GIM INTERNATIONAL INTERVIEWS PROFESSOR DR ZHANG JIXIAN

China Leaps Ahead with Geospatial Research

Prof. Dr John van Genderen, himself a leading western expert on geospatial developments in China, interviews Professor Dr ZHANG Jixian, acting president of the Chinese Academy of Surveying and Mapping on the rapid evolution of geospatial ideas in China.

Could you provide a brief overview of Chinaâ€™s earth observation missions, from their start up until now?

China initiated a plan to develop a self-owned, proprietary (in terms of intellectual property rights) earth observation system after DFH-1, the first Chinese satellite, in 1970. Since then, many earth observation missions have been launched. As of today, we have developed five series of operational satellite series; these include those dedicated to meteorological studies (the FY-1, 2 series), earth resources (CBERS-1/2), ocean (HY-1), the small satellites (Shijian-5 and Qinghua-1) and geo-space exploration satellites. Alongside these there is full capability in designing airborne and space-borne remote sensors covering a spectrum ranging from visible, near infrared, and thermal infrared to microwave.

What have been the developments in research and application?

The developments in remote sensing research and application have gone through three stages.

- In the 1970s Chinese scientists began to employ foreign satellite data, such as Landsat MSS data, for natural resources mapping by visual interpretation. Some comprehensive experiments, including aerial photo-graphy, data processing and interpretation, were also carried out; for example, the Tengchong airborne remote sensing experiment. These experiments fostered a group of professional remote sensing specialists.
- In the 1980s China began to establish its educational system, research institutions, ground stations and government department to promote remote sensing research and development, industrialisation and application. Digital processing of remote sensing data, including pre-processing, transformation, classification and interpretation were studied.
- Since the 1990s, we have entered on a quantitative era. High-resolution, hyper-spectral radar data has been widely studied in applications such as meteorology, agriculture, geology, mineral resource inventory, surveying, agriculture, forestry, water conservancy, oceanography, seismology and urban planning. International co-operation with Asian and European countries, Canada and the USA has been established and developed. Meanwhile, very promising industry and business markets have been created by data production, sensor platforms and software development. In general, China aims at building up a comprehensive, advanced earth observation system to collect, process and deliver remote sensing and application products to serve sustainable social and economic development.

Which RS satellites are currently available in China and for what applications are they used?

China has launched meteorological satellites, earth-resource satellites, marine, and small satellites. These form four series, as already described, which have been fully applied in many fields of social and economic development. FY meteorological satellites include polar orbit FY-1 and geostationary FY-2 used for weather forecasting, climate study, disaster management and global environment monitoring. HY marine satellites take as their main tasks the observation of ocean optical characteristics, shallow seafloor mapping, and ocean environment stereoscopic monitoring. Resource satellites CBERS-1 and ZY-2, are the result of aerospace co-operation between China and Brazil and have been applied in crop-yield estimation, resource exploration and inventory, environmental monitoring, urban planning and dynamic resource and environmental information services. Tsinghua University has launched a micro-satellite. Another two small satellites will be launched in 2005 for environmental monitoring and disaster forecasting. It is estimated that more than twenty earth observation satellites will be launched in the next five years. China is also able to receive data from most foreign satellites such as LANDSAT-5/7, SPOT-1/2/4/5, RADARSAT-1, JERS-1, ERS-1/2, ENVISAT-1, MODIS and NOAA/ AVHRR.

What is the scope of RS co-operation between China and countries like India and Brazil, USA and the European Community?

China aims at building up a comprehensive earth observation system. Over the last two decades China has taken part in bilateral,

regional, multilateral and international RS co-operation. This has taken different forms covering many fields, such as sensor development, earth environment monitoring and exploration, global change, and technology education and training, which have yielded extensive achievements. Since 1988 China and Brazil have had co-operation on remote-sensing satellite development. Under the â€˜Satellite Sino-Brazilian Project of Land Resourcesâ€™ agreement China successfully launched the resource satellites CBERS-1 and ZY-2. In 1993 China participated in the Committee on Earth Observation Satellites (CEOS), becoming one of its 23 Members. The Dragon Project is a joint project of the Chinese Ministry of Science and Technology and the European Space Agency. At the end of last year this co-operation entered the implementation phase; the project covers twelve themes, including agricultural applications, flood monitoring, forestry mapping, ozone monitoring and ocean-colour research. China is an official partner in the Galileo programme, having signed a Co-operation Agreement with Europe in October 2003; this represents the largest scientific and technological co-operation project between the two entities. China has had long-term official scientific co-operation with the USA for more than twenty years, since Mr Deng Xiaopingâ€™s 1979 visit to the USA during which he signed the â€˜Sino-American Scientific-Technical Co-operation Memorandumâ€™ with President Carter. This memorandum led to the founding of the China Remote Sensing Satellite Ground Station in 1986, after which it started to receive earth resources data from various remote-sensing satellites other than Chinese ones.

What are the ground stations for RS data in China (and abroad)? And are these also RS application centres?

The major station is the China Remote Sensing Satellite Ground Station (China RSGS), the main missions of which are to receive, process, archive and distribute earth resources data from various remote-sensing satellites and undertake scientific research regarding data receiving, processing and the relevant various techniques and methods involved. It is also an RS application centre. Three Meteorological Satellite Ground Stations are located in Beijing, Guangzhou and Urumchi, respectively. These stations are responsible for receiving, processing, archiving and distributing data from FY-1, FY-2 and NOAA/ AVHRR etc. In addition, there are several MODIS ground stations, some of which are also RS application centres.

With which disciplines in China are RS applications integrated?

Remote sensing is tightly integrated with GIS and GPS - recently become known as GNSS - in many applications. Together these are called â€˜3Sâ€™. This integration is indispensable because RS provides the data source for GIS, and GPS gives RS precise location control. The basic geo-spatial products are Digital Raster Graphics (DRG), Digital Line Graphics (DLG), Digital Ortho-rectified Model (DOM) and Digital Elevation Model (DEM), also known as â€˜4Dâ€™. Using 3S technology we have built 1:1,000,000 and 1: 250,000-scale â€˜4Dâ€™ databases for the whole of China, and 1:50,000 for 80% of the territory. Our Academy, CASM, integrates many geosciences disciplines, such as remote sensing, photogrammetry, geodesy, GIS, cartography and GNSS. The reason for remote sensing integration is to solve problems in many applications like deforestation monitoring, natural resource management, land use/land cover mapping, environmental protection, disaster reduction, and infrastructure development.

What foreign RS satellite data is used in China, and for what type of applications?

China has used almost all the most popular foreign RS satellite data for a variety of operational applications.

- For nation-wide applications, meteorological and ocean-satellite data such as that derived from NOAA AVHRR MODIS Terra/Aqua, OrbView-2 and SeaWiFS is used for weather forecasting, ocean-product generation, and forest-fire, vegetation and crop monitoring.
- For regional applications, Landsat TM/ETM+ and SPOT data is used for natural-resources management such as land use/land cover change mapping, forest and geological mapping.
- SAR imagery such as that derived from RADARSAT, ERS-1/2 and ENVISAT is also used for topography mapping, forest inventory, flood mapping, landslide monitoring and earthquake influence analysis.
- In large-scale applications, SPOT 5 data is used for dynamic monitoring of urban land use.
- IKONOS and Quickbird are sometimes involved in urban planning and facility mapping.

Some other satellite data is used for scientific studies in the geo-environmental sciences. Chinaâ€™s demands for high-quality, stable, either domestic or foreign satellite data will continue to increase in the future.

What do you expect in terms of global RS future developments?

Industrialisation and routine operational applications of RS technology will become a highlight all over the world. With more and more RS satellites launched and RS data processing methodologies developed, RS technology is gradually entering into operational applications covering not only professional areas but also daily life: intelligent map and e-business. Furthermore, various RS sensors with diverse spatial resolution, spectral bands and coverage, especially radar sensors, guarantee RS data acquisition in real-time under whatever conditions. This will result in quick and efficient global monitoring. In addition, development, operational application and industrialisation of RS technology will greatly help to solve regional and global issues.

What will be the future role of China in all this?

China has given much attention to RS technology development and applications, with rich achievements. RS data is one of the most important strategic information sources in China. At present China is involved in long and mid-term planning for establishing a global earth observation system, RS technology industrialisation and global-change monitoring, etc., in order to maintain the sustainable development of the Chinese economy and society. We are very glad to contribute to helping solve regional and global problems using RS technology. And China will continue to do its best to be a participant in international collaboration and play its role in promoting the development of RS technology all over the world.

How do you see the integration of geospatial techniques like RS, GIS, GPS, lidar, and photogrammetry in the future?

China has realised the importance of the integration of geospatial techniques and has successfully integrated these for problem solving in many fields. Fast developments in computer science and space technology make such integration easier and more efficient, so that geospatial technique integration will continue and develop further. A very good example is the intelligent transport system that integrates

RS, GIS and GPS and which has become an important component for cars in Europe, also enjoying a very big market in China. Many issues related to global change obviously concern all the people on the Earth. To address such complicated issues we need to integrate every kind of geospatial technique.

How do you see the integration with RS with other, different types of sensors such as the ten on the ESA ENVISAT satellite?

Developments in science and technology have provided us with this possibility of integrating different types of sensors such as those on the ENVISAT: MERIS, ASAR, RA-2 and so on. This has given people much more convenient means of analysing earth observation and monitoring atmospheric activity or ocean phenomenon and many problems have been resolved as a result. In my view, future sensors will become more and more dedicated; that is to say, it will become a more specialised process to resolve any one specific problem.

What is the future of microsatellites in China and what is presently under design and testing?

A microsatellite, with a weight of 10kg to 100kg, is characterised by compactness, lightness, good performance, low cost and short development cycle. These satellites may further be built up into a network, forming a â€˜virtualâ€™ big satellite, according to the distributed constellations. Microsatellites can be used in military affairs, communications, navigation, resource surveys, environment and disaster monitoring, scientific experiments and space exploration, especially in low-earth-orbital applications. The Chinese government attaches much importance to the development of microsatellite techniques and applications. The first microsatellite, Aerospace Tsinghua-1 was launched on 28th June 2000, weighing 50kg. It had 40m spatial resolution and was jointly developed by Tsinghua University, the University of Surrey in the UK and China Aerospace Science and Industry Corporation. Examples of other microsatellites already launched are Innovation-1 (88kg) and Nano-satelliteâ€“1 (25kg) launched on 21st October 2003 and 18th April 2004, respectively. Last year China began its â€˜Earth Observation Microsatellites Formation Flight and Network Composing Programâ€™, which will launch four to eight microsatellites before 2008. At the end of 2004 China built the worldâ€™s largest small-satellite development and experiment centre. It is envisaged that this will greatly speed up the modernisation, industrialisation and internationalisation process of microsatellites in China.

Major Remote Sensing Institutes in China
Over two hundred major RS institutions exist in China, the main ones being:

- *Chinese Academy of Surveying and Mapping*
- *National Remote Sensing Center of China*
- *National Geomatics Center of China*
- *National Satellite Meteorological Center*
- *National Satellite Ocean Application Service*
- *School of Remote Sensing and Information Engineering, Wuhan University*
- *the GIS, RS and GPS Research Center of Tsinghua University*
- *Institute of Remote Sensing and Geographical Information System, Peking University*
- *Institute of Remote Sensing Applications, Chinese Academy of Sciences.*

For detailed information the reader is referred to the book General Introduction of Remote Sensing Institutions in China, published by China Land Press in 2003.

Acknowledgement
GIM International would like to express its thanks to Professor Dr John van Genderen for this interview.