MAIN TRENDS IN DEVELOPMENT OF THE EARTH REMOTE SENSING

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Nowadays we can surely declare that remote sensing of the Earth from Space is one of the most successfully and dynamically developing areas of knowledge and technologies. With the cost reduction and the increasing availability of the modern technological and principal components necessary and sufficient for creation of remote sensing advanced systems, one can easily notice the trend to creation and development of numerous national space programs including remote sensing ones.

Just 5 years ago there were only very few countries belonged to closed "club" of those who possessed appropriate technologies such as Russia, USA, France, Japan, Canada, Israel, Germany, Italy, the Great Britain in addition to strong traditional players like Brazil, China and India. Now we see the new-comers knocking in the door - Kazakhstan, Belarus, Thailand, Malaysia, Vietnam, Korea, Taiwan, Egypt, South Africa, etc.

17-18 satellites are launched in the orbit in recent 2-3 year in comparison with 5-7 ones used to have been launched annually the decade before. With increasing number of the satellite in space, their characteristics and data features are improving getting unique properties and parameters. Thus the designers are trying to more specialize the new remote sensing systems.

If we consider this situation in more details we can receive interesting results.

The United States.

Nowadays a new Remote Sensing system is under construction in the USA. This system is built with the strong support from the Government and it is well financed. The basis for the new RS system will be very high resolution satellites of the new generation. From the one hand the competition between two main players in the field – DigitalGlobe and GeoEye companies remains. From the other hand each company is constructing its own satellites, which are quite different, unique and in the same time complementary to the others. The common feature for all very high resolution satellites of the new generation is their unprecedented top accuracy without ground control points (GCPs) and thus their readiness to provide imagery ready to be used for large-scale mapping. The accuracy of the data acquired by the new satellites will be at least 3 m (Root Mean Squire Error) RMSE without GCPs.

Nevertheless every new satellite under construction is unique. So WorldView-1 advantage is its agility and effectiveness despite its multispectral features are sacrificed. In the same time WorldView-2 will have enhanced multispectral capabilities sake to 8 bands instead of 4 standard ones. Visa versa very high resolution satellite of the new generation GeoEye-1 will have the highest accuracy possible – up to 2 m RMSE without ground control points but less agility. It will retain multispectral capabilities with 4 standard spectral bands.

France.

The main national French Remote Sensing operator is SPOT Image Company. It provides for the imagery acquired by medium and high resolution satellites SPOT-2/4 and SPOT-5. SPOT Image also owns exclusive rights on distribution of data from Taiwan satellite FORMOSAT-2 and Korean KOMPSAT-2.

In relation to the imagery from SPOT series satellites SPOT Image Company ismore and more relying on the creation and distribution of the value-added products on the basis of imagery processing – these are SPOT DEM, Reference 3D, SPOT View and SPOT Maps products.

Earth observation systems offer more or less broad coverage and ever-finer detail, but their revisit frequency is still limited for surveillance purposes. FORMOSAT-2, the first and only high-resolution satellite with a daily revisit capability, overcomes this obstacle to provide a new response to your surveillance needs.

The ability to acquire repeat imagery of an area of interest every day with the same sensor, from the same angle and under the same lighting conditions guarantees a timely flow of compatible data.

Japan.

Japan made huge step forward in exploration of space including Remote Sensing. The Advanced Land Observing Satellite (ALOS, also known as Daichi) is a Japanese satellite launched on 24 January 2006. The ALOS has three remote-sensing instruments: the Panchromatic Remote-sensing Instrument for Stereo Mapping (PRISM) for digital elevation mapping, the Advanced Visible and Near Infrared Radiometer type 2 (AVNIR-2) for precise land coverage observation, and the Phased Array type L-band Synthetic Aperture Radar (PALSAR) for day-and-night and all-weather land observation. Each instrument comprises the newest technologies and has its own unique features.

1. PRISM: Panchromatic Remote-sensing Instrument for Stereo Mapping

The PRISM sensor is mainly designed for mapping. It consists of three sets of telescopes for forward, nadir and backward viewing with each telescope providing 2.5 metre spatial resolution. These specifications facilitate generation of precise Digital Elevation Models (DEM), and achieve the accuracy for 1:25,000 scale maps. The PRISM also has a capability to acquire in wide swath mode (70 kilometre) although it is expected most acquisitions will be in triplet mode (35 kilometre swath).

2. AVNIR-2: Advanced Visible and Near Infrared Radiometer type 2

The AVNIR-2 sensor is useful for observing land and coastal zones and provides better spatial land coverage maps and land-use classification maps for monitoring regional environments. The instrument has a cross track pointing function for disaster monitoring. This may also allow simultaneous observation with PALSAR.

3. PALSAR: Phased Array type L-band Synthetic Aperture Radar

The PALSAR is an active microwave sensor for cloud-free and day-and-night land observation. It has very good specifications including its capability to acquire imagery in polarization mode.

Italy

COSMO-SkyMed (**CO**nstellation of small **S**atellites for the **M**editerranean basin **O**bservation) is an Earth observation satellite system funded by the Italian Ministry of Research and Ministry of Defence and conducted by the Italian Space Agency (ASI), intended for both military and civilian use.

The space segment of the system will include four medium-sized satellites equipped with synthetic aperture radar (SAR) sensors with global coverage of the planet. Observations of an area of interest will be repeated several times a day in all-weather conditions. The imagery will be applied to defense and security assurance in Italy and other countries, seismic hazard analysis, environmental disaster monitoring, and agricultural mapping.

COSMO-1 and COSMO-2 were successfully launched in 2007, COSMO-3 and COSMO-4 are scheduled to launch in 2008.

Germany

Infoterra GmbH, Germany, holds the exclusive commercial exploitation rights for the new German radar satellite TerraSAR-X, and supplies weather-independent, high-resolution, new-quality data as well as a variety of radar-based geo-information products.

TerraSAR-X is an Earth observation satellite that uses an X-band SAR to provide high-quality topographic information for commercial and scientific applications. Launched 15 June 2007 aboard a Dnepr rocket from Baikonur, it produced preliminary imagery on June 19, 2007.

The satellite works in the X-band (wavelength 31 mm, frequency 9.6 GHz) and is called therefore TerraSAR-X. The short wavelength makes the technical development a little more difficult but permits a high resolution of the digital radar images, up to 1 meter at the earth's surface.

Applications of space-based radar imagery of Earth include measurement of elevation changes of the Earth's surface, the production of maps, geosciences such as hydrology (soil dampness etc.) and meteorology, land use monitoring for agriculture, forest management, and environmental protection.

In general German and Italian space radar Remote Sensing programs are developing simultaneously and similar in the configuration and technical ideas but they differ in distribution and marketing approaches.

On the basis of analysis of the modern trends in the Remote Sensing it is possible to make a conclusion that in the nearest future we can expect appearance of the new satellites and sensors with even more advanced capabilities. It would be interesting to see in the orbit new satellites with hyper spectral capabilities as well as new radar systems working in different bands, constellations of the small sized satellite, etc.

We also feel great influence that impact the Remote Sensing industry from the side of the new neighboring fields – GIS, navigation and positioning, telecom, Internet, etc.