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Application of Satellite Imagery on Clandestine Nuclear Activities

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1. Introduction

Ever since originally introducing the satellite imagery with military purposes, the usage has been even expanded to the public areas like disaster analysis, environment monitoring, urban planning, etc. The resolution of the satellite imagery is being improved remarkably compared to its early stage, and various type of imagery can be acquired with the help of advanced remote sensing technology. The IAEA has been strengthening its verification tools, especially for detecting undeclared nuclear activities, so it is trying to prepare full capabilities for environmental sampling and satellite imagery analysis. With the expectation that the usage of satellite imagery in the safeguards will be greatly expanded, it is highly required to review the current technology level and previous examples about monitoring clandestine nuclear activities.

2. Status of Remote Sensing Technology

In 1999, the US firm Space Imaging Inc. has successfully launched the first commercial earth observation satellite with the spatial resolution of 1m. Currently, more than 20 satellites are being operated with their specific tasks like reconnaissance, scientific data collection, monitoring ground activities or changes around the earth. The ROK has been being operated a high resolution EO (Earth Observation) satellite, KOMPSAT-II which was launched in 2006, and has a plan to launch two more satellite within 2011. With the great advance of image processing technology, we have now various graphic analysis tools and techniques enough for recognizing what is going on the ground with satellite imagery, although the computer based graphic analysis tools are needed to be developed further to get the more precise details on the ground objects and to speed up the overall image processing procedure which require enormous time with current status of the art.

2.1 Earth Observation Satellites

The representative earth observation satellites are as listed in the following table.

Table 1. Major Earth Observation Satellites

Name	Owner	Resolution	Launch	Purpose
IKONOS	Space Imaging (USA)	1m	1999	commercial
QuickBird	Digital Globe(USA)	0.6m	2001	Commercial
Landsat 7	NASA(USA)	15m	1999	Scientific
SPOT 5	CNES(France)	2.5	2002	Commercial
ASTER	NASA(USA)	15	2000	Scientific
AVNIR-2	NASAD(Japan)	10	2004	Scientific

Since the launch of KOMPSAT-I in 1999, the ROK is now operating KOMPSAT-II and will launch the following satellites, KOMPSAT-III, and –V within 2011. The specifications of KOMPSAT-I and –II are shown in the Table 2.

Table 2. KOMPSAT-I & -II Specification

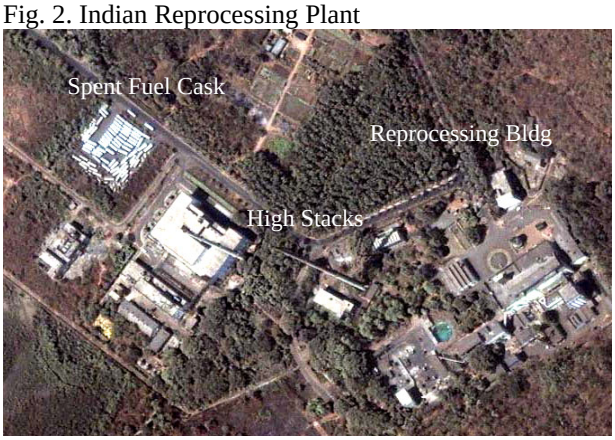
	KOMPSAT-I	KOMPSAT-II
Tasks	Land/ Ocean Observation, Scientific Data Acquisition	Land Observation, RS/GIS application
Resolution	Monochrome 6.6m	Color 1m
Swath width	17km	15km
Altitude	685km	685km
Weight	470kg	800kg
Revisit cycle	28 d	28 d
Launch year	1999	2006
Mission Life	3 year	3 year

2.2 Examples of Detecting Clandestine Nuclear Activities

Previous attempts by the IAEA have been shown that the satellite imagery can be effectively used to find some clandestine nuclear activities performed with some intention. Nuclear facilities, especially related with fuel cycle, have some specific features which can be identified by satellite imagery analysis. The facilities for uranium enrichment or plutonium reprocessing must have huge ground structures necessary for their operation like high stacks or cooling towers. The ground activities at the facilities can be detected also as movement of vehicles or staffs are inevitable for the operation of the facilities. The satellite images captured for some sensitive facilities are used to monitor and analyze the present status of them as following photos.

Fig. 1. Russian Plutonium Production Plant

Fig. 2. Indian Reprocessing Plant



2.3 Safeguards Application

The IAEA operates SIAL (Safeguards Imagery Analysis Lab), which holds the overall capabilities about satellite imagery analysis. With the support from the member states, it is now equipped with all necessary technical tools including remote sensing software, geospatial database, workstations for image analysis, etc. It acquires the satellite imageries of the nuclear facilities around the world, and analyzes to find whether there are any undeclared nuclear activities or any breaches on the safeguards agreement. The IAEA always requests the support from the member states about providing any recent advanced analysis technology and satellite imagery to maintain high level capability. Now we have all the infra for the application of spatial information to the nuclear safeguards, because we are operating our own earth observation satellite and possess the top level IT technology. So it should be considered to apply the satellite imagery to the current safeguards implementation like the AP report preparation, and confirming the facility report through periodic acquisition of satellite imageries for the domestic nuclear facilities.

3. Conclusions

Spatial information like satellite imagery can be successfully applied to the nuclear safeguards, which has been shown in the previous examples of searching clandestine nuclear activities by the IAEA. In line with the IAEA's effort for fortifying its verification ability using satellite imagery information, it is necessary to counteract the trend by preparing our own analytic capability about spatial information and develop application ideas for safeguards implementation. Moreover, the cooperation program about satellite imagery analysis with the IAEA is needed to be developed through MSSP.

REFERENCES

[1] Jasani, B., Richer, B., Stein, G., Ward, M.D., and Killinger, M. (1996) Enhancing IAEA Safeguards Using Commercial Satellite Imagery: A pilot study, November 1996.
[2] Safeguards: Sources and Applications of Open Source information, IAEA Report and Proceedings of a Seminar held in Vienna, 15-19 September 1997.
[3] Bhupendra Jasani, Gotthard Stein, Commercial Satellite Imagery: A tactic in nuclear weapon deterrence, Springer, 2002