ACRES

UPDATE • MAY 1995

ACRES launches Customer Service Guarantee

Paul Trezise

On 1st of May 1995 ACRES launched its Customer Service Guarantee. This initiative is designed to give ACRES distributors and direct customers added confidence in the level of service they can expect. Through improved service to distributors, all customers will benefit.

Over the last few years ACRES has set challenging performance targets in all areas of its production operation. While these targets have sometimes not been achieved, they have undoubtedly served to focus attention on problem areas and to achieve significant improvements. The ACRES Customer Service Guarantee is designed to put the same discipline on the cutting edge of our operation, customer service. The 8 elements of the guarantee are designed to be challenging but achievable – we have had to change the way we operate in a number of areas in order to be confident of meeting these targets.

The ACRES Customer Service Guarantee is not intended to be a static document. We intend to update it at least annually to reflect improvements in our capabilities and the desires of our customers. With this in mind, I would like to point out a couple of items in Version 1 that we anticipate improving upon in future versions.

INSIDE

ORDER DELIVERY

Delivery time for orders will naturally vary due to the overall workload at the time, the level of processing required and whether photographic processing is involved. Many simpler orders routinely are delivered well inside our 10 working day deadline. For example, over 50 percent of orders for products from the archive are delivered within 5 working days. Due to projected improvements in ACRES production management system, we plan to introduce a new arrangement in January 1996. From that time, all order confirmations for ACRES products will include a guaranteed delivery date. This guaranteed delivery date will then form part of the Customer Service Guarantee.

OUR QUALITY GUARANTEE

I have been concerned for some time that there is no comprehensive, clear and accessible set of product specifications for ACRES products. This often makes assessing whether products meet specifications a difficult and subjective exercise. While we have erred on the side of giving the benefit of the doubt to the customer, and will continue to do so, I have initiated a project to develop specifications to the standard required. These specifications will be readily accessible, probably in an on-line form in conjunction with our new digital catalogue initiative. Our Order Confirmation process will then include recognition by both ACRES and its customers of the exact nature of product that is to be delivered.

I would appreciate any feedback on this initiative. I plan to use the ACRES User Reference Group as another means of obtaining independent feedback.

AUSLIG

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Manager's message

Paul Trezise

Our efforts to further improve customer service form the focus of this issue of ACRES Update.

Over the past few years ACRES customers will have undoubtedly perceived a marked improvement in our performance. Through implementing technical and organisational efficiencies, key performance measures have indicated good progress. For example, 92% of orders for products from our archive are currently delivered within 10 working days.

ACRES new Customer Service Guarantee, which is described in detail in this newsletter, commits us to high levels of service to our distributors and direct customers. Our distributors will then be in a position to pass the benefits on to all users of ACRES products. We will be closely monitoring our performance against the 8 elements of the Customer Service Guarantee and reporting back to you on how we shape up.

To mark our new emphasis on customer service ACRES has adopted the new-look logo that features in this issue. The logo and accompanying re-designed stationery are initiatives of ACRES staff Rosalie Booth and Peter Pistoor. The new logo has a more modern look, clearly identifies us with the remote sensing business and sits more comfortably with the corporate styles of AUSLIG and the Department of Administrative Services (DAS).

As always, I welcome feedback on these initiatives or on any other aspect of ACRES performance.

Editorial information

ACRES Update is a quarterly newsletter published to provide ACRES customers and the remote sensing community with up to date information about ACRES products and services, international and national remote sensing news and innovative applications of the technology. Articles from readers are welcome and should be forwarded to the Editor:

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ACRES CUSTOMER SERVICE GUARANTEE

1. HOURS OF SERVICE
If you ring our customer service number (06) 201 4107 during ACRES Standard Working Hours you are guaranteed prompt, personal service. ACRES Standard Working Hours are 0830 to 1700 local Canberra time, Monday to Friday, Canberra public holidays excluded.

2. CATALOGUE SEARCHES
If you need us to perform an ACRES catalogue search, you will receive a faxed copy of the search results within 4 working hours of your request.

3. MAPPING UP
If you require us to 'map up' your data request, you will receive a faxed copy of the results within 24 hours of your request.

4. ORDER CONFIRMATION
We will enter your order into our production system and fax you an Order Confirmation within 4 working hours of receiving your official order.

5. INTERNATIONAL ORDERS
If you place a completed order with us that requires processing by one of our international partners, we will place your order with them by fax the same day, provided we receive your order before 1600.

6. PROGRAMMING REQUESTS
If your order involves a satellite programming request, we will advise you by fax of the success level of the acquisition attempt by 1700 on the 3rd working day following the attempt.

7. ORDER DELIVERY
We deliver over 90% of all orders for data from our archive within 10 working days of Order Confirmation. We can provide faster delivery on specific request.

8. OUR QUALITY GUARANTEE
If you believe the product you receive does not meet standard ACRES product specifications, we will advise you by fax of our assessment within 48 hours of receiving the returned product from you. If we agree that the product does not meet specifications, we will remake your product free of charge and dispatch it to you via courier within 48 hours, or provide a credit note (at your choice).

New ACRES logo

Rosalie Booth

Although the ACRES staff were very possessive of the existing ACRES logo, it was brought up as an issue at the Total Quality Service (TQS) workshop we all attended during late 1994. This logo issue was taken up as a project by one of the TQS groups.

The existing logo was out of date and did not communicate ACRES activities. The new logo needed to suit our image for the 1990's pushing ACRES into the 2000's plus indicate the association with our parent organisation, AUSLIG.

Peggy Bright from Communication Partners was approached to review the logo. One of their designers, Andrew Rooney, drafted a few options with examples showing how they would be implemented on our documents. After a brief discussion ACRES staff agreed, almost unanimously, that the new logo be accepted!

Over the past six months Peter Pistoor, Bob Jones and I have gone through the process of learning the new skills associated with the various design and printing phases for organising the new documentation. We are very pleased with the results, which from now on you will be seeing!

ACRES

THE EARTH'S SURFACE AS SEEN FROM A SENSOR IN SPACE.

RADARSAT

Latest information to hand is that the Canadian RADARSAT satellite is due for launch 20 September 1995, with operational data due to become available early 1996. ACRES is currently in discussion with RADARSAT International (RSI) regarding the possibility of RADARSAT reception in Australia.

New ACRES distributor appointed

Geo Mapping Technologies (GMT) is a Brisbane based company that specialises in the provision of spatial data services, particularly GIS and remote sensing. The company was established by David Moore and Adrya Kovarch in May 1994. David Moore has 8 years experience in the application of GIS and Image Processing, mostly in the fields of ecological modelling, forest mapping and impact assessment. Adrya Kovarch is a qualified geologist specialising in geophysical image processing and the application of GIS for mineral exploration and geological mapping. A third principle, Richard Croome, will join the company in May 1995. Richard has spent the previous three years as manager of the GIS and Remote Sensing department in the Papua New Guinea National Mapping Bureau. Previously Richard worked as a consultant for Dames and Moore Pty Ltd. As a team GMT provides a high level of expertise in spatial modelling and the application of GIS and Remote Sensing technologies in a wide range of fields.

To date, GMT has concentrated its efforts towards the provision of GIS and Image Processing services to the mining industry and has performed a number of innovative projects in this field. This will remain a major activity of the company, the increasing availability and decreasing cost of geophysical and other spatial data sets provides enormous opportunities for the exploration and mining industries in Australia.

GMT is the PNG representative for MicroImages inc., the developers of the TNTmips map and image processing system. However in recognition of the fact that no single GIS or image processing system is suitable for all situations, company policy is to assist clients in selecting the most appropriate system for their specific requirements.

Short and medium term plans include GMT's expansion into PNG and the distribution of spatial data and bundled GIS systems that include software and data. Its recently acquired status as a distributor of ACRES products represents an important advance in this effort. GMT is currently compiling a catalogue of spatial data sets for Australia, PNG and the Asia Pacific region. In future, GMT will promote its multi-disciplinary Remote Sensing and GIS services more generally to include forest inventory, land use mapping, agricultural inventory and monitoring, coastal and near-shore mapping and monitoring, impact assessment and other fields that benefit from these technologies.

For further information contact:

David Moore or Adrya Kovarch

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Fax:	(07) 353 0534
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Address:	6 Nyora Street Everton Hills Brisbane QLD 4053

ACRES performance improves

In the past few years ACRES has made big strides in improving quality and timeliness of service while at the same time:

- the demand for products has increased significantly;
- the complexity of products being requested has increased;
- the product range has been broadened.

If you are one of our regular customers, you would undoubtedly have noticed these improvements in service.

ACRES has a set of performance indicators which are scrutinised closely on a monthly basis. These indicators include delivery times, remakes (returned products), acquisition success rate and systems up-time. Each year we set new targets that stretch performance a little further, if this is feasible. As an incentive, achievement of the performance targets leads to a bonus for the ACRES Contractor, part of which is passed on to ACRES contract staff. This approach has proved extremely successful.

The table below illustrates current performance against some of our key indicators.

Performance Indicator	Target	Achieved 93/94	Achieved 94/95 YTD
Alice Springs Acquisition	>99% of available passes	99.6%	99.5%
System up-time	>95% of working hours	93%	97%
Delivery	>95% in 10 working days	81%	92%
Remake Rate	<1.5% of all products	2.2%	1.5%

EOSAT team visits ACRES

(LEFT TO RIGHT)

1. ROBERT DENIZE, CHIEF ENGINEER ACRES;
2. EDWARD MOWLE, DIRECTOR SPACE SYSTEMS EOSAT;
3. MICKI BARBER, DIRECTOR INTERNATIONAL BUSINESS DEVELOPMENT EOSAT;
4. TIMOTHY PUCKORIUS, DIRECTOR MARKETING & BUSINESS DEVELOPMENT EOSAT;
5. GARY NELSON, DIRECTOR GROUND SYSTEMS EOSAT;
6. PAUL WISE, DIRECTOR OPERATIONS ACRES.

In the last week of March 1995, ACRES hosted a visit by an EOSAT delegation lead by Tim Puckorius, their international marketing director.

Wide ranging discussions were held with the main focus being opportunities arising from the EOSAT partnership with the Indian Space Research Organization. Tim was accompanied by Ed Mowle, Gary Nelson and Micki Barber, the newly appointed EOSAT representative for the Asia Pacific region.

New manufacturing management software installed at ACRES

Computer Associates' MANMAN/X manufacturing software has been installed at ACRES and is currently in the testing phase. MANMAN/X is a comprehensive, order entry, inventory control, production, project control and finance system and facilitates for the users a high level of control over their manufacturing business. ACRES configuration is a customised version of the software running on a DEC Alpha workstation serving a PC network and interfacing to ACRES GICS (production), MQS (cataloguing) and SOSS (satellite programming) systems.

The adaptation of this factory-system manufacturing software to the needs of an earth resources satellite ground station has been undertaken by an ACRES project team working under the Project name 'AMANDA' (ACRES Manufacturing and Distribution Application). The project has been underway for 12 months and is due for completion when the MANMAN/X system goes operational at the beginning of July this year. This will mean the shut down of the present order entry/production system DIPCS which has been operational since the beginning of 1989.

Our customers will be the main beneficiaries of the utilisation of the MANMAN/X software. Greater control of the production queue and prediction of firm product delivery dates to customers will result in a nett improvement of service. Internally, ACRES will gain enhanced knowledge of our business through the flow of costing and performance information from MANMAN/X.

Information on the AMANDA Project can be obtained from the Project Team:

Jenny Weissel
Tel: (06) 201 4108

AUSLIG's quality system accredited

Paul Wise
ACRES Quality Coordinator

The recognition that AUSLIG's products needed to:

- be technically sound;
- be delivered on time and within budget;
- represent value for money; and
- meet or exceed our client's expectations every time;

led to AUSLIG seeking quality accreditation from the international accreditation agency Det Norske Veritas (DNV). DNV is an internationally recognised organisation in the business of providing independent certification. Accreditation signifies AUSLIG's commitment to quality and assures our customers that our products and services conform to the Australian Standard AS/IS0 9002, meet world quality levels, and are consistent.

The AUSLIG quality system has been developed to satisfy the requirements of, and ensure compliance with, the Australian Standard and allows each Office Manager to customise the quality activities for their sphere of operation. The quality model consists of setting up an independent quality system within the business so that the quality system and associated control activities are independent of the day to day management and production.

ACRES has been accredited for over a year and recently underwent a successful periodic check for continued compliance. Adherence to the ACRES system, between external audits, is monitored by ACRES own independent auditors reporting back to the ACRES Quality Coordinator.

However, it is AUSLIG's and ACRES aim not only to maintain compliance with the standard but to use the system developed as a springboard for continuous improvement.

Certification has set up:

- a defined way to do tasks that affect quality;
- a means of assessing where improvement might be focused; and
- a means of measuring the success of any improvement(s).

While all areas of the quality standard affect the customer, the Confirmation Copy and Work Order number have a specific role. The standard ACRES contract with a customer consists of an order form signed by that customer. To ensure that this contract is unambiguous a Confirmation Copy is printed automatically by the system and faxed to the Client seeking their confirmation that the product which the system will now generate is complete, correct and meets their requirements. The system also gives each order a unique Work Order identifier which is provided to the customer and estimated delivery time is also quoted as part of the fax cover sheet.

The Confirmation Copy provides the customer with the opportunity to correct any misinterpretations of their order and the unique Work Order identifier provides the means to track that order. Once a product is made it may undergo a series of checks to ensure that it meets the known requirements. These checks are not exhaustive but are intended to show any major problems in the data or the production process.

At ACRES we now have formally established procedures for:

- the confirmation of an order, establishing our contract with the customer;
- checks on our products;
- focusing customer queries;
- the regeneration of products;
- systems' calibration; and
- handling system hardware and software problems.

In addition, ACRES has its Customer Service Guarantee which sets down the level of service our customers can expect.

New space education underpinned by pilot studies

Space education using locally developed self paced learning software is now a reality following pilot studies involving high school students, university undergraduates and remote sensing specialists. Two new computer aided learning modules covering Air Photo Interpretation and Multispectral Scanner Interpretation have just been released. They complement the earlier *What is Remote Sensing?* and *Spectral Signatures* modules.

Developed by Drs Gail Kelly and Greg Hill and funded by the Australian Key Centre in Land Information Studies (AKCLIS), these two new modules make extensive use of animated computer graphics, aerial photography and satellite imagery. They will be used to show how to apply and make measurements from traditional aerial photos or satellite images.

Two earlier modules created by the same team focussed on developing background concepts and knowledge of Remote Sensing and won awards for excellence from the Australian Institute of Cartographers and the Australian Society for Educational Technology. Previous modules have been sold across the world for use by students and professionals undertaking skills updating.

A unique feature of these new modules involves an innovative games environment which tests the knowledge gained from the classroom. Organised around the theme of a Space Rally, each module offers a choice of three separate game locations and their associated images, to assess different facets of the student's learning. Scores and elapsed times are recorded for entry onto the Rally Honour Board.

Each module can stand alone running on any IBM (or IBM compatible) personal computer with a minimum configuration: DOS environment, 5Mb free hard disk space per module, VGA Graphics card, colour monitor and mouse. Presently the software will not run in a Windows environment.

Five classroom topics and three practical exercises comprise each of the two new modules. The practical exercises are structured around a Remote Sensing Rally theme – each user completes the computer games as accurately and quickly as possible.

In addition to containing interesting instructional techniques in each module, remedial advice is provided to those whose 'rally' performance lags, with informative feedback providing clues to the correct answers.

With each rally conducted in different geographical locations using varying scales of remotely sensed data (ie. photography and scanner images) learning outcomes are assured. Users are exposed to oblique and vertical photography in module 3 while module 4 incorporates 10 and 20 metre SPOT data, and LANDSAT 30 metre data.

Module 3

Air Photo Interpretation
The Air Photo
Air Photo Annotation
Simple Measurements from Air Photos
Radial Displacement
Air Photo Interpretation

Module 4

Multispectral Scanner Interpretation
The Multispectral Scanner
Scanner Platforms
Image Annotation
Image Interpretation
Digital Image Processing

Price is $185 per module with multiple copy discounts available.

For further information contact:

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GPO Box 2434
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Tel: (07) 864 2900
Fax: (07) 229 2659

ERS-2 in orbit

European Space Agency (ESA) Press Release

ERS-2 was successfully launched by Ariane on Flight 72 during the night of Thursday 20/Friday 21 April 1995 at 22h44 Kourou time (01h44 GMT, 03h44 Paris time) and placed into polar orbit 780 km above the Earth.

The telemetry data received some minutes after the launch at ESA's space operations centre (ECOC) in Darmstadt, Germany even before satellite separation from the launcher showed that ERS-2 was in good working order.

During the first two orbits, a sequence of delicate manoeuvres was successfully completed: in particular, deployment of the solar arrays and the various antennas.

Under the overall supervision of ESOC, seven ground stations around the world were involved in this first phase.

Over the following two weeks, the operational team was scheduled to switch on all the satellite's instruments in turn. A first set of images and data will be available shortly after that.

Following a three-month commissioning phase, ERS-2 – which has a lifetime of 30 months – will operate for nine months in tandem with ERS-1, which was launched on 16 July 1991 and is still in good working order.

ColorView® provides satellite image integration for the AutoCAD Desktop Mapping Environment

ColourView® R3.1 is an innovative software solution to incorporating high resolution imagery, such as scanned aerial photos and digital orthophotos, and satellite imagery and digital colour raster maps, as a truly interactive and equal partner to graphics and text in the GIS data model. ColorView® provides access to the 'seamless' GIS image data base combining gray scale, colour, and different spatial resolutions across your region of interest. ColorView® is your imaging software on ramp to the AutoCAD desktop mapping environment.

GIS image mapping is new to many desktop mapping and GIS professionals because of historical technological and financial barriers. Most productive image mapping software ran only on UNIX workstations and the software costs alone were prohibitive. And none of these software products were compatible with the AutoCAD software environment running on PC platforms, the most widely used mapping environment in the world.

Through ColorView® you can integrate imagery and add vision to your CAD representations of the geographic environment. Updating and editing the CAD database and creating new CAD mapping are simplified activities now that you can see the oriented image features. With ColorView®, digital imagery can be incorporated with the CAD map drawings and output to low cost ink jet plotters, thus eliminating much of the post process photo lab costs. With ColorView® you can export geocoded image maps directly to ESRI's ARC\INFO and Arc View GIS product lines.

Whether your source data is digital orthophotos, scanned aerial photography, satellite imagery or color raster maps, ColorView® will certainly make the GIS image mapping component accessible to everyone in your organisation, which is something that can't be said about most other mapping software products. If you are a data supplier, use ColorView® as your vehicle to the AutoCAD desktop mapping arena and increase your sales.

The ColorView software requires AutoCAD DOS R12, a 486 PC platform with a minimum of 8MB of memory (16MB+ provides better performance), sufficient disk space, and a display card capable of 'high color mode' (32K/64K capability which means 16 bit color at 800x600 resolution). Most SVGA cards with 1MB of display memory made within the past year have this 'high color mode' capability.

The ColorView software is very capable of using large image data sets. The digital orthophotos in use are commonly between 20MB and 80MB depending on their pixel resolution and geographic coverage. Image files of this size can be displayed in a few seconds on a 486/66 PC. No other PC software for AutoCAD can match this performance. And no other AutoCAD compatible software supports 16 bits and 24 bit color, and can output gray scale and color image maps with color AutoCAD graphics on low cost ink jet plotters such as the HP650C and Encad Novajet II.

Please contact Geo Products, 124 Primrose Way, Palo Alto, CA 94303, USA, tel/fax (415) 494-6920. Dealer inquires are welcome. ColorView(R) is marketed only by professionals in mapping, photogrammetry, and GIS.

The cost for ColorView is US$2,095.

Nargis 95 – update

Darwin, 18–20 July 1995

The Organising Committee plan to have a preliminary program for NARGIS 95 ready for circulation by late April/early May. There will be approximately 30 paper presentations, as well as a number of poster papers and research bites presented over the three days. Presentations covering a range of topics related to technical issues of remote sensing and GIS integration and analysis, to application issues in the geological and natural resources disciplines, and defence have been submitted.

At the moment it is anticipated that there will also be a few workshops and/or meetings related to remote sensing and GIS held in Darwin either before, after or during the week of NARGIS 95. These are being organised by individuals or groups outside the NARGIS 95 Organising Committee and are yet to be confirmed.

If you would like further information on NARGIS 95 please contact:

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Airborne mineralogy – a new exploration method

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Edited version of paper presented at Horizons of Science Forum University of Technology, Sydney August 1994.

SUMMARY

We are developing new methods to map the distribution of specific minerals associated with mineral deposits, from the air and without reference to the ground at all.

This new, proactive approach to geological remote sensing is based upon sensing reflected light from the ground, not just in six bands or 'colours', as one might do with the LANDSAT satellite system, but in several hundred bands spread across a much wider range of the infrared spectrum, well beyond the range of the human eye. This is termed 'hyperspectral imaging spectrometry'.

Initially, the Mineral Mapping Technologies Group of which I am Group Leader targeted about 20 minerals that commonly form in haloes around gold deposits and which can be used as pointers to hidden mineralisation. More recently we have been working on additional mineral groups likely to be associated with copper, and, more difficult still, lead and zinc deposits. While we cannot sense the actual economic metals themselves we can detect many mineral groups that are formed as alteration products of the host rocks during the formation of the mineral deposit.

If these can be mapped non-invasively and quickly from the air, at an early stage of an exploration program, then considerable savings in time and money may follow. Such a strategy would help direct subsequent, more expensive ground resources, such as geochemical surveys or drilling, to the most prospective areas. These methods are particularly suited to the many remote, frontier regions of the world which are less well mapped than Australia and where an increasing number of our Australian exploration and mining companies are now operating.

For our research we are working with NASA's high altitude AVIRIS (Advanced Visible Infrared Imaging Spectrometer), the Australian GEOSCAN scanner and our own unique airborne, CO2 Laserspectrometer, MIRACO2LAS. If Australian industry is to prosper from these developments we need to develop an operational instrument and put this in the hands of a service company. We have plans for such an instrument, called GIMMS (Geophysically Integrated Mineral Mapping Spectrometer), and a commercialisation strategy for this is being developed.

BACKGROUND

The human visual system sees trees and grass as green because the chlorophyll in the leaves absorbs blue and red light, thus reflecting more green light. Most rocks, soils and minerals, however, do not have strong colours or absorptions, appearing either grey, brown or red, and their curves, over the visible spectral range, are either flat or just gently sloping. This is not enough variation to allow us to identify their mineralogical composition, other than that red rocks are usually iron rich.

If we could see beyond our limited 'visible' region, i.e. to the right of 700 nanometres, we would be astounded by the variety of colour rocks and minerals possessed. This is evident in the large number of different absorption features which are caused by the interaction of light with the different molecules making up these materials and allow us to identify the rock and mineral composition.

In contrast to minerals, the vegetation reflectance curve shows mostly the effects of leaf water. Thus while traditionally environmental and agricultural remote sensing has concentrated on the visible and near infrared wavelength regions for mapping vegetation type and condition, geologists need to have instruments that operate further out in the so-called shortwave infrared (SWIR), between 1 and 2.5 micrometres.

So how do we build an instrument to capture all the variety of different mineral absorption's in this spectral region? The current LANDSAT satellite only senses the reflected light in two bands or colours in the shortwave infrared at 1600 and 2200 nanometres, it is essential to sample the true reflectance curve of the material at enough points to capture all the variation needed to effect discrimination between the materials. Ideally this requires something like 150 points or colour bands, dramatic increase over most current systems. Add to this say another 100 bands in the visible spectrum leads to a device that measures 256 colours for every piece of ground, typically a 10 metre pixel (or picture element) flown over.

This gives rise to the idea of an 'image cube', consisting of two spatial dimensions, equivalent to the latitude and longitude of the scene imaged and made up of say 512 x 512 neighbouring pixels, plus a third dimension representing the 256 different wavelength 'colours'. Given the amount of data that these systems therefore produce requires a quite different approach to interpretation than used with today's LANDSAT-type images, which only have 7 bands or 'colours'.

MINERAL MAPPING RESULTS

Our group, which now numbers seven people, showed in 1983 that mineral identification from the air was possible using these 'hyperspectral' concepts. Since then we have been working, albeit with meagre resources, to further our knowledge in this area, gathering databases of the reflectance characteristics of many minerals and rocks and devising computer software methods to convert the radiation collected by an aircraft system into reflectances to match pure reference spectra stored in a computer. The problem here is that the radiation initially sensed contains a lot of unwanted signal from the atmosphere, the instrument and the surrounding aircraft, in addition to the mineralogical reflectance, which is what we are really after.

In addition to the initial four mineral spectra developed we now have a list of some 30 different minerals we know how to sense from the air. Today's challenge is getting the investment to build operational versions of these instruments to provide a commercial service to exploration companies wanting to use this technology.

Only a few systems capable of doing this sort of mineral identification exist today. One we have used is NASA's research instrument AVIRIS (Airborne Visible Infrared Imaging Spectrometer) that flies in a rather expensive, high-altitude, U2 aircraft. With this sensor one of our group, Dr Joe Boardman, has been able to correct the data for atmospheric effects and produce both a mineralogical map and relectance spectra that match our computer reference libraries of minerals, all without reference to the ground. Clearly in some cases this could bring dramatic improvements to mapping and the selection of targets for further ground study (e.g. geochemistry or drilling), particularly if this could be done over large regions at very early stages in an exploration program.

We have also done similar mineralogical mapping with the Australian-built Geoscan scanner, though this instrument only samples the spectrum in 24 bands compared to AVIRIS's 224 bands. There are clearly trade-offs in building these sorts of instruments: the more bands and more sensitivity required the more expensive the instrument is to build and operate. In our view an operational hyperspectral imaging system would be some compromise between these two limits.

CSIRO'S MIRACO^{2}LAS (MID INFRARED CO^2 LASER SPECTROMETER)

If we sense even further out in the infrared near 11000 nanometres, further still than seen even by NASA's AVIRIS, we can sense another group of important rock forming minerals, the silicates. Working in this region is doubly hard as the technology is very new and there is little reflected sunlight left to work with. Thus people normally use the energy emitted by the ground rather than reflected from it.

Results using this method have been only marginally successful in other than very arid areas, like Death Valley in Nevada. Over the past six years, however, we have taken a novel approach and built a unique airborne spectrometer that illuminates the ground with our own sun, a carbon dioxide laser. This instrument, called MIRACO^{2}LAS, measures the laser signal reflected from the ground after it has been differentially absorbed by the minerals present.

We do this from a mere 500 metres above the ground and get back a 100 point spectrum that allows us to identify such minerals as quartz, garnet, feldspar and dolomite. Many of these cannot be adequately identified in the previously mentioned, shortwave infrared used by the AVIRIS instrument.

THE FUTURE

Despite the exciting mineral identification results alluded to above our real objective is to work towards operational solutions that a contracting company would use to run a service business for the exploration industry. Thus our future requires us to find external collaborators and investors to help us translate this exciting, strategic but prototype airborne mineral mapping capability in operational reality. We believe that there are great advantages to be gained by Australian industry exploring in this country or overseas from aircraft-based solutions that can be developed for niche markets, rather than wait for some overseas agency or country to place such technology in space, which is a much longer, more expensive, often compromise route.

Space Office announces satellite project shortlist

The Australian Space Office is proposing to provide a grant of up to $5 million for the construction of an Australian 'small satellite'. They have recently announced the shortlist of candidates for the submission of detailed proposals. Three of the shortlisted candidates are telecommunications proposals and three are remote sensing. The remote sensing projects selected are:

Remote sensing satellite for marine and maritime monitoring and meteorological data collection.
Proposed by: British Aerospace, Aeroastro, Australian Space Centre for Signal Processing, Telstra and Kennett International Technology.

AMMSAT–1 (Australian Minerals Mapping Satellite).
Proposed by: CSIRO, ACRES, AMIRA, Auspace, Earth Resource Mapping, Integrated Spectronics, Geoimage and Technical and Field Surveys; and

Operation multi-spectral, high spatial resolution, satellite sensor.
Proposed by: Specterra Systems and the Boeing Company.

1995 Australia Prize – scientists show the earth in new light

Outstanding achievements by Australians in the field of remote sensing recently received special recognition with the announcement by the Federal Minister for Science, Senator Peter Cook, of winners of the 1995 Australia Prize.

The $300,000 Australia Prize, awarded for international scientific achievement, has played a major role in establishing Australia as a real player in the world science community.

Three scientists who have used satellite images to revolutionise the search for minerals in Australia's deeply weathered landscapes, and an engineer whose inventions have brought new precision to weather forecasting, were presented with their awards at a celebration dinner at Parliament House, Canberra on 10th April by Senator Cook.

Dr Ken McCracken, founding chief of the CSIRO's Division of Mineral Physics, and his colleagues, Dr Andrew Green and Dr Jonathan Huntington, of the Division of Exploration and Mining, will share the award with Dr Richard Moore, Emeritus Professor of Electrical and Computer Engineering at the University of Kansas.

The $300,000 Australia Prize is an international award for researchers who have made outstanding contributions to science and technology promoting human welfare. The research category changes each year – this year's prize honours achievement in the field of remote sensing.

Senator Cook said Dr McCracken, Dr Green and Dr Huntington were an outstanding research team which had pioneered satellite-based remote sensing in Australia.

"Dr McCracken, an astronomer, Dr Green, a physical chemist, and Dr Huntington a geologist specialising in air-photo interpretation, have brought complementary skills to a new field of research," he said.

"In the face of initial scepticism, they have persuaded Australian mineral companies that remote sensing could be a powerful new tool for mineral exploration."

Senator Cook said that while the CSIRO group had focused on mineral exploration, its work had provided the springboard for Australia to extend its use of satellite imagery to include:

- monitoring the development and health of crops,
- mapping ecosystems and
- monitoring overgrazing, erosion, flooding and fire damage.

"The strong support given by Australian industry to remote sensing as a consequence of the team's work has been a big factor in the Federal Government deciding to enter a joint venture with the United Kingdom to construct the infrared remote-sensing instrument on the European satellites ERS-1 and ERS-2," he said.

"This joint venture has allowed the Australian aerospace industry to obtain first-hand experience in satellite manufacture."

"The group's research, supported in part by funding through the Australian Minerals Industry Research Association, provides a fine example of industry and government collaboration."

"This will have enormous spillover effects in other areas of public national importance," he said.

The fourth researcher honoured by this year's Australia Prize, Professor Richard Moore, works in a branch of space-based remote sensing which uses microwave radar systems to observe and explore the Earth's land surfaces and oceans.

Professor Moore devised the radar scatterometer/radiometer flown on the US Skylab space station in 1973. This was the first radar to fly in space and observe the earth.

More recently, he and a colleague, Professor Willard Peirson of New York University, conceived the use of a radar in space to measure the winds over the ocean surface. Dr Moore coined the name 'scatterometer' for this type of radar.

Scatterometers already flying, and others due for launch soon, should lead to big improvements in weather and wave forecasting over the oceans.

As early as 1965, Professor Moore had conceived the idea of a Synthetic Aperture Radar (SAR). These radars can monitor soil moisture, crop conditions, forest health, and ocean wave patterns.

Senator Cook said that between them, the four winners of this year's Australia Prize, had made enormous contributions to human welfare, by literally showing the Earth in a new light.

"The Australia prize plays a valuable role in highlighting the importance of science and technology to Australia's development as a nation," he said.

1995 AUSTRALIA PRIZE – WINNER'S PROFILES

Dr Ken McCracken

KEN MCCRAKEN AT PRIZE CEREMONY WITH DAVID CARTWRIGHT (DSTO)

Dr Ken McCraken, 61, was founding chief of the CSIRO Division of Mineral Physics in Sydney, and Director of the CSIRO Office of Space Science and applications, until his retirement in 1989. He now combines life as a beef grazier with work as a private consultant to the minerals exploration industry, working from his home at 'Jellore', near Bowral in NSW.

Dr McCraken is a fellow of both the Australian Academy of Science and of the Australian Academy of Technological Sciences and Engineering.

As a post-doctoral fellow he became involved in space science in 1959 at the Massachusetts Institute of Technology, and later at the University of Texas, designing instruments that flew on nine US space probes.

His research for NASA was instrumental in protecting US astronauts from exposure to possibly fatal doses of cosmic radiation from enormous explosions – called flares – on the Sun.

As Professor of Physics at Adelaide University between 1966 and 1969, Dr McCracken led a team that pioneered X-ray astronomy of the southern sky with instruments launched on Skylark rockets from the Woomera Rocket Range.

In 1970, Dr McCracken was appointed chief of the CSIRO's new Division of Mineral Physics in Sydney. His first official task was to attend a research meeting in Canberra which was preparing Australia's response to a NASA invitation to make use of satellite images of Australia obtained by it recently launched Earth Resources Technology Satellite (later renamed LANDSAT).

"I knew nothing about remote sensing, but I had been building satellites for 15 years and knew of the enormous revolution satellites had brought to communications," he said.

"It was clear to me that if somebody could put an eye into a satellite orbiting 800 kilometres above the earth, it would be another sea change in technology."

"I was also attracted by the physics involved in satellite images – it seemed to me that it could overcome some of the limitations f conventional aerial photography."

Dr McCraken made two key appointments during the next four years: Australian spectroscopist Dr Andrew Green in 1972, and British-born geologist and air-photo expert Dr John Huntington in 1974.

The division's first satellite data came in the form of third or fourth-generation photographic negatives, which had lost much of their original detail. Dr McCraken and Dr Green asked NASA for computer tapes of the original digital data from which the images had been generated.

After three years of development, the CSIRO group was ready to apply its findings to mineral exploration, but its initial submission for funding from the Australian Minerals Industry. Research Association (AMIRA) was rejected – the industry saw little virtue in the new technology. A year later, in 1977, a revised submission met with enthusiastic support, and an AMIRA research contract marked the beginning of one of Australia's most durable and successful industrial research collaborations.

By 1982 NASA had greatly improved the technology of its LANDSAT satellite, but the Australian Government decided against modifying the Australian satellite reception station to take advantage of the improvements.

Dr McCraken proposed that the necessary modifications should be provided by Australian researchers, and succeeded in gaining financial support from Australian industry and research laboratories to allow the project to proceed.

His colleague Dr Andy Green led the team that designed and manufactured the reception equipment. It provided Australian industry and research laboratories with the highest-quality remote sensing data available – and an important competitive advantage in the field. The value of satellite images often depends on their immediacy; the tapes from NASA were often several months old before the CSIRO group could process them.

In the early 1980's Dr McCracken became concerned that Australia's space industry was fragmented and lacking direction, and had already missed out on commercial opportunities that had been seized by other Western nations.

He convinced the CSIRO Executive to establish the CSIRO Office of Space Science and Application (COSSA) to provide a focus for space-related research in the organisation – COSSA's main focus was still remote sensing.

Soon after, the Australian Government established the Australian Space Board to coordinate Australia's space program. Dr McCracken was appointed as a board member, and later became chairman of its remote sensing committee.

Remote sensing has since become a major component of the Australian space program, and Australia has invested $17 million in a joint venture with the UK to build remote-sensing instruments for the European satellites ERS-1 and 2.

Apart from its application to mineral application, remote sensing has become an indispensable tool for Australian agencies involved in oceanographic and climate-change research, or in monitoring agriculture, forestry, water pollution and desertification.

In addition to his interest in remote sensing, Dr McCraken has played a key role in the development of a number of forms of geophysics which allow Australian minerals explorers to detect deeply buried mineral deposits.

Reflecting on a research career that earned him the 1995 Australia Price, Dr McCraken said back in the 1970s we asked ourselves what the minerals industry needed that it didn't know it needed yet.

"Scientists of the world are the custodians of the knowledge of things that are about to happen," he said.

"I had been a part of the revolution in digital electronics, and used some of the world's first big computers in 1959. Both had an enormous impact on society and industry."

"We took a calculated gamble in predicting that, for very similar reasons, the satellite revolution would be of great benefit to the minerals exploration industry, at a time when there was probably only one person with any expertise in the field working within industry."

Dr McCracken said the CSIRO administration of the 1970s must take some of the credit for the award of the Australia Prize to his team.

"They set the broad research goals and stipulated that I and my colleagues should develop the techniques and instruments the industry would need 10 years into the future," he said.

"At first, much of what we did was against the industry wisdom of the day, yet after half a decade, the industry was using virtually all our research results and making a major financial contribution to the research program."

"Because Australia was among the first countries to develop these new techniques, the minerals exploration industry gained an enormous competitive advantage over the rest of the world."

"It would not have done so if it had been forced to import the technology, or if research had started three years later – in practical research, the early bird really does get the one and only worm"

"Anticipating the technologies of the future is a very tricky business ànd very few people have the ability to do so. I was lucky to answer to a very small, stable group of scientific managers – leaders, really – who possessed that rare skill and who had the confidence to back young turks like me."

"I believe Australia has scientists today who are just as good and who are thinking abut what their client industries may be doing in the future. Some will be right, others will be wrong, but Australia has to accept this as a cost of progress. Industries must also be prepared to take a chance and invest in their own future."

"Research is the key to the competitive industries of the future. The key to our future is that the very best of our research minds should be harnessed to deliver what our industries will need ten years hence. The challenge for our research managers is to know what to back when everyone seems to disagree with them."

Dr Andrew Green

Since 1992 Dr Andrew Green, 48, has been director of the Co-operative Research Centre for Australian Mineral Exploration Technologies.

He began his remote sensing career as a CSIRO post-doctoral researcher at Stanford University's Department of Earth Sciences. His PhD training as a spectroscopist at the University of WA proved an ideal grounding for his subsequent involvement in a new, space-based form of spectroscopy: potential mineral deposits can be identified in LANDSAT images through their distinctive spectral signatures at infra-red and visible wavelengths.

When he joined the CSIRO Division of Mineral Physics in 1972, Dr Green began developing computer software to analyse digital images from NASA's first remote-sensing satellite, ERTS-1 (later to renamed LANDSAT-1).

Because LANDSAT's visible light and infra-red sensors were designed to optimise images of the green, forested landscapes of the northern hemisphere, they produced poor quality images of Australia's brown, sparsely vegetated landscapes. Dr Green devised one of the world's first image processing facilities to recover information hidden by background 'noise', revealing previously hidden detail.

In the late 1970's on the basis of these research results, Dr Green then defined the specifications for, the helped establish, Australia's reception facility for the LANDSAT multi-spectral scanner (MSS).

"The availability of these enhanced images made people realise the potential benefits of LANDSAT data," Dr Green said.

"Other projects flowed from our success, which produced large amounts of quality data."

Dr Green said that once potential users – including the minerals industry, agriculture and environment protection agencies – began to use LANDSAT images, it generated a strong demand for Australia to install its own receiving station to obtain data from NASA's new LANDSAT thematic mapper.

"The work is still fascinating because of the constant challenge to detect the very weakly expressed characteristics of mineralisation which tend to be swamped by other, more dominant features in a satellite image."

"I think of it as a signal-to-noise problem: the geological targets of interest are very hard to recognise against a background of paddock boundaries, fire scars, topographic features and other natural and man-made variability."

"Our success has been based on our ability to find new ways to express and enhance subtle geological features present in satellite data."

More recently, Dr Green and Dr Huntington have been involved in the development of the world's first pulsed-laser profiling spectrometer. The instrument, carried by a low-flying aircraft, can identify silicate and carbonate minerals that make up most rocks, and help detect patterns that may indicate mineral deposits.

Dr Jonathan Huntington

JON HUNTINGTON (RIGHT) WITH PROFESSOR JOHN RICHARDS (ADFA)

Dr Jonathan Huntington, 50, is a geologist and senior principal research scientist with the CSIRO Division of Exploration and Mining. Born and educated in England, he joined the CSIRO Division of Mineral Physics in 1974 after working as remote sensing expert with International Nickel Australia Ltd.

In 1972, Dr Huntington became involved in the early work to exploit images from NASA's LANDSAT satellites for mineral exploration and coal extraction. The later application included pioneering work interpreting LANDSAT data to reveal the surface expression of major fault systems intersecting coal seams in several NSW collieries and causing hazardous working conditions and loss of production.

In the early 1980s he spent three years trying to persuade the Commonwealth Government of the benefits of Australia building its own ground station to receive LANDSAT data. When support was not forthcoming, he played a key role in securing industry support to develop the facility.

"In some respects, the same scepticism and ignorance of the true value of this technology to end-users, as opposed to a space industry, per se, applies in official circles today, and has been responsible for Australia's failure so far to fully capitalise on space-based sensing technologies," Dr Huntington said.

"Our remote-sensing group in CSIRO consciously avoided direct involvement in the space industry. While others were trying to establish a space industry without really thinking about how to use the technology, we were more interested in the end uses, rather than the means – we focused on solving the minerals exploration industry's problems using remote sensing."

"Our philosophy has been very much one of studying the industry problem and being proactive in its solution by developing the most appropriate technology, rather than waiting for someone else to develop something that may, or may not, be applicable to exploration."

"Despite enormous use of LANDSAT and SPOT data by the mining and exploration industry, no space-based sensing system has ever been specifically developed for the needs of this industry. So the benefit has been basically fortuitous."

"We think it is long overdue for Australia to take a lead in tailoring technologies to the needs of specific users, without the compromises in performance that result from a system that tries to be all things to all men."

"The reality is that Australia couldn't afford a space program costing hundreds of millions of dollars. But that doesn't mean we can't obtain a huge competitive advantage by being more subtle and focusing on specific technologies capable of delivering benefit to Australian users. We should aim for excellence in niche areas rather than spreading our efforts too thinly."

"Clearly, one of the things that has worked in our favour is that the minerals exploration industry has been on our side almost from the beginning. We're very grateful for this."

"But the benefit has been two-way. The close relationship we have developed through collaborative, consortium research with this industry (through the Australian Minerals Industry Research Association) has led to our research results being rapidly implemented."

"I really believe this is a model for research support and interaction that could be very profitably followed for better application of remote sensing to renewable resources issues in this country."

Dr Huntington said the fact that Australia previously could not afford to develop its own space-based sensing industry had led him and his colleagues to develop remote-sensing technologies that could be fitted into low-flying aircraft.

"These can be more versatile, allow you to test out new concepts, develop credibility and can directly involve your customers in the process, at a fraction of the cost of space borne systems. If you do this successfully then you may later develop the credibility and experience to develop space borne systems."

Australia now led the world in airborne geophysical survey techniques, while the Australian mining industry had become a global player, spending some 40 per cent of its exploration funds in exploring virgin ground overseas.

The results of the team's research, applied from airborne platforms, had the potential to increase the international competitiveness of many Australian companies.

"Remote-sensing provides its greatest benefits to exploration of virgin areas, as opposed to old established mining districts like those in some parts of Australia."

In 1980, he and his colleagues had concluded that airborne spectroscopy was the future direction of remote sensing, and had embarked on a 10-year project to develop airborne spectrometers that could simultaneously map at least 20 minerals. The relative abundance of these clay, silicate and carbonate minerals could signal the presence of buried mineral deposits.

This had been achieved using the world's first profiling reflectance spectrometer in the early 1980s and had, in turn, led to a new-generation of Australian airborne spectrometers, already in advanced stage of development, that could identify some 50 different minerals simultaneously.

These developments were part of the team's continuing commercialisation strategy, which was aimed at allowing Australian companies to gain operational benefits from their research.

Dr Huntington described remote sensing as 'very much a hybrid subject'.

"I have been fortunate to have had such a long and successful association with Dr McCracken and Dr Green and other members of the research teams they built up."

"It has been enormous fun doing the research. I enjoy working beside scientists whose science is foreign to me, but who need me as much as I need them. I get an enormous charge out of that."

Professor Richard K. Moore

Dr Richard Moore, Professor Emeritus of Computer and Electrical Engineering at the University of Kansas, was a pioneer in the filed of microwave-based satellite remote sensing, a prolific inventor of new remote-sensing devices that have helped revolutionise mapping and monitoring of the Earth's surface. He is also a major contributor to understanding how microwave signals vary with surface characteristics.

In 1957, before the US had even launched its first satellite, Prof Moore co-authored a research paper that described how a pulsed radar could be used as an altimeter to map the Earth's topography from orbit.

By 1963 the US was preparing to launch the first generation of communications and weather satellites; Prof Moore joined a NASA team which investigated how short wavelength (microwave) radar systems could be used for satellite-based remote sensing. Microwave systems offered at least one significant advantage over visible light and infra-red sensing systems: they could see the Earth's surface by day or night, and through dense cloud.

Prof Moore recognised the potential of synthetic aperture radar (SAR) for earth observation from space. Synthetic aperture radar employs a microwave beam that is scanned across the Earth's surface from orbit – or from a low-flying aircraft. The motion of the vehicle carrying the SAR produces images of the terrain below in a long, wide swathe. SARs flown on aircraft, unmanned spacecraft and the Space Shuttle have provided high-resolution, stereoscopic images of the Earth's land surfaces.

As early as 1965 Prof Moore and several colleagues put to NASA a proposal for a multi band orbiting SAR to study and map the Earth's surface at many different wavelengths. But their visionary project was rejected.

"In the 1960s the Moon was the name of the game," he said.

NASA had the idea of putting sophisticated satellites into orbit around the Moon to study its surface, but we were more interested in doing the same thing for the Earth. We had couched our proposal in terms of testing all these new instruments in Earth orbit, before sending similar instruments to the Moon.

The concept was finally realised 29 years later with the launch of the Space Shuttle carrying the SIR-C synthetic aperture radar system. SARs had flown previously on unmanned spacecraft, and Professor Moore was involved in some way with all but those from Russia. These included Seasat (US), ERS-1 (European Space Agency), and JERS-1 (Japan), as well as single-band instruments (SIR-A and SIR-B) on earlier Space Shuttle flights.

In 1965 Prof Moore coined the name ëscatterometer' for a radar sensor that could measure how the Earth's surface scattered a microwave beam looking down on the Earth from space; the scattering characteristics reveal detail of the structure and composition of the surface, including phenomena such as waves on the surface of the ocean.

Prof Moore found that ripples on the ocean's surface scattered microwave beams in patterns which could be interpreted to reveal both the strength and direction of the prevailing winds. Radiometers, scatterometers, and SARs also monitor sea ice cover in polar regions; ice is a natural insulator, and in ocean areas free of ice, or with only a thin cover, heat transfer to the atmosphere can be a hundred times more rapid that in ice-covered areas, resulting in significant changes in the earth's weather.

NASA began launching weather satellites equipped with radiometers in the early 1970s. NASA also had a scatterometer on the Seasat spacecraft, and European Space Agency has one on its ERS-1. They have helped revolutionise weather forecasting by mapping wind fields over remote oceanic regions where weather data is sparse – the technique has proved particularly valuable over tropical oceans, which are often obscured by dense cumulus cloud. SARs can also detect natural or man-made slicks on the ocean surface.

In the early 1970s Prof Moore helped develop a combined radiometer /scatterometer, called RADSCAT, for NASA. It was designed to explore the best ways to monitor the ocean's surface. The instrument was test-flown over the ocean on a C-130 Starlifter aircraft, and also on NASA's Skylab.

Because microwave radars operate at wavelengths beyond the visible and infra-red spectrum, they ësee' aspects of the Earth's surface that are invisible at these wavelengths. This was dramatically demonstrated when RADSCAT aboard SEASAT scanned the Sahara Desert.

Because the sand was extremely low in moisture, the dunes became transparent to the radar, and instead of producing images of the desert's sandy surface, Seasat revealed ancient river beds below the desert. Subsequently, SARs aboard the Space Shuttle produced large-scale images of ancient rivers beneath the Sahara, and beneath the deserts of north-western Australia.

Prof Moore's invention of the microwave scatterometer and promotion of spaceborne SAR has allowed researchers to monitor soil moisture levels from space, as an aid to weather forecasting. Crops also scatter microwave radar beams in distinctive ways that vary with the moisture content and architecture of their foliage. To study crops, SAR is needed to distinguish between the different fields.

These applications depend on an understanding of how microwave sensors ësee' the Earth's surface. Since the early 1970s, Prof Moore and his faculty colleagues and students have conducted extensive experiments to determine how land and ocean surfaces, and agricultural landscapes, scatter and re-radiate microwave radiation. This information has been invaluable to agriculture, environment and resource managers, and weather forecasters.

This year NASA will launch a Canadian satellite carrying a sophisticated new synthetic-aperture radar, capable of more frequent imaging because of another of Prof. Moore's inventions, the SCANSAR. With its capacity to monitor any rapid change in features on the Earth's surface, it is expected to become one of the world's most powerful tools for monitoring global resources.

Still active in research, Prof Moore is now working on another microwave sensor to improve weather forecasting – it will monitor the dynamics of weather systems by observing rain and other cloud particles in motion.

Today, remote-sensing instruments designed, developed, and promoted by Prof Moore are used worldwide for:

- Monitoring and mapping forests in remote or inaccessible regions.
- Monitoring oceanic phenomena that influence weather.
- Identifying hurricanes, typhoons and cyclones in the early stages of formation.
- Collecting data on global weather and climate trends.
- Mapping and imaging cloud-covered landscapes.
- Synoptic-scale monitoring of soil-moisture levels that influence crop yields.
- Managing and monitoring land and water resources.
- Monitoring sea and lake ice.

Landsat-5 status report from EOSAT

March 1995

The Landsat-5 satellite, which was launched over eleven years ago in March on 1984, continues to provide high quality multispectral imagery to its global network of international receiving stations. EOSAT continues to forecast an operational capability of Landsat-5 out to the 1997–1998 time frame.

There are no known Landsat-5 spacecraft bus or payload near-term performance trends that would impact nominal operations. Both the thematic mapper (TM) and the multispectral scanner (MSS) instruments have experienced only minor degradation over their mission life and they both continue to operate nominally. As previously reported, TM bumper wear has resulted in line lengthening. Recent analysis has indicated that the Landsat-5 TM line lengthening trend has decreased slightly to the point where the growth rate is now less than 10 minor frames a year. Based on our experience, EOSAT believes that this effect can be routinely handled by adjusting the data collection window in the image processing software at the individual Landsat receiving stations. The x-band communications subsystem continues to provide reliable image data downlink service. Analysis of the Redundant x-band travelling wave tube amplifier (TWTA) helix current indicates a favourable trend consistent with the 1997–1998 operational capability forecast.

According to past practice, EOSAT continues to maintain the Landsat-5 spacecraft on the Landsat World Reference System (WRS) by performing small, periodic orbit altitude adjust manoeuvres. Groundtrack error, as determined at the equator, is controlled to be less than +/- 10KM. Currently, with NOAA's concurrence, we do not plan to perform a Landsat-5 orbit inclination adjust manoeuvre to change the descending node equator crossing time. EOSAT believes that performing such a manoeuvre is unnecessary at this time. To date our analysis reveals no operational impact or performance degradation to Landsat-5 as the crossing time continues to drift earlier. NOAA and EOSAT intend to re-visit the Landsat-5 inclination manoeuvre trade-offs in October 1995. For reference, the Landsat-5 descending node (equator) crossing time is currently approximately 09:22 mean local sum time (MLST). Our analysis indicates that the crossing time will drift to 09:15 MLST by September 1995 and to 09:00 MLST May 1995. As usual, EOSAT will keep all users appraised of any changes in the Landsat-5 status.

Japanese delegation visits Australia

Paul Wise

On 24th March 1995 a delegation from ERSDAC/MITI visited Canberra for discussions on JERS developments and future Japanese initiatives in remote sensing. A meeting with Australian delegates was held at CSIRO Office of Space Science Applications (COSSA). Japanese delegates included:

ERSDAC/Ministry of International Trade and Industry, JAPAN

Dr. Yasushi Yamaguchi
Dr. Yoshinori Miyazaki
Geological Survey of Japan

Mr. Yoshiaki Nemoto
Japanese Resources Observation System Organisation (JAROS)

Mr. Genya Saito
National Institute of Agro-Environment Sciences

Mr. Itoshi Kohno
Earth Remote Sensing Data Analysis Centre (ERSDAC)

AIMS OF THE MEETING

The scientists provided an overview of the results of their research using JERS-1 and ERS-1 SAR data.

OVERVIEW OF JERS-1 RESULTS

Dr. Y. Yamaguchi

The Japanese Earth Resources Satellite (JERS-1) launched on 11th February 1992, carries both a Synthetic Aperture Radar (SAR) and an Optical Sensor (OPS), and has obtained more than 140,000 SAR scenes and 90,000 OPS scenes.

The SAR is acquiring surface images through cloud cover and is thus quite useful for areas such as tropical rainforest and Arctic terrain. The JERS-1 SAR images taken with an off-nadir angle of 35 degrees have much smaller topographic distortion compared with the imagery acquired by the ESA ERS-1 SAR whose off-nadir angle is 23 degrees. As the L-band microwaves of the JERS-1 SAR can penetrate leaves and are scattered at trunks and branches it is possible to distinguish forests from grasslands and agricultural fields. Lithologic type can be discriminated and geologic structures detected in the SAR imagery by conventional photo-geologic interpretation.

The OPS has three spectral bands in the very near infra red region (VNIR), four bands in the short wave infra red (SWIR) region and one forward viewing band for along-track stereo capability with 0.3 base-height ratio. The OPS images are useful to discriminate rock types such as hydrothermal alteration zones and carbonate rocks.

The height precision of OPS digital elevation model (DEM) data ranges from 40m to 80m which corresponds to topographic maps at 1:500,000 to 1:200,000 scale. The height error of limited SAR DEMs is less than 10m.

SAR APPLICATION FOR NATURAL HAZARD MITIGATION WITH INTERFEROMETRY BY

Dr. Y. Miyazaki

Future SAR planning is partially dedicated to the application of Natural Hazard Mitigation with Interferometry techniques. More than 5000 people were killed during the recent Kobe earthquake in Japan, and satellite monitoring is gaining importance in the field of crustal movement.

It is also very important to observe and monitor the small surface magma movement at depth, and these precursory deformation data can be used to assess and mitigate natural hazards. A number of activities are in progress at the Geological Survey of Japan in relation to United Nations International Decade of Natural Disaster Reduction (IDNDR) program, and a volcanic hazard mitigation program is one of those programs.

It is possible to use multiple synthetic aperture radar (SAR) images to detect very small elevation changes over large areas. Unlike conventional surveying techniques there is no need to install ground stations and SAR techniques work at night and through clouds/gas or precipitation.

SAR DATA APPLICATION TO AGRICULTURE

Mr. G. Saito

A study of SAR data application to agriculture using JERS-1 and ERS-1 SAR images was made at the National Institute of Agro-Environment Sciences, Hokkaido Agriculture Experimental Station.

The comparison between JERS-1 and ERS-1 SAR images showed that JERS-1 SAR (L-band SAR) microwaves pass through agricultural plants and then scatter at the land surface while ERS-1 SAR (C-band SAR) microwaves scatter at agricultural plants. Specific information about agricultural plants cannot be obtained, but useful information about the agricultural environment is available, using JERS-1 SAR data. The ERS-1 SAR can directly measure agricultural crops, but the data is contaminated by information about soil surface and topographical conditions.

SAR DATA APPLICATION TO MINERAL EXPLORATION IN RAIN FOREST

Mr. I. Kohno

In the rain forest areas, there is sparse geographical and geological information because of its poor accessibility. Satellite remotely sensed data is a valid and efficient information source increasing the understanding of these areas. Data acquired by JERS-1 in Rondonia, Brazil, and in Sabah, Malaysia, were used and evaluated in mineral exploration.

The following are the main subjects of this study:

(a) Extraction of geologic information from different seasonal SAR data.

(b) Data integration of SAR and other data source for geologic interpretation.

(c) Extraction of granite bodies and geologic structure related to tin mineralization from JERS-1 SAR data.

The rainy season image shows detailed drainage and topographical differences. The tonal changes which might show areas of different forest types were obvious on the dry season image.

It was concluded that SAR combined with geophysical or geochemical data can be useful for understanding the relationship between anomalies and geology.

Cooperative Research Centre for Sensor Signal and Information Processing

CSSIP announces its extended continuing education program in 1995.

COURSES AND WORKSHOPS

(Dates from April onwards are provisional)

Estimation Theory (in Melbourne)	23–25 May
Introduction to MATLAB for Signal Processing	13–15 June
Digital Image Processing	20–22 June
Introductory Signal Processing	7–9 August
Advanced Signal Processing	10–11 August
Neural Networks	19–21 September
Multisensor Data Fusion	10–12 October

All events in Adelaide unless otherwise stated. Further details will be circulated about 6 weeks before each event. Course fees vary. Discounts usually available for employees and students of CSSIP partners.

POSTGRADUATE QUALIFICATIONS

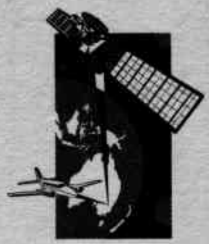
Many of the courses listed above can be credited towards the Master of Engineering in Signal Processing and the Graduate Certificate of Engineering in Signal Processing in the University of South Australia.

Further details available from:

Mary Ayre
Education Coordinator, CSSIP
SPRI Building
Technology Park Adelaide
South Australia 5095
Tel: (08) 302 3928
Fax: (08) 302 3124
Email: mary.ayre@cssip.edu.au

8th Australasian Remote Sensing Conference

CALL FOR PAPERS AND EXPRESSIONS OF INTEREST



8th Australasian Remote Sensing Conference

The 8th Australasian Remote Sensing Conference is the premier event in the region addressing issues in remote sensing, photogrammetry and related fields. The event is held under the auspices of the Remote Sensing and Photogrammetry Association of Australasia Ltd and will for the first time be held in the National Capital, Canberra under the banner of SPACEWORKS 96. SPACEWORKS 96 will incorporate the 8th ARSC, the Space Industry Development Conference and the Space Engineering Symposium and will include a major international Space Exhibition.

The event is to be held at the National Convention Centre in Canberra in the last week of March 1996 (perfect Autumn weather) with workshops, short courses and user group meetings on Monday and Tuesday 25th and 26th March, the Technical Exhibition from Tuesday 26th to Friday 29th March and the conference sessions on the Wednesday to Friday. An opening cocktail party and a gala dinner in the Great Hall of Parliament House are planned as part of the attractions for the event. Internationally renowned speakers in the space industry and in specialist remote sensing fields will be invited to provide keynote addresses.

Call for Papers

Prospective authors of contributed papers for 8ARSC are invited to submit abstracts to the organisers. The theme of the conference is "What Works, What's New" thus concentrating on proven applications as well as new developments in the fields of airborne and spaceborne remote sensing and photogrammetry. Sub themes for the conference include:

What Works	
Applications	Agriculture Local government Water resources and Environment Meteorology and climatology Regional and global issues Natural policy directions Geoscience and Forestry Natural Disasters Valuation and Insurance
Media and communications	
Commercial practices and issues	
Legal issues	

What's New	
Hardware	Satellite platforms and sensors Airborne platforms and sensors Radar
Software	Image processing techniques Softcopy photogrammetry
Products	High resolution and Hyperspectral data
Regional and global issues	
Natural policy directions	

Abstracts should be no more than 300 words and include authors names and contact details (address, telephone, fax and email if possible). The programme will cater for both presented papers and poster papers. The abstract should identify the preferred presentation method. Abstracts are due by 21st June 1995 and should be forwarded to the ACTS address below. Authors will be notified of their acceptance by 31st July and full papers will be due by 15th November. All papers will be published in the conference Proceedings to be provided to all delegates at the conference.

Workshops, shortcourses and user group meetings will be catered for in the week's activities and submissions of interest are invited, also by 1st June 1995.

Space works 96 technical exhibition will provide an unrivalled opportunity to gain access to up to 1000 professionals in the remote sensing and other space industries. A brochure outlining this opportunity is available from Australian Convention and Travel Services Pty Ltd (ACTS).

All proposals should be submitted to ACTS who can also provide further contacts if needed.

Australian Convention and Travel Services Pty Ltd
GPO Box 2200
Canberra ACT 2601 Australia
Tel: (06) 257 3299 or International + 61 6 257 3299
Tel: (06) 257 3256 or International + 61 6 257 3256

1995 calendar

Remote sensing and associated events

22 – 26 May Palm Springs, California, USA

ESRI 15th Annual User Conference Wyndham Hotel and Palm Springs Convention Center. Palm Springs, California, USA.

Contact: Environmental Systems Research Institute
(ESRI), User Conference Registration
380 New York Street
Redlands, CA 92373 USA
Tel: +1 909 793 2853, +1909 793 5953
Email: ucregis@esri.com

23 – 25 May Bremen, Federal Republic of Germany

The Space Congress – 9 Concurrent Space Conferences, 3 Round Tables and a major Space Exhibition. Remote Sensing events include: Remote Sensing for Oil Exploration and Environment, Small Satellites for Remote Sensing; Coastal Zone Management; Applications of Hyperspectral Remote Sensing and SAR Interferometry.

Contact: KOMMA, GMBH; Emmastrasee 220:
D28213, Bremen,
Federal Republic of Germany.
Tel: +49 421 219 073
Fax: +49 421 216 419

17 – 20 July Adelaide

3rd National Conference and Trade Exhibition on the Management of Geoscience Information and Data.

Contact: Australian Mineral Foundation
63 Conyaghan Street
Glenside, SA 5065
Tel: (08) 379 0444
Fax: (08) 379 4634

18 – 20 July Darwin

NARGIS 95, North Australian Remote Sensing and Geographic Information Systems Forum.

Contact: NARGIS 95 Secretariat
PO Box 4011
Darwin, NT 0801
Tel: (089) 81 8818
Fax: (089) 41 1530

19 – 23 August Brisbane

Sugar 2000 – Towards a sweeter future.

Contact: Carillon Conference Management
PO Box 177
Red Hill, QLD 4059
Tel: (07) 368 2644
Fax: (07) 369 3731

12 – 16 September Taipei, Taiwan

COSPAR Colloquium on Space Remote Sensing of Subtropical Ocean.

Contact: Prof. Cho-Teng Liu
Institute of Oceanography
National Taiwan University, Taipei
PO Box 23–13, Taiwan, ROC 106
Tel: +886 2 362 0624
Fax: +886 2 363 5165

18 – 20 September Seattle, USA

3rd Thematic Conference, Remote Sensing for Marine & Coastal Environments.

Contact: ERIM
PO Box 134001
Ann Arbor, MI 48113-4001, USA
Tel: +313 994 1200
Fax: +313 994 3123

2 – 6 October Darwin

20th Annual AMIC Environmental Workshop. Workshops, Posters and Trade Exhibit related to Mine Rehabilitation.

Contact: Moya Vanags-Lang
Tel: (06) 279 3600
Fax: (06) 279 3699

31 Oct – 2 Nov Singapore

GIS Asia Pacific Conference.

Contact: GIS World
155 E.Boardwalk Drive, Suite 250
Fort Collins, CO 80525, USA
Tel: +303 223 4848
Fax: +303 223 5700

4 Nov – 16 Dec Nakhon Ratchasima, Thailand

World Tech 95, World Agriculture and Industrial Exhibition including 16th Asian Conference on Remote Sensing.

Contact: World Tech 95, Bangkok
Tel: +662 216 5750 1
Fax: +662 216 5752

20 – 24 November Melbourne

AURISA 95 Conference, workshops, user groups and technical exhibition. The premier Australasian event in GIS and spatial information disciplines. Theme: providing community benefits in the 90s and beyond. Radison President Hotel.

Contact: Australian Convention and Travel Services
GPO Box 2200
ACT 2601
Tel: (06) 257 3299
Fax: (06) 257 3256

26 Nov – 1 Dec Melbourne

International Symposium on Spectral Sensing Research (ISSSR)

Contact: Science and Technology Corporation
Meetings Division, (Judy Cole)
Tel: +804 865 7604
Fax: +804 865 8721

ACRES official distributors

NEW SOUTH WALES

Land Information Centre (LIC)
Department of Conservation & Land Management
Panorama Avenue
PO Box 143
Bathurst NSW 2795
Tel: (063) 32 8419
Fax: (063) 31 8095

SPOT Imaging Services Pty Ltd (SIS)
Suite 502
156 Pacific Highway
PO Box 197
St Leonards NSW 2065
Tel: (02) 906 1733
Fax: (02) 906 5109

ENCOM Technology Pty Limited
Level 2
118 Alfred Street
PO Box 422
Milson's Point NSW 2061
Tel: (02) 957 4117
Fax: (02) 922 6141

ESRI Australia
Level 3
1 Kent Street
Sydney NSW 2000
Tel: (02) 241 2138
Fax: (02) 241 1249

VICTORIA

Resource Industry Associates (RIA)
538 Brunswick Street
North Fitzroy Vic 3068
Tel: (03) 9482 4945
Fax: (03) 9482 4956

AUSTRALIAN CAPITAL TERRITORY

AGRECON Pty Ltd
University of Canberra
PO Box 1
Belconnen ACT 2616
Tel: (06) 201 2565 (BH)
Fax: (06) 201 5353 (BH)
Tel/Fax: (06) 227 5021 (AH)
Mobile: 015 26 4623

QUEENSLAND

Department of Lands
Remote Sensing Unit
Cnr Main and Vulture Streets
Woolloongabba QLD 4102
Locked Bag 40
Coorparoo Delivery Centre
QLD 4151
Tel: (07) 896 3187
Fax: (07) 896 2762

GEOIMAGE Pty Ltd
13/180 Moggill Road
Taringa QLD 4068
PO Box 789
Indooroophilly QLD 4068
Tel: (07) 871 0088
Fax: (07) 871 0042

Mapping & Monitoring Technology Pty Ltd (MMT)
37 Tully Street
South Townsville QLD 4810
PO Box 5704 MC
Townsville Qld 4810
Tel: (077) 71 6622
Fax: (077) 71 6626

Geo Mapping Technology Pty Ltd (GMT)
6 Nyora Street
Everton Hills
Brisbane QLD 4053
Tel: (07) 353 0533
Fax: (07) 353 0534

SOUTH AUSTRALIA

Department of Environment & Natural Resources (DENR)
Resource Information Group
Image Data Services
282 Richmond Road
Netley SA 5037
GPO Box 1047
Adelaide SA 5001
Tel: (08) 226 4903
Fax: (08) 226 4906
(08) 293 4898

WESTERN AUSTRALIA

Remote Sensing Applications Centre (RSAC)
Department of Land Administration
65 Brockway Road
Floreat WA 6014
PO Box 471
Wembley WA 6014
Tel: (09) 340 9330
Fax: (09) 383 7142

NORTHERN TERRITORY

GEOIMAGE Pty Ltd
Ground Floor
CML Building
59 Smith Street
Darwin NT 0800
GPO Box 3499
Darwin NT 0801
Tel: (089) 41 3677
Fax: (089) 41 3670

TASMANIA

Space Images
Central Science Laboratory
University of Tasmania
Sandy Bay TAS 7005
Tel: (002) 20 2156
Fax: (002) 20 2494

INTERNATIONAL

Earth Observation Satellite Company (EOSAT)
International Headquarters
4300 Forbes Boulevard
Lanham
Maryland 20706
USA
Tel: +1 301 552 0565
Fax: +1 301 552 3762

PT Indica Dharma Consulting Services
Golden Plaza Blok 43-44
Fatmawati no 15, Jakarta
Indonesia
Tel: +62 21 750 8986
+62 21 750 6361
+62 21 750 6350
Fax: +62 21 750 8985
Internet:
indica@server.indo.net.id

SPECIALIST CONSULTANTS

Environmental Research & Information Consortium Pty Ltd (ERIC)
8 Trickett Street
Holt ACT 2615
Tel: (06) 255 1398
Fax: (06) 255 2460

Southern Remote Sensing
24 Curtis Street
North Adelaide SA 5006
Tel/Fax: (08) 267 3983

Technical & Field Surveys Pty Ltd (TFS)
Building 3
CSIRO Complex
30 Delhi Road
North Ryde NSW 2113
Tel: (02) 887 8642
Fax: (02) 887 8647

SPECTRASCAN Pty Ltd
2/184 Harbourne Street
Wembley WA 6014
Tel: (09) 387 8188
Fax: (09) 387 8400

National Geographic Information Systems Pty Ltd (NGIS)
Suite 4
Kishorn Court
58 Kishorn Road
Mount Pleasant WA 6153
Tel: (09) 364 3878
Fax: (09) 364 9200

Australian Centre for Remote Sensing

Dunlop Court
Fern Hill Park
Bruce ACT 2617
PO Box 28
Belconnen ACT 2616
Tel: (06) 201 4201
Fax: (06) 251 6326

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AUSLIG
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