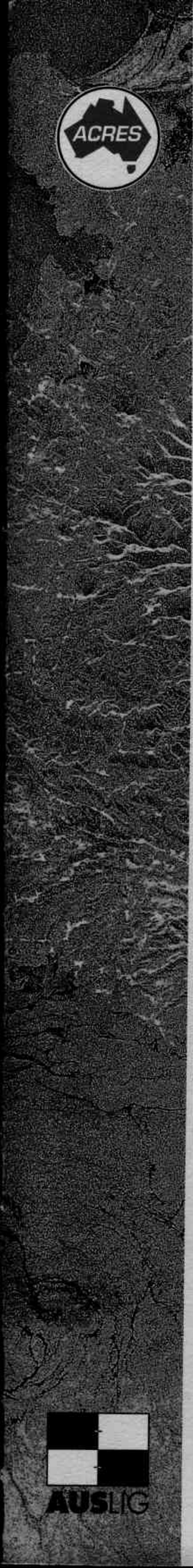

Australian Centre for Remote Sensing

ACRES

UPDATE

The Antenna at the Iranian Remote Sensing Centre near Tehran

Australia represented at key regional meeting

RADAR SPECIAL EDITION

Why Microwaves?

Radarsat

JERS SAR Results

JULY 1994

Dennis Puniard as Acting Manager of ACRES recently attended the 10th Meeting of the Directors of the National Remote Sensing Programmes (RRSP) in the ESCAP region and the 10th Session of the Intergovernmental Consultative Committee (ICC) on the Regional Remote Sensing Programme. The activity was sponsored by the Australian Space Office as part of its support for Australia's participation in significant space related international activity.

The meeting was hosted by the Islamic Republic of Iran and the Iranian Centre for Remote Sensing (ICRS). Meetings were held at the ICRS headquarters building in the northern suburbs of Tehran. The meeting was opened by the President of Iran, Akbar Hashemi Rafsanjani in the Presidential Chambers in central Tehran.

In his introductory remarks President Akbar Hashemi Rafsnajani said that negligence of the useful modern

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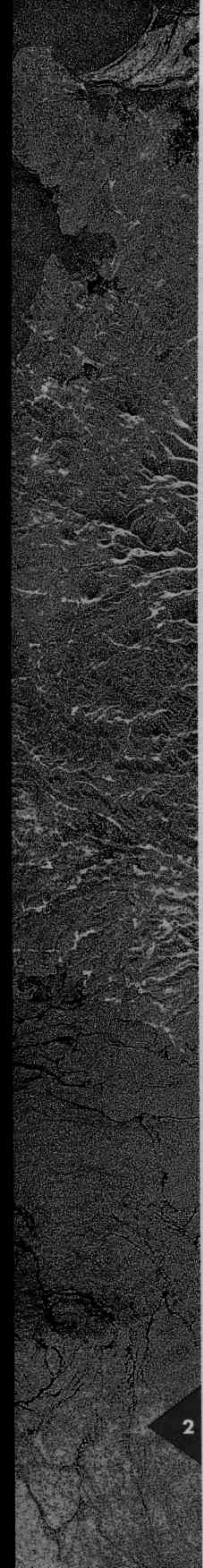


Manager's Message

Last month I was appointed by AUSLIG as the new Manager for ACRES. Following in Carl McMaster's footsteps is a pretty daunting task but one that I am looking forward to. There are clearly many exciting developments on the horizon.

My background consists of 20 years in the geographic information industry, including time in both the private and public sectors. While my educational background and initial work experience was as a surveyor, for the last twelve years I have worked primarily in the fields of digital cartography and Geographic Information Systems. Prior to commencing at ACRES I was Research and Development Manager for AUSLIG.

I would like to take this opportunity to thank Carl McMaster for his great efforts during his four years as Manager of ACRES. The industry has been very fortunate to have had the benefit of Carl's vision and drive during this critical period. I would also like to thank Dennis Puniard for his valuable contribution as Acting Manager over the last six months. We all wish Dennis well in his new role as AUSLIG's Product Manager for remote sensing.

One of my first official duties was to attend the opening of the Tasmanian Earth Resources Satellite Station (TERSS) in Hobart. TERSS is the first X-band satellite reception facility to be designed and built in Australia. It provides the opportunity to collect valuable earth observation data for scientific studies over the southern Ocean and parts of Antarctica. It also offers the potential to back up ACRES Alice Springs ground station for a large portion of Australia. TERSS will be operated by a consortium which includes the CSIRO Division of Oceanography, University of Tasmania, Bureau of Meteorology, COSSA, Antarctic Division and ACRES.

As I settle into my new job over the next few months I look forward to meeting many of ACRES distributors, customers and industry partners.

Paul Trezise

Peter Pistoor (ACRES System Manager) and Mike Linney (Production Coordinator) inspect the key.

LANDSAT'S future decided

At the recent LANDSAT Ground Station Operators Meeting held at Annapolis, USA the future of the US Government's LANDSAT programme was advised to the representatives of the international ground station operators. I represented Australia at the meeting. The LANDSAT 7 satellite will be a straight replacement for LANDSAT 6, lost at launch in October last year. The 15m Pan instrument and 7 band Enhanced Thematic Mapper will be the sensors on board. The resolution of Band 6 (Thermal Band) is to be improved. The downlinks are now to be 2 simultaneous 150 mbs links, not the 85 mbs of LANDSAT 6. These are the only differences to the technical specifications.

The whole LANDSAT programme is now to be managed by US Government agencies. NASA will oversee the contract to design, build and launch the satellite; NOAA will manage the operations and launch and negotiate international agreements whilst the Department of the Interior (USGS/EROS Data Centre) will carry out Data Distribution. Launch of LANDSAT 7 is planned for 1998. EOSAT, whilst still managing LANDSAT 4/5, is not to have a major role with LANDSAT 7.

Dennis Puniard

New manager takes over

Paul Trezise has been appointed as the new Manager of ACRES to replace Carl McMaster. Paul took over at a short ceremony at ACRES on 16th June. Paul was previously the Research and Development Manager in AUSLIG for two years. Prior to that he spent twelve months on secondment to Ordnance Survey in the UK.

Paul, Dennis and Tim discuss the future!

Laurie Oliver hands over the ACRES key to Paul Trezise – Tim Shirley, Paul Gardner and Bob Jones look on.

continued from page 1…

technology means disregard for the interests of regional countries, and it was time to give practical shape to decisions from mere words.

Speaking to the remote sensing and aerospace affairs body of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), he described the realm of ESCAP activity as a strong framework to take advantage of aerospace technology and remote sensing to discover new resources and make optimal use of the region's rich potential.

The president said different channels should be explored to promote science and technology in the contemporary world, and that Islamic Iran in view of the priorities attached to research and education in the world development plan, is ready to set up a centre to upgrade ESCAP's education and research section through investing money and workforce.

He said Iran as an active member of ESCAP and the Economic Co-operation Organisation (ECO) can play an important co-ordinating role to make proper use of scientific capabilities and the existing possibilities.

Rafsanjani appreciated UN assistance to ESCAP and its contribution to development plans in the region.

He hoped the Tehran meeting would pave the ground for taking practical decisions at the ESCAP ministerial meeting in Beijing in September.

Dr Jahedi addresses the official reception with Mr Michael Schulenburg (UNDP Tehran Representative) on his left and the Iranian Minister for Posts, Telegraph and Telephone, Mohammad Gharazi on his right.

The meeting was attended by representatives from Australia, Bangladesh, China (2), Fiji, India, Indonesia (2), Iran, Japan (5), Malaysia, Mongolia, Nepal, Pakistan, Philippines, Republic of Korea, Thailand, Vietnam, Mekong Delta Co-ordination Group, FAO, UNEP, UNDP and ITC (Netherlands). The Secretariat was represented by Mr He Changchui, Chief Space Technology Applications Unit (STAU), UNESCAP, Bangkok, and Mr M. Chaudhury (STAU). Members of the group not represented at the meeting were Vanuatu, Sri Lanka, Afghanistan and Singapore.

The meeting elected Mr Farshid Jahedi (Iran) as Chairman, Dr A.A.Z. Ahmad (Bangladesh) as Vice-Chairman and Mr Nik Nasruddin Mahmood (Malaysia) as Rapporteur.

Dennis Puniard (ACRES), Dr Farshid Jahedi (Chairman) and Mr He Changchui (ESCAP Secretariat).

RRSP MEETING

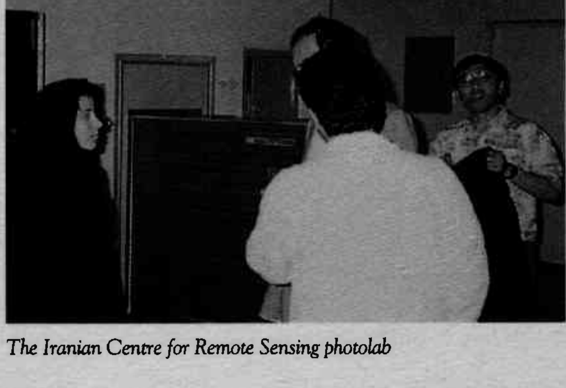
The meeting included:

- a report by the ESCAP Secretariat on Regional Activity;
- a report from each member country plus reports by ITC on regional training activities, the Mekong Secretariat on developments in the Mekong River catchment, United Nations Environment Programme (UNEP) and the Global Research Information Database (GRID) Programme based at the Asian Institute of Technology (AIT) in Bangkok, the Food and Agricultural Organisation (FAO) and the OLIVIA programme, and the United Nations Development Programme (UNDP) as the major sponsor and funding agency for the UNESCAP RRSP;
- a progress report on preparations for the Ministerial Conference on Space Applications to be held in Beijing in September; and
- the presentation by FAO of the results of a fact finding mission and concept formulation for the OLIVIA programme.

ICC MEETING

All countries and agencies involved in the RRSP meeting were also represented at the ICC meeting, also chaired by Mr Farshid Jahedi. The meeting endorsed the report of the RRSP meeting and in addition:

- reviewed the proposal work plan for RRSP for 1993 to 1996;
- discussed contributions from member countries to the programme, particularly training activities.



The Iranian Centre for Remote Sensing photolab

PACIFIC REGION DATA RECEPTION

One of the recommendations from the ICC meeting was that a mobile receiving capability be investigated for the Pacific sub region. Australia was seen as the potential provider, although France and New Zealand are identified as potential 'donors'. Fiji was particularly supporting of this proposal.

The computer facilities at IRSC being inspected by (left to right) Mr Mahsun Irysam and Mr Suharso Manta Diwirya (both Indonesia), Mr Jose Solis (Philippines) and Dr Bandarch Mendbayaryn (Mongolia)

AUSTRALIAN PARTICIPATION/SPONSORSHIP IN FUTURE ACTIVITIES

The RRSP programme for 1993-96 includes proposed activities that could be hosted/sponsored by Australia. These include:

M-95-2 An Expert Working Group

Meeting on GIS standardisation and guidelines proposed for March 1995

M-96-2 Workshop for Senior Decision Makers

on Operational use of Remote Sensing and GIS for Integrated Natural Resource, Environment and Development Planning proposed for February 1996. If this could be brought together with the 8th Australasian Remote Sensing Conference (March 1996) there could be considerable benefits.

Two other key regional activities, sponsored by ESCAP this year, include:

Regional Seminar on Tropical Ecosystem Management using RS/GIS

Bali, 23-28 August 1994
sponsored by NASDA/LAPAN

The Asian Remote Sensing Conference Hyderabad, India

17-23 November 1994
The next meeting of RRSP/ICC is to be held in Dhaka, Bangladesh in either June or August 1995. The elected officials for this meeting are:

- Mr A.A.Z. Ahmad (Bangladesh) – Chairman
- Mr Nik Nasruddin Mahmood (Malaysia) – Vice Chairman
- Mr Jose Solis (Philippines) – Rapporteur

Why microwaves for remote sensing?

Peter Radonyi, ACRES Project Engineer

Introduction

Historically microwave radiometric techniques were developed in the 1930's and 1940s to measure electromagnetic energy of extraterrestrial origin. Terrestrial microwave radiometric sensing had its beginnings in the late 1950s, following about two decades of radioastronomical and atmospheric observation made with antennas pointing away from the surface of the each. Photography has been used for over 100 years and colour photography for about 50 years, and more recently optical pictures from space. Why then use microwaves?

The question has several answers: the most important reason for using microwaves is their ability to penetrate clouds – and to some extent rain, and their independence of the sun as a source of illumination. Ice clouds that are dense enough to completely obscure the ground, thus precluding aerial photography almost have no effect on microwaves.

Another reason for use of microwaves is that they are able to penetrate more deeply into vegetation than optical waves can. The extent of penetration into vegetation depends upon the moisture content and density of the vegetation as well as upon the wavelength of the microwaves. The longer wavelengths penetrate much better than the shorter wavelength. The shorter wavelengths yield information about the upper layers and the shorter wavelengths yield information about the lower layers and the ground beneath. In sufficiently arid regions (not Australia) microwaves are able to penetrate significantly into the ground itself.

A third reason for the use of microwaves is simply that the information available from microwaves is different from that available in the visible and infrared regions, so that when conditions are suitable for all three regions, the sensors operating in these regions complement each other. For example, the colour observed in the visible and near infrared is determined primarily by molecular resonances in the surface layer of the vegetation or soil whereas the 'colour' in the microwave region is a result of geometric and bulk-dielectric properties of the surface volume studied.

The amount of radar backscatter is related mainly to the surface and near-surface physical properties – specifically slope, roughness and volumetric inhomogeneities and, to a lesser extent, the surface dielectric properties. Thus radar are particularly useful for morphological structural mapping, terrain classification, surface cover delineation, cartographic mapping, polar ice observation, and monitoring ocean features – all expressed as roughness or slope variation.

SAR images can provide two types of information: the patterns or shapes of the areas observed, and the tone and texture of the radar images. Large-scale geological formations, such as folds, domes, drainage patterns, and fault lines, can be detected by their shape, as in an optical image. Radar has the advantage that direction of illumination can be selected by the observer. Surface roughness can be used to distinguish and separate different types of surface, and for further enhancing contrasts.

Because of these factors the albedo of surfaces in the radar images varies much more than that in optical or IR (infrared) images. The maximum range in optical albedo is about a factor of 10 from the darkest base to the brightest salts. With radar the backscattered energy at high incidence angles is determined by the roughness and can easily change by a factor of 10 between neighbouring geological units. At small incidence angles (less than 30 degrees), a change in surface slope of a few degrees can change the amplitude of the radar by a factor of 2 or more.

More importantly if the conditions are right (depending on the orbit of the satellite) it is possible to detect the phase changes between two or more close orbits of the returned signal and use radar data for topographic mapping. SAR interferometry was used to capture the movements produced by the 1992 earthquake in Landers, California (Massonet, et al, Nature).

SAR DEVELOPMENT HISTORY

The first onboard digital SAR processor for non military applications is believed to be the Macdonald Dettwiler and Associates (MDA) system built for the Canadian Centre for Remote Sensing (CCRS), which is a one look system (Bennett et al., 1980).

Digital techniques are preferred today because with optical processing some of the radiometric information is lost. To produce DEM's (Digital Elevation Models) one needs to preserve the phase, which of course is preserved in the optical processing however it is much more convenient to manipulate this information digitally.

In the early days of SAR the digital technology could not handle the quantity of data in any reasonable time and analogue techniques using optics were used to give real-time processing. These techniques in some of the papers are referred to as optical computing.

The following table is reproduced from a paper by John C. Kirk from the IEEE, international radar conference, 1975.

Table 1: Important milestones in the development of SAR.

Date	Development
1951	Carl Wiley of Goodyear postulates doppler beam-sharpening concept.
1952	University of Illinois demonstrates beam sharpening concept.
1953	Project Wolverine formulates SAR radar development program
1957	Project Michigan produces first SAR imagery using optical correlator.
Mid 1960s	Analog electronic SAR correlation demonstrated in non-real time.
Late 1960s	Digital electronic SAR correlation demonstrated in non-real time.
Early 1970s	Real-time digital SAR demonstrated with motion compensation.

SAR Processor Evolution

The synthetic-aperture-radar permitted the production of an image whose pixel (picture resolution element) dimension in the along-track direction was independent of distance from the radar and could be much smaller than possible for a feasibly small antenna. This represented a major step forward in improved resolution for airborne radars and made feasible the concept of a spaceborne imaging radar with fine resolution.

Production of an image from the signal received, by a synthetic-aperture-radar is a complex task. Most of the early processing of SAR was done by an optical system similar to that used for producing holograms. (Harger, 1970). Development of electronic systems had to wait until the introduction of large scale integrated circuits (Kirk 1975).