COMMERCIAL USE OF SATELLITE IMAGERY

Friend or Foe — The Choice is Ours

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With the advent of commercial licensing of U.S. commercial satellite builders, the possibility exists for the Department of Defense (DoD) — or its adversaries — to purchase military operations planning data in the form of 1- to 3-meter imagery. When U.S. commercial satellite makers launch their first vehicles into low earth orbit in the 1997-1998 time frame, the DoD will be faced with a delicate choice of whether or not to buy imagery to supplement their operations planning and execution needs. While this is not a new choice given the existing LANDSAT and SPOT satellites, the enhanced commercial capabilities promise to offer an even more tempting product. This development forces new questions on the military Services at a time when they are being pushed to satisfy more of their needs with commercially available products.

Opportunities and Challenges

Since the advent of reconnaissance airplanes in World War I, we in the U.S. military relied on remote sensing data in the form of imagery to support our operations. Photo reconnaissance proved just as important in World War II for U.S. operations. During the Cold War, highly secret national technical capabilities evolved to provide imagery data to those in the national security community. Today, we've seen the technology shift dramatically to a point where civilian and commercial satellite operators sell imagery data with operational support quality to worldwide civilian customers, even potential U.S. adversaries. This growing availability of increasingly higher quality imagery brings opportunities and challenges for the U.S. military's operational forces as they attempt to meet the expanding mission assignments given them in today's turbulent environment.

Initial Commercial Imagery is Still Available

Government sponsorship was the catalyst for development of medium- to low-resolution imagery (10-meter on up), currently available for global purchase. Starting in 1984, the U.S. Government put the imagery of LANDSATS 4 and 5 in the hands of a private company for operations and marketing. These two satellites have six bands of imagery, with 30-meter resolution and a thermal band of 120-meter resolution.[1] The satellites were digitally recording the world in 185km x 185km image data sets since the launch of LANDSAT 4 in 1982, followed by LANDSAT 5 in 1984. While LANDSAT 6 failed to reach final orbit, NASA is currently developing LANDSAT 7, anticipated to launch in 1998. The Clinton administration continues to foster earth remote sensing for worldwide public use.

Satellite image of Langley Air Force Base, Va., taken on 11 June 1988, at 3.5m resolution by a Russian KVR-1000 Resurs satellite.

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While the U.S. instituted LANDSAT, the French Government sponsored their own remote sensing capability — the SPOT satellite. The latest in this series, according to *Aviation Week & Space Technology* (4 October 1993), "SPOT 3 began Sept. 27 [1993] to return excellent panchromatic images with 10-meter (33-ft.) resolution and three bands of multispectral data at 20-meter (66-ft.) resolution." These imagery data are also available for purchase by the world community and bring the capability of stereo imagery formats for

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added usefulness. France has been working on an improved capability to follow SPOT 4, for use in military reconnaissance. In fact, according to the 21 June 1993 issue of *Aviation Week & Space Technology*, "...France has been actively seeking users for its Helios military reconnaissance satellite — which has an announced resolution of 1 meter." We as military operators ought to be interested in *who* is taking advantage of this capability and *how* this might impact our planning and operations.

Other Countries Offer Imaging Capabilities

Following the lead of the other space-faring nations, Russia presented imagery for sale to the world community starting in the late 1980s. Today, Russia maintains Resurs — an earth resources satellite — with imagery available for purchase. Also, Russian panchromatic images with resolutions down to 2 - 3 meters are available in the U.S., sold through EOSAT — a joint venture of General Motors and General Electric (based just outside Washington, D.C. in Lanham, Maryland). These film-based images are estimated to come from the "Russian Kometa fourth-generation reconnaissance spacecraft," as detailed in a 23 May 1994 *Aviation Week & Space Technology* article.

Other countries besides the U.S., France and Russia have flown imaging satellites and offered the data for sale. These include Japan (MOS-1 and 1B, JERS); European Space Agency (ERS-1); and India (IRS-1A and 1B). South Africa displayed a model of a 1.5-meter resolution — "Green Sat" — and announced its intentions to launch in 1995. Japan has similarly announced a new satellite — "Hiros" — to have a 2.5-meter panchromatic resolution complemented by 10-meter multispectral bands.[2] In addition, Germany, China and Israel are all believed to have or be developing reconnaissance satellite capabilities.[3] The availability of imagery from other country satellite operations will continue to grow as the technology improves and becomes more easily available.

Potential Commercial Satellite Operations from the U.S.

Several U.S. companies have remote sensing efforts under way for the U.S. commercial space marketplace. These systems would all have imaging capabilities in the 1- to 3-meter resolution range. They are vying for the mixture of commercial, civil government and national security market share that has purchased LANDSAT and SPOT images to this point. They will also be trying to branch into the much bigger aerial photography market.

For instance, WorldView Imaging and CTA Inc., plan to launch two satellites with 3-meter resolution in the 1995 time frame to compete in this market.[4] Eyeglass International, a jointly owned company formed by GDE Systems Inc., Litton Itek Optical and Orbital Sciences Corporation recently won a license from the Commerce Department to proceed with a 1-meter resolution satellite system to be launched by 1997.[5] As reported in *Aviation Week & Space Technology* (23 May 1994), Lockheed's board of directors recently approved investment in a 1-meter resolution satellite system that could also be operational by the end of 1997, and could involve other U.S. and foreign partners.

In addition, Litton Itek Optical entered into separate discussions to build a reconnaissance satellite system for the United Arab Emirates, with an expected resolution as good as 0.8m, according to *Aviation Week & Space Technology* (21 June 1993). Meanwhile, NASA selected two firms — CTA Inc., and TRW — to build light satellites for earth remote sensing. While CTA's solution will be in the medium (3-meter) resolution class (and identical to the two planned to be flown commercially), TRW's will combine a 30-meter resolution multispectral imaging (MSI) capability with 5-meter panchromatic capability.[6]

These cases illustrate the search by U.S. aerospace firms to broaden into the growing commercial remote sensing marketplace and the resulting pressure on the U.S. Government to "ease export restriction on higher-

resolution imaging satellites and data in order to compete with foreign systems offering resolutions of 1 meter or better."[7] This competition will only increase the on-orbit capabilities available through the commercial marketplace. We in the military need to be aware of the evolution in spaceborne imaging capabilities over the next 5 years. We will have the option of acquiring the data for our own uses, but we cannot ignore this evolution any longer — or we will pay the price in future missions.

How Will the New Availability of Data Look?

With the successful launch of one, some or all of the potential U.S. commercial capabilities, combined with the expanding foreign space remote sensing capabilities, there will be a burgeoning selection of satellite imagery data in the near- to mid-future. The data will fall into the range of 1- to 5-meter data (typically in a panchromatic, or black and white band), with much of it complemented by coarser resolution MSI. These multispectral data add entirely new dimensions to the image data utility — dimensions beyond the scope of this article. Not only will resolutions improve, but with new sensor technologies the width of the image itself should also increase, allowing single-image swaths of a larger surface on the ground for a given resolution.

Augmenting the increased resolutions, band sets and image surface areas will be the ability to use Global Positioning System (GPS) data to accurately relate the space images to actual ground locations. This ability to precisely locate ground objects in scene data sets is a major improvement not only for cartographers and urban planners, but for anyone interested in using the satellite imagery for calculating potential target coordinates.

Another related factor is the timeliness involved with actually acquiring an image of interest and making it available to the end user. With the increase in space platforms and ground processing capabilities, the time lines for providing a requested image should shorten dramatically. This will enhance the value of the imagery to support any operational need.

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With the increasing number of sensors and their enhanced area coverage, a correspondingly larger portion of the globe will be acquired and hence be available as imagery stored in archives for manipulation and exploitation by the commercial public, foreign countries and, of course, the U.S. Government and Armed Forces.

Challenge and Opportunity for U.S. Forces

The challenge for those of us in the U.S. Armed Forces will be to operate in environments where potential adversaries, such as Third World nations or even terrorist groups, will have access to this open flow of reconnaissance quality data in the form of commercial satellite imagery. U.S. commanders must assume that our opponents have access to this kind of information and could be forewarned of U.S. intentions, and even our specific operational plans unless we maintain operational security precautions. With GPS information, these data could potentially be used for calculating target coordinates of U.S. installations by an enemy force. We will be facing a capable threat that did not exist 5 years ago.

An opportunity arises for us as well, since we are in an excellent position to take advantage of the growing information flow. In many instances, we are already capable of accepting digital satellite imagery. Today for instance, according to the Defense Mapping Agency (DMA) in their publication, *Digitizing the Future* (3d Edition), "DoD uses multispectral imagery (MSI) for geographic information applications, bathymetry, special map products, trafficability analysis, aircrew perspective views and contingency planning. The use of MSI is developing throughout DoD agencies, Services, and the Unified and Specified Commands...Aircrews using natural color perspective views created by 'draping' the imagery over Digital Terrain Elevation Data (DTED) said it was 'like being there.'"

Various agencies of the DoD purchased LANDSAT and SPOT for a number of years to supplement information that they normally obtain through other means. As pointed out in *Digitizing the Future* (3d Edition), "The Defense Mapping Agency is the primary action office for the procurement of MSI [multispectral imagery] remote sensing data by the Department of Defense agencies and Military Departments." In fact, the Defense Mapping School offers a 10-day course to DoD personnel for "familiarization training in the analysis, interpretation and application of digital MSI." Accordingly, some of us in the

military are already aware of how this unclassified imagery is useful to augment our normal mission data.

DoD Stated Needs

The use of unclassified, commercially available data for the U.S. military was acknowledged again in a February 1994 memorandum: "The Joint Requirements Oversight Council (JROC) has reviewed the Remote Earth Sensing (RES) Mission Need Statement...we believe other alternatives, such as an RES sensor on a DoD satellite (i.e., Defense Meteorological Satellite Program), commercial satellite, foreign satellite...may be cost effective and affordable."[8] In this memorandum, the senior leadership validated our continued use of RES data and recognized the likelihood that future image data may come from a source beyond our control. More recently, as reported in *Aviation Week & Space Technology* (23 May 1994), the U.S. Air Force and DMA reportedly purchased Russian "Earth Resources" imaging data sets for evaluation of the unclassified data's applicability to DoD needs.

Potential Uses of Future Purchased Imagery

With access to commercial imagery data comes some advantages for our operational forces. In planning for humanitarian and joint operations the commercial imagery is very useful as a common reference graphic, since it's already unclassified and can be distributed quickly to our allied partners or participating local officials. Some U.S. forces have already used LANDSAT and SPOT data to make image maps with this in mind. The multispectral aspect of this future imagery, while not discussed here, also addresses new areas of DoD responsibility, such as environmental impact analysis for use during base cleanup operations. Also, we must address our vulnerability to potential compromise through an adversary's access to the same commercially available data.

An example showing civilian use of commercial satellite imagery combined with seismic data occurred when the Verification and Technology Information Center (VERTIC) (based at Imperial College, London) announced the location of a 5 October 1993 underground nuclear explosion. VERTIC publicized its findings, including the test site location in China, a mere 3 hours after the event took place. The scientists used LANDSAT 30-meter data and SPOT 10-meter data (although they attempted to get Russian higher-resolution data as well) to monitor and evaluate possible test sites. The previously acquired imagery along with the seismic information allowed the VERTIC scientists to quickly eliminate potential sites and select the suspected test site once the seismic data indicated an event had occurred.[9] This example illustrates the capabilities offered to us to augment the existing DoD structures as well as the possibilities of some other group tracking our activities in the future, especially when improved satellites reach orbit.

Conclusion

The availability of commercially supplied satellite imagery in 1- to 3-meter resolutions presents both an opportunity and a challenge to the DoD operational forces. Through seeking to understand this opportunity, we will discover the challenge to our forces. This growing number of satellite systems supplying imagery with varying qualities to multiple users must be taken into consideration by our military leaders as they plan operations for U.S. forces. Our commanders must assume that their adversaries have access to this level of satellite imaging capability, and conduct their operations accordingly.

The former Director, DMA, Maj. Gen. William K. James, USAF (Ret.), set the tone for his own agency and perhaps for the rest of the DoD: "It is the policy of the Defense Mapping Agency to review and analyze mapping, charting and geodesy products and data...derived from commercial imaging satellites for their usefulness in satisfying DMA customer requirements."[10] In an era of diminishing defense budgets, we in the DoD should continue and potentially increase our use of commercial imagery to take full advantage of the civil/commercial dollars already spent and to more fully understand the potential threat to U.S. security.

Endnotes

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