The AGI Foresight Study - The UK Geospatial Industry in 2015

An Expert Paper

Satellite Imagery

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Scope

Remote sensing can broadly be defined as the collection of information about a distant object using electromagnetic energy as the means of both detecting and measuring the objects characteristics. In more recent years this has also been termed Earth Observation (EO) when applied to studying the Earth. The platforms were originally aircraft, with airborne imagery continuing to develop in its own right, transitioning into satellites and also unmanned aerial vehicles (UAVs). In this review I will concentrate on satellite rather than airborne platforms, but also mention UAVs.

Background and current position

Satellite (optical) imagery first became available nearly 40 years ago with the launch of the Earth Resources Technology Satellite (later renamed Landsat 1) in July 1972. The Landsat series of satellites has continued to the present day with the Landsat 7 Enhanced Thematic Mapper plus (ETM+) sensor although, due to technical difficulties with ETM, Landsat 5 (with the ETM sensor) is still in operation and more widely used. These US missions have been joined by similar instruments operated within Europe, such as the SPOT (Satellite Pour l'Observation de la Terre) initially launched in 1986 with the latest SPOT 5 satellite in May 2002. The Disaster Monitoring Constellation (DMC) is a series of satellites (constellation) owned by different countries (such as Algeria, China, Nigeria, Spain, Turkey and the UK), but run through a UK firm (DMCii) so that the acquisition of imagery is less dependent on revisit time that can be 10 days for a single satellite. These instruments can be classed as medium resolution – spatial resolutions of the order of 5 to 30 m.

There are also, primarily commercial, high and very high spatial resolution sensors that image much smaller footprints, but with a spatial resolution of less than 5m down to sub-metre resolutions e.g. GeoEye's IKONOS and DigitalGlobe's Quickbird and WorldView-2 satellites. These missions are global, but don't aim to collect global databases – they are often targeted according to paying customers requirements. At the other end there are coarse resolution instruments such as the Moderate Resolution Imaging Spectrometer (MODIS) and Medium Resolution Imaging Spectrometer (MERIS) with spatial resolutions ranging from 300m to 1km. The MODIS sensors were launched by National Aeronautics and Space Administration (NASA) onboard both the Terra (EOS AM-1) satellite in December 1999 and the Aqua (EOS PM-1) satellite in May 2002, and MERIS was launched onboard the ENVISAT satellite, by the European Space Agency (ESA), in March 2002. These instruments are used primarily for regional and global products and aim to produce long time series datasets suitable for climate applications.

UAVs are still at a preliminary stage of development in terms of civil remote sensing, but there are interests in terms of both large high altitude vehicles and small 'model type' vehicles. Applications include agriculture, coastal zone mapping, forestry, pipeline monitoring and traffic monitoring. I will not discuss this further as this is outside my area of expertise, but these could be platforms of the future.

Anticipated Changes

In Europe, future non-commercial missions are being driven by the Global Monitoring for Environment and Security (GMES) initiative that is jointly funded by ESA and the European Commission. There will be Sentinel-2 (planned initial launch in 2012) with an instrument similar to Landsat & SPOT and Sentinel-3 (planned initial launch in 2013) with an instrument similar to MERIS called the Ocean and Land Colour Instrument (OLCI). Funding has already been secured for the A and B satellites, with future launches planned so a 20+ year time series can be created and there is also redundancy in case of problems with a single satellite. Plans are also underway for the US Landsat Data Continuity Mission (LDCM) to be launched in 2012.

There is a drive with initiatives such as Quality Assurance framework for Earth Observation (QA4EO) that is based on the adoption of guiding principles, which are implemented through a set of key operational guidelines derived from best practices, for implementation by the Group on Earth Observations (GEO) community. In essence, satellite data should come with Quality Indicators and metadata explaining how it was collected and processed.

Impact of Changes upon the geospatial industry and upon customers

Positive:

- With the advent of commercial firms such as Google making satellite imagery widely available with Google Earth™, this form of information is now acknowledged and used by the general public.
- Satellite imagery is being recognised as a valuable data source by sectors such as the insurance industry as they're increasingly using physical models linked to financial and risk management models, and need a source of data to drive these models towards reality.

Negative:

- The available of data via the WWW at no or low cost has lead to a wide use of this information source by non-experts where incorrect assumptions/interpretations have being made. Therefore, there is a need to improve the quality information associated with the data.
- Sometimes satellite imagery can be seen as replacement for other forms of data collection, especially ground based, which is often perceived to be more expensive because of the

immediate costs/equipment required. The reality is that several sources need to be brought together in a synergistic way as they each have their complimentary aspects.

Scenarios

- Imagery is already widely available, but often the high/very high resolution imagery is expensive and so can only be used in projects where the customer is prepared to pay for this added expense. As such it may remain out of research for many users who require large amounts of data or have limited financial resources.

- There has been a shift in the origin of non-commercial satellite missions; a few years ago the US, with NASA, would have been considered the leading player. However, there has been a recent lack of funding in the US with the Bush administration. Therefore, Europe is leading the way with GMES and developing countries, such as China, are actively launching satellites. A question remains the availability of data from non-European/US missions as data access policies are often more restrictive. Initiatives by organisations such as the GEO Data Sharing Principles aim to make data freely available to the benefit of all.

- UAVs could become an increasingly utilised platform in the future if the legislative constraints are solved; the need to show how demonstrating how UAVs and manned aircraft can fly together in harmony.

Summary of key points

- Satellite imagery has come a long way since the first imagery was collected: it's now widely available via the WWW and often for free or at a relatively low cost.

- With the advent of products such as Google Earth™, the general public has become aware of this source of information and there is a growing consumer base. However, there is a need to appreciate the effort that is required to create high accuracy datasets and the accompanying need to put in place quality assurance procedures/documentation.

- It has been recognised that single satellites have limited applicability because paying customers need to have the assurance of a continued data stream if they are going to invest in using satellite imagery.