ICUS/INCEDE NEWSLETTER

International Center for Urban Safety Engineering

Institute of Industrial Science
The University of Tokyo

VOLUME 2 NUMBER 3
OCTOBER-DECEMBER 2002

Remote Sensing Activities in India

by

R. S. TIWARI and Onkar DIKSHIT

Remote Sensing (RS) activities, in India, may be said to have started in 1962 with the formation of the Indian National Committee for Space Research. In the same year, work on equatorial rocket launching station at Thumba (TERLS) was started from where the first sounding rocket was launched in 1963. The early remote sensing scene was primarily dominated by the Geological Survey of India (GSI), where with the advent of low-flying aircraft for aerial surveys, large sections of the country were surveyed using magnetic, electro-magnetic and radiometric sensors. Aerial magnetic surveys over parts of states of Rajasthan, Bihar, West Bengal and Andhra Pradesh, covering nearly 90,000 sq. km, were carried out in 1967-68 under 'Operation Hardrock', which yielded a wealth of information on geophysical anomalies.

The Indian Space Research Organization (ISRO), which is the nodal agency for various RS activities India was established in 1969. ISRO has been involved in the development of satellite launch vehicles, sensors, aerial surveys, image analysis and interpretation and planning of satellite based resource surveys. A number of successful RS surveys for a variety of applications, in collaboration with other user agencies, have since been carried out by ISRO. The establishment of the Space Applications Centre (SAC) at Ahmedabad in 1972 put RS activities in the country on a more organized basis and sound footing. Following the launch of India's first satellite Aryabhatta in 1975, ISRO has sent a number of satellites in space and has initiated actions for future space programmes.

REMOTE SENSING IN INDIA

The widespread RS activities in India are presently taken care of by the central and state government departments, academic institutions and private enterprises. Primarily, the Department of Space (DOS), a nodal department of the central government, is involved in RS activities through its various wings such as ISRO, National Natural Resources Management System (NNRMS), and National Remote Sensing Agency (NRSA). ISRO, through the Space Application Center (SAC) at Ahmedabad and Regional Remote Sensing Service Centres (RRSSCs) situated at Nagpur, Bangalore, Kharagpur, Dehradun, and Jodhpur, promotes regional and national RS applications. Besides undertaking various application programmes, an important aspect on which ISRO has directed its efforts, all along since its inception, is to develop technology for sending country's own satellites in space. The NNRMS is responsible for ensuring optimized utilization of the country's natural resources through a proper and systematic inventory of various resources. For this, it has created the Natural Resource Information System (NRIS) where resources data at district, state and national level has been maintained. It also facilitates establishment of infrastructure, generation of

trained manpower and supports collaborative efforts in development of hardware and software for processing of satellite and other data.

The establishment of NRSA in 1974, an autonomous organization of the Department of Space, has further strengthened RS activities in the country. Its objectives have remained as remote sensing data acquisition, archival, processing and dissemination; operation of flight facility to provide aerial remote sensing; applications of remote sensing for survey and monitoring of natural resources and research and development. It has carried out a number of projects that include airborne geophysical survey for the Department of Atomic Energy (DAE) and aerial photographic surveys for the Survey of India (SOI). It also imparts training in various application areas to the personnel from user departments through the Indian Institute of Remote Sensing (IIRS), Dehradun. IIRS, established initially as a part of the SOI, was brought under the NRSA in 1976 with the primary responsibility of developing trained manpower in RS. The IIRS campus at Dehradun has another unique facility at the initiative of United Nations, known as the Center for Space Science and Technology Education in Asia and Pacific (CSSTE-AP), to provide education and training in remote sensing to personnel from Asia and Pacific region.

The Indian space programmes have remained directed to three aspects, i.e., development of remote sensing satellites called IRS series, development of communication and meteorological satellites called INSAT series and development of different types of launch vehicles to put the satellites in proper orbits. So far seven IRS satellites known as IRS-1A, IRS-1B, IRS-1C, IRS-1D, IRS-P3 and IRS-P4 (OCEANSAT), and Technology Experiment Satellite (TES) have been launched. Out of these the first two, IRS-1A and 1B, have completed their useful life while the remaining five form the largest constellation of remote sensing satellites in the world, offering a variety of data in different spectral bands and spatial resolutions. Some important characteristics of Indian satellites and sensors have been listed in Table given below. The TES, launched on board PSLV-C3 on October 22, 2001, is an

Table: Characteristics of (a) Indian satellites for earth observation, and (b) the on-board sensors

(a)

Parameters	**Bhasakara-I & II**	**IRS-1A/1B**	**IRS-1C/1D**
Class	Spin-stabilized	3-axis stabilization	3-axis stabilization
Weight (Kg)	444	975/989	1247
Power (W)	47 W from solar panels and Ni-Cd batteries	709 W from solar array (EOL) 2 Ni-Cd batteries	813 W from solar array (EOL) 2 Ni-Cd batteries
Mission life	One year	Three years	Three years
Launch	1979, 1981	1988 / 1991	1995
Orbit			
Height (km)	Apogee 557 Perigee 572	904	≈ 817
Inclination (degrees)	50.7	99.028	98.12
Type	Near circular	Sun-synchronous	Sun-synchronous
Equator crossing time		10:25 Hrs.	10:30 Hrs.
Repetitivity (days)	-	22	24

(b)

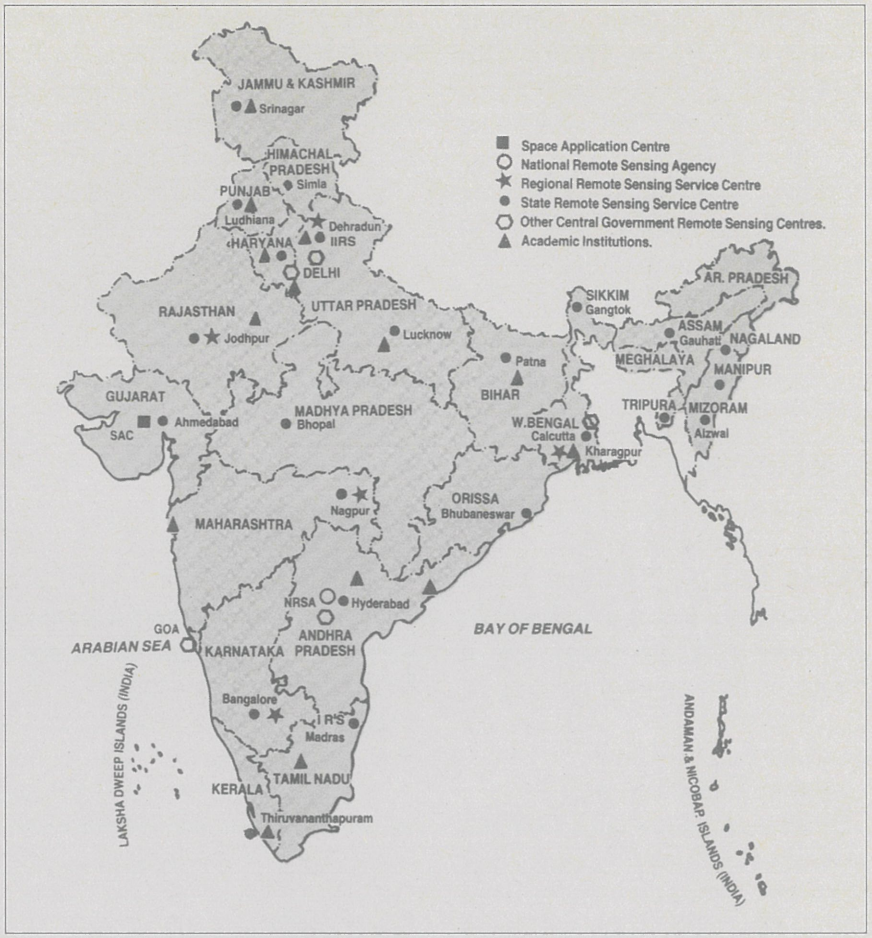
	Bhasakar I/II TV	**Bhasakar I/II SAMIR**	**IRS-1A/1B LISS-I/II**	**IRS-1C/1D LISS-III**	**IRS-1C/1D PAN**	**IRS-1C/1D WiFS**
Type	TV camera microwave radiometer	Dick-type	CCD camera	CCD camera	CCD camera	CCD camera
Spectral Bands (μm)	0.54-0.66 0.75-0.85	19, 22, 31 (GHz)	0.45-0.52 0.52-0.59 0.62-0.68 0.77-0.86	0.52-0.59 0.62-0.68 0.77-0.86 1.55-1.70	0.50-0.75	0.62-0.68 0.77-0.86
Ground resolution	1 km	125 km	73 m/36.5 m	≈23.5 m (Visible) 5.8 m ≈70.5 m (SWIR)		188 m
Swath (km)	≈341	148/2X74	≈141 ≈148	70	810	
Steering	Nadir	Nadir	Nadir	Nadir	Steerable ±26°, stereo	Nadir looking

experimental satellite to demonstrate and validate in-orbit technology that could be used in the future satellite programmes. TES also carries a panchromatic camera with a spatial resolution of 1 m.

INSAT system is the largest domestic satellite communication system in Asia Pacific Region comprising of four satellites, INSAT-2C, INSAT-2D, INSAT-2E and INSAT-3B. The earlier satellite INSAT-1D, launched in June 1990, was used for meteorological imaging and a few other services. INSAT-2B, which was launched in July 1993, has been decommissioned from regular services but is being used for Satellite Aided Search and Rescue and Data Relay Services and a few other scientific experiments.

The successful first test-flight of Geo-synchronous Satellite Launch Vehicle (GSLV-D1) from Sriharikota on April 18, 2001 has been a significant milestone in the development of country's space launch vehicle programme. Another important event, during this period, has been the successful flight of PSLV-C3 on October 22, 2001 from Sriharikota. In this fifth consecutive successful flight, PSLV placed three satellites- Indian TES, Belgian PROBA and German BIRD into polar sun-synchronous orbit thus establishing the reliability of PSLV for launching multiple satellites.

Besides above, almost all the state governments have established state remote sensing application centers to take care of their RS related activities. Further, several other departments such as Oil and Natural Gas Commission (ONGC), Forest Survey of India, Department of Agriculture and Cooperation, Department of Environment and Forest, and GSI



Locations of major Remote Sensing facilities in India

Table: Academic and other institutions offering degree and other programmes in Remote Sensing

No.	Name of Univ. / Institute	Course
1.	Aligarh Muslim Univ..	M. Phil and Ph. D.
2.	Andhra Univ., Visakhapatnam	M. Tech.
3.	Anna Univ., Chennai	M. Tech. and Ph. D.
4.	B. M. Birla Science and Technology Center, Jaipur	M. Tech.
5.	Bharatidasan Univ., Tiruchirapally	P.G. Diploma, M. Phil. and Ph. D.
6.	Indian Institute of Technology, Kanpur	M. Tech. and Ph. D.
7.	Indian Institute of Technology, Mumbai	M. Tech. and Ph. D.
8.	Indian School of Mines, Dhanbad	M. Tech.
9.	Jamia Millia Islamia, New Delhi	M. A. / M. Sc.
10.	Indian Institute of Technology, Roorkee	M. E. and Ph. D.
11.	Regional Engineering College, Warangal	M. Tech. and Ph. D.
12.	Jawahar Lal Nehru Technical Univ., Hyderabad	M. Tech. and Ph. D.
13.	Indian Institute of Remote Sensing (IIRS), Dehradun	Training programmes of varying lengths of time. These programmes are usually attended by staff of various user organizations.
14.	Survey Training Institute (STI), Survey of India, Hyderabad	
15.	National Bureau of Soil Survey and Land Use Planning, Nagpur, Bangalore	
16.	Forest Survey of India, Dehradun	
17.	Geological Survey of India Training Institute, Hyderabad	
18.	National Natural Resources Management System, Bangalore, Dehradun, Jodhpur, Kharagpur, Nagpur	
19.	Space Application Center, Bangalore	
20.	National Remote Sensing Agency, Hyderabad	

etc., and private organizations such as ROLTA India (Mumbai), Speck Systems Limited (Hyderabad), HOPE Technologies (Delhi), RMSI (Delhi) etc. are also involved in remote sensing applications related project.

The location of the some of the facilities involved in RS in India is shown in the map of the country given on the previous page.

EDUCATION, TRAINING AND RESEARCH

The names of the universities/institutes and other institutions offering degree and other training programmes in remote sensing - on regular basis are given in the Table on the previous page. It can be seen that education and training in RS and allied subjects in various institutions has, unfortunately, not been undertaken at the desired pace, in spite of the fact that there is a growing need for trained personnel in these fields. The result is that there is a dearth of trained personnel to handle and efficiently utilize the large amount of data available from country's own satellite system. In fact, the school and college level education in this field is practically non-existent.

Non-availability of qualified and trained personnel in RS and allied fields has not only hampered proper exploitation of the available data but has also affected the related research programmes in various application areas. The research in RS and related areas is being carried out either at the government departments/organizations or the academic institutions and the funding generally comes from government departments such as University Grants Commission (UGC), Department of Science and Technology (DST), All India Council for Technical Education (AICTE), Indian Space Research Organization (ISRO) and Defense Organizations. There is a need, however, to have more concerted efforts to generate coherent research and education programmes than the present isolated efforts on the part of individuals.

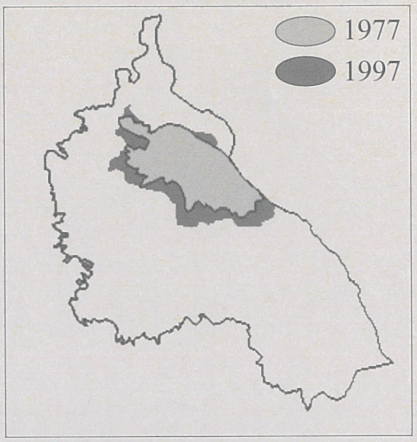
APPLICATIONS OF REMOTE SENSING

As mentioned earlier, RS applications started in the country with the advent of aerial photography, particularly in the field of geology and mineral exploration. Subsequent applications in the field of natural resources exploration were taken up, after the development of space borne multispectral sensors. Some major applications carried out at the national level include the mapping of forest cover, wasteland, soil resources and land use mapping for agro-climatic zoning. With the availability of more sophisticated sensors, the application areas have been extended to urban mapping, industrial site selections, pollution studies, engineering applications and disaster management such as floods and drought monitoring, landslide hazard zonation, earthquake damage assessment etc.

Two examples of RS applications are briefly explained using the adjacent figures. The top two photographs show the urbanization observed in the neighbourhood of the city of Kanpur during the last 20 years, and a false color composite of the district using IRS 1C LISS III sensor data. The photographs at the bottom show the emergence of channels due to liquefaction in Rann of Kachchh in western India after the major earthquake in Gujarat in January 2001.

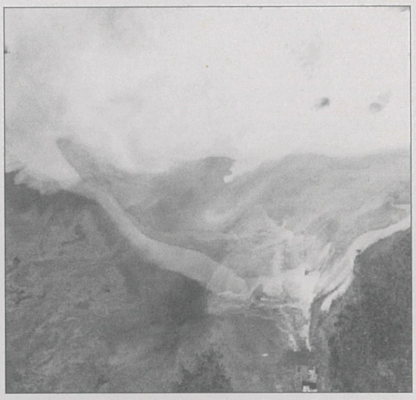
The following projects are also noteworthy from the viewpoint of RS application in the country:

- Mapping and monitoring of major floods in the country

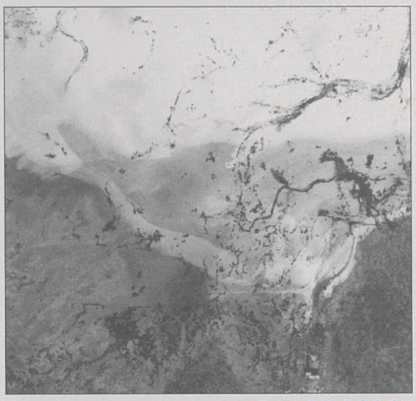


Urbanization in the Kanpur district over 20 years

FCC of Kanpur district using IRS 1C LISS sensor data



(a)Pre-earthquake(Jan 2,2001)



(b)Post earthquake(Jan 29,2001)

Channel formation in the Rann of Kutch due to liquefaction during earthquake

using IRS (optical) and RADARSAT (microwave) satellite data to get district level inundation information for relief operations
- Change detection analysis of Gujarat earthquake of January 2001 for damage assessment using LISS-3 and PAN data, including changes in ocean parameters,
- Landslide hazard zonation mapping at 1:25,000 by merging LISS-3 and PAN data
- Preparation of district level zoning atlases for environmental risk assessment in siting of industries
- Change detection and growth trend analysis for planning urban development
- Integrated mission for sustainable development
- Carrying capacity based development planning for Delhi and Doon valley
- Mineral targeting on a regional scale under project Vasundhara

FUTURE PROGRAMMES

RS activities in India have come a long way to make the country as one of the leading nations in space programmes. Future programmes, besides routine applications, are more interesting and ambitious. These envisage using satellite data for advanced cartographic applications, launching of recoverable satellites so that payload could be reused to cut down the cost of future missions and launching of a satellite for telemedicine purposes. For cartographic applications such as cadastral mapping, urban and rural management, coastal land use and regulation, utilities mapping and development etc., CARTOSAT series satellites have been planned. IRS-P5 (CARTOSAT-1), having spatial resolution better than 2.5 m, will be launched by PSLV in polar sun-synchronous orbit at an altitude of 618 km with a 30 km swath. The satellite will carry two steerable panchromatic cameras suitably mounted to provide stereo pairs of images. Likewise, CARTOSAT-2 will also be launched in polar sun-synchronous orbit at an altitude of 630 km and a special orbit of 560 km, so as to have a revisit period of 4 days and 1 day respectively. It will carry an advanced panchromatic CCD camera with the spatial resolution of less than 1 m with 10 km swath.

Another satellite, IRS-P6 (RESOURCESAT) will have a polar sun-synchronous orbit at an altitude of 817 km. The payload of this resource satellite will have multi-spectral camera LISS-3 having 23.5 m spatial resolution in all four bands with a swath greater than 140 km, a high resolution multispectral camera LISS-4 to provide 5.8 m resolution in three bands and an Advanced Wide Field Sensor (AWiFS) camera with a spatial resolution better than 70 m in three bands with a swath of 700 km.

ACKNOWLEDGEMENT

The information derived from various publications of ISRO and NNRMS, Bangalore, NEERI Nagpur, and Current Science, Bangalore, for this paper is gratefully acknowledged.

Editor's note: Due to limitations of space, some tables, etc could not be included here. An extended version of this article, including a historical review of the remote sensing activities in the country, is available at the ICUS website. Though the readers could write to ICUS also, the authors will be only too glad to assist and provide additional information. Correspondence to the authors can be addressed to onkar@iitk.ac.in

- Authors -

Prof. R. S. Tiwari is Adjunct Professor in the Dept of CE at Indian Institute of Technology, Kanpur, where he joined after a distinguished career spanning more than 35 years at the IIT Roorkee. Prof Tiwari has been one of the pioneers in Remote Sensing activities in India, and his research interests include applications of close range photogrammetry in engineering and biomedicine, and applications of remote sensing and photogrammetry for mapping and natural resources evaluation.

Dr. Onkar Dikshit is Associate Professor at Dept of CE at Indian Institute of Technology, Kanpur. His research interests include applications of remote sensing, photogrammetry, GIS, GPS, and digital image processing to engineering and natural resource management problems.


Dr. Tiwari


Dr. Dikshit

ICUS Activities Recognized

Mr. H. Kanada working with Prof. Uomoto, and Mr. S. Fujita, Ms. M. Enomoto and Ms. P. Mayorca working with Prof. Meguro, won a prize for excellent presentation at the 2002 Annual meeting of the Japan Society of Civil Engineers held at Sapporo in September. The names of awardees were announced in November.

Mr. W. Takeuchi a graduate student working with Prof Yasuoka won the Best Paper award for his paper at the autumn meeting of the Japan Society for Photogrammetry and Remote Sensing.

International Symposium on

New Technologies for Urban Safety of Mega Cities in Asia

The International Center for Urban-safety Engineering (ICUS) of the Institute of Industrial Science (IIS), the University of Tokyo and the School of Civil Engineering, Asian Institute of Technology, Bangkok organized a one-day International Symposium on New Technologies for the Safety of Mega Cities of Asia on October 28th at Bangkok. The symposium sought to bring together all the participants involved in creating and maintaining the present day urban environment - policy makers, planners, engineers and architects.

The Symposium was inaugurated by the Honorable Minister of Transport HE Mr Suriya Jungrungreongkit of the Royal Thai Government and Honorable Senior Vice-Minister HE Mr Kenzo Yoneda in the Cabinet Office of Japan.

In his inaugural address, HE Mr. Suriya Jungrungreongkit welcomed the timely discussion on the subject of Urban Safety, and mentioned the urgent need to address the issue of partially completed building structures in Bangkok, whose present integrity needs to be established before a decision on their further development can be taken. In his inaugural address, HE Mr. Yoneda briefly outlined and reiterated Japan's continued support and participation in efforts related to disaster mitigation and urban safety. He also emphasized Japanese willingness to share with the other countries know-how and expertise gathered over the ages in dealing with natural forces such as earthquakes and typhoons.

The inaugural session of the symposium was co-chaired by Prof. Y Yasuoka, Deputy Director-General, IIS, University of Tokyo and Prof. JL Armand, President of AIT. Speaking at the symposium, Prof. Armand welcomed the delegates and participants, and lauded the important role Japan had played in building and maintaining the international stature of AIT. In his message to the Symposium read out by Prof. Yasuoka, the Director General of the IIS, University of Tokyo, called for a closer cooperation between the researchers and academicians of the region to ensure better utilization of scarce technical and human resources.

Prof. Shunji Murai, Professor Emeritus, University of Tokyo and Professor, Keio University, delivered one of the two Keynote lectures. The title of his talk was Advanced Technologies in Geoinformatics. Dr. Wicha Jiwalai, Chairman, Executive Board, Geo-Informatics and Space Technology Development Agency of Thailand (GISTDA), delivered the other Keynote lecture on the Information Needs for Urban Safety Assessment.

Dr. Suvit Vibulsresth, Director, GISTDA, and Prof. Worsak Kanok-Nukulchai, Dean, School of Civil Engineering, AIT, also delivered Special Lectures in the morning session of the Symposium. While Dr. Vibulsresth's talk concentrated on the Satellite Observation Programs in Asia, Prof. Worsak highlighted the different facets of activities for urban safety at the AIT.

In the afternoon session of the Symposium, more than 20 technical papers were presented by researchers and professionals from Thailand, Japan, Singapore, and Hong Kong, highlighting the advanced technologies, such as remote sensing, GIS, GPS and other computational tools that can be used to devise appropriate methodologies for the management and maintenance of urban buildings and infrastructures in mega cities, and disaster mitigation.

Readers may also visit the ICUS website for more information on the Symposium, The Proceedings of the papers presented has also been published, and readers may write to us for more information - Editor

ICUS Director(Extreme left)with other dignitaries

Participants at the symposium

Regional ICUS office inaugurated

At a simple ceremony on October 29th, 2002, the School of Civil Engineering, Asian Institute of Technology (AIT) and the International Center for Urban-safety Engineering (ICUS) of the Institute of Industrial Science (IIS), the University of Tokyo established a Regional Network Office for Urban Safety (RNUS), at the AIT's School of Civil Engineering (SCE). An agreement towards developing joint research programmes and cooperate in developing strategies for tackling issues related to urban safety was also signed.

Prof. Jean-Louis Armand, AIT President, Prof. Mario Tabucanon, Provost, AIT, Prof. Yoshifumi Yasuoka, Vice Director-General of IIS, University of Tokyo attended the ceremony in addition to Prof. Taketo Uomoto, Director, ICUS and Prof. Worsak Kanok-Nukulchai, Dean, School of Civil Engineering, AIT, and other members of the ICUS and AIT faculty.

In their brief remarks, the dignitaries recalled the longstanding partnership between the AIT and the University of Tokyo, and the agreement for long-term cooperation between the AIT and the Institute of Industrial Science/University of Tokyo. It was unanimously felt that the establishment of the RNUS could serve as an important milestone in closer cooperation between the academicians and researchers of the region.

The brief ceremony was followed by a meeting between faculty members of the ICUS, and the SCE, AIT, and academics and researchers from some of the academic and research institutions in Bangkok, besides the AIT such as the Thammasat University and the Chulalongkorn University. The meeting focused on identifying areas of common interest for future collaborative research. During the meeting, the importance of developing accurate databases for large cities was emphasized. It was decided to form two working groups to work in the following areas:

(a) collection of information related to concrete structures including the incomplete and 'abandoned' buildings', deteriorated infrastructure such as highway bridges, etc., and,

(b) use of remote sensing data for applications such as mitigation of damage on account of floods.

With the opening of the Regional office at AIT, it will become possible for an ICUS faculty to spend more time there and participate in the formulation and execution of joint research programmes.

Prof. Uomoto and Prof.Worsak sign a MOU for mutual cooperation

Some of the AIT and ICUS faculty at the regional office opening

ICUS/INCEDE Activities Record

Besides the symposium on New Technologies for the Safety of Mega Cities of Asia, the following are some of the International Conferences and Symposia attended by the ICUS staff.

Prof. T.Uomoto and Prof. S. Misra attended the meeting of the International Concrete Committee for Model Code and the Asian Concrete Forum at Seoul from 1st to 4th November. Prof. Uomoto also attended the 9th Intl. Conf. on Shotcrete for Underground Support at Kyoto from 17th to 20th November.

Prof. Y.Yasuoka attended the Third Intl. Asia-Pacific Symposium. on Remote Sensing of the Atmosphere, Ocean, Environment, and Space, at Hangzhou China from 22nd to 27th October.

Prof. R.Ooka participated in the 2nd Intl Workshop on Energy and Environment of Residential Building China from 13th to 17th October at Shanghai, China.

Visitor to ICUS/INCEDE

Ms Natacha Matsunuma, of the CIRMM - CNRS, Paris, visited ICUS on December 6th and met Prof. T.Uomoto, Director, who briefed her about the activities of the ICUS and the setting up of the office at AIT.

Editor's Note

Konnichiwa. I feel happy and privileged to have the opportunity to work on the present issue, and I hope you find it interesting. I also hope that our Newsletter has now become a regular part of your office library, as this seventh issue reaches you after the Center was established in April 2001.

I joined the center in July and have now gotten more or less used to the working here, though Japan is not a new place for me, as I did my graduate studies at the University in Tokyo, and also worked here for about 5 years. Apart from the tremendous proliferation of the mobile phones (keitai), its business as usual. Only, as part of an rationalization of portfolios at the highest level, the Ministry of Construction (Kensetsusho), which played a tremendous role in the rebuilding of Japan after the Second World War, and was a 'dream job' for many a Japanese civil engineer has been reorganized into a 'Ministry of Land, Infrastructure and Transport'. Well, old order changeth!!

Some of my time here has been spent on helping in the organizing the symposium at Bangkok and opening of the regional office at AIT, as reported in the current issue. I hope that this marks a new era in regional cooperation and sharing of scarce human and technical resources. The growth of the number of cities with a population exceeding one million from 28 in 1950, to 136 in 1995 and projected to be almost 250 in 2015, is a clear indication of the burden on the urban infrastructure in the years to come.

Besides the work at the center, I have tried to update my information about the developments in the traditional Japanese sport of Sumo. I have discovered that Asashoryu, a fighter from Mongolia, is the new 'emerging' star, and should be in line for attaining the (highest) rank of yokozuna, if he does well in the January tournament.

On behalf of the ICUS, I invite you to send us a short communication on research and other activities at your end, which we could include in future issues of the Newsletter. You can send mail at icus@iis.u-tokyo.ac.jp.

(Sudhir Misra)

International Center for Urban Safety Engineering (ICUS/INCEDE)
Institute of Industrial Science, The University of Tokyo
4-6-1 Komada, Meguro-ku, Tokyo 153-8505, Japan
Tel: (+81-3)5452-6472, Fax: (+81-3)5452-6476, E-mail:icus@iis.u-tokyo.ac.jp
http://icus-incede.iis.u-tokyo.ac.jp/

International Center for Urban Safety Engineering, ICUS/INCEDE
Institute of Industrial Science, The University of Tokyo
4-6-1 Komaba, Meguro-ku, Tokyo 153-8505, Japan

ICUS/INCEDE
INSTITUTE OF INDUSTRIAL SCIENCE THE UNIVERSITY OF TOKYO
International Center for
Urban Safety Engineering