/s. This system can decrease the processing time by increasing the number of the image processors. This high-speed SAR processing system was evaluated with one image processor by processing Seasat SAR data. Based on this result, the processing time of the ERS-1 SAR in this system can be estimated. One scene of SAR data can be reproduced in about 3 min by using 56 image processors, and 80 scenes can be processed in one day.

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. 6 Refs.

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.

A91-37151 A side-looking SAR with a DBF antenna. TAKAHIKO FUJISAKA, YOSHIMASA OH-HASHI, and MICHIMASA KONDO, *Noise and clutter rejection in radars and imaging sensors; Proceedings of the 2nd International Symposium,* Kyoto, Japan, Nov. 14–16, 1989 (A91-37076 15-32). Amsterdam, Elsevier Science Publishers, 1990, pp. 738–743. 5 Refs.

A side-looking SAR (synthetic aperture radar) with a DBF (digital beamforming) antenna was found to improve its cross-range resolution in proportion to the number of antenna beams without increasing PRF (pulse repetition frequency). The cross-range compression algorithm of the SAR is discussed, and it is shown that the algorithm gives good results by computer simulations.

A91-37148 Relocatable imaging using a delayed-action radar calibrator for SAR calibration. KOJI KOMIYAMA, YOSHIHIKO KATO, and ICHIRO YOKOSHIMA, *Noise and clutter rejection in radars and imaging sensors; Proceedings of the 2nd International Symposium,* Kyoto, Japan, Nov. 14–16, 1989 (A91-37076 15-32). Amsterdam, Elsevier Science Publishers, 1990, pp. 717–722. 6 Refs.

A delayed-action radar calibrator (DARC) is described and evaluated in terms of effective reduction in image intensity when applied to a terrain-imaging orbital SAR. The DARC separates the delayed radar return from other interfering direct returns—including the background terrain and the structure and support of the reflector—on the SAR image map. The DARC image is relocated to the imaging background of the SAR map with a small radar cross section to reduce the uncertainty of the external radar calibration. Problems related to the application of DARC to SAR are discussed including dispersion characteristics of the time delay, the difference between azimuth reference functions, and the range curvature difference. The reduction of the image strength for a low-earth-orbit SAR is evaluated and shown to produce some error. Because the reduction is deterministic and the correction can be made without considering the uncertainty of the calibration, DARC can lead to accurate external calibration in the SAR.

A91-37147 Generation of speckle-reduced one-look SAR images. HARUTO HIROSAWA and HIROSHI KIMURA, *Noise and clutter rejection in radars and imaging sensors; Proceedings of the 2nd International Symposium,* Kyoto, Japan, Nov. 14–16, 1989 (A91-37076 15-32). Amsterdam, Elsevier Science Publishers, 1990, pp. 705–710. Research supported by Technology Research Association of Resources Remote Sensing System. 11 Refs.

Speckle-reduced, one-look synthetic-aperture radar images are generated using an algorithm that reduces the amplitude of intensity fluctuation of speckle of one-look images to a level of three- or four-look while preserving the resolution of spatial details in one-look images. The intensity of each pixel is varied so that the difference between the power and the average power of a homogeneous local area about the pixel is reduced at a constant rate. The algorithm also gives the original intensity value to a pixel when the intensities of pixels within the local area do not obey the statistics of speckle. Images generated with the algorithm are shown and compared to typical one-look images and normally processed three-look images. The algorithm is shown to preserve the fine spatial details of one-look images, and the amplitude of the speckle's intensity fluctuation is similar to that of 3-4-look images. The images generated with the speckle-reduction algorithm are visually natural and of high quality. Because these images are suitable for visual interpretation, the algorithm makes the application of one-look SAR images more effective.

A90-13322 JERS-1 development status. K. YONEYAMA, T. KOIZUMI, T. SUZUKI, R. KURAMASU, T. ARAKI et al., *Proceedings of the 40th IAF International Astronautical Congress,* Malaga, Spain, Oct. 7–13, 1989. 10 pp. 5 Refs.

Consideration is given to the development of the Japanese Earth Resources Satellite-1 (JERS-1). JERS-1 is a remote sensing satellite planned to carry an L-band SAR and optical sensors. Additional instruments for the JERS-1 include the mission data recorder, the mission data transmitter, and the satellite bus system. The subsystems of the satellite bus system are discussed, including the structural, the communications and data handling, reaction control, attitude and orbit control, electrical power, thermal control, and integration subsystems. The objectives of the JERS-1 program are listed and the configurations and functions of the satellite and mission instrumentation are described.