Standardization of Sensor and Data Models

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SUMMARY

In the last 10 years the standardization for geographic information has developed rapidly. The major organizations involved are the ISO/TC 211 “Geographic information / Geomatics” which publishes the official standards, and the Open Geospatial Consortium (OGC), which publishes industry standards. After the standardization for the vector world had reached maturity both organizations focus their activities on the imagery data. Most important are the ISO/TC 211 Working Group 6 “Imagery” and the OGC’s Sensor Web Enablement. In addition the ISPRS and EuroSDR are active in the field of orientation and calibration of the new sensors such as the digital aerial camera.

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1. INTRODUCTION

The awareness of the need for standards of geographic information has grown enormously since the ISO/TC 211 "Geographic information / Geomatics" has almost completed the ISO 19100 family of standards. Their content is well accepted as the base for all major GIS-projects. The first generation of ISO 19100 standards cover the vector-world.

At this time the ISO/TC 211 activities are focused on the imagery standards. Three of those have reached the Committee Draft stage (CD): ISO 19101-2 "Reference model – Part 2: Imagery", ISO 19115-2 "Metadata – Part 2: Imagery and gridded data", and ISO 19130 "Sensor data models for imagery and gridded data". The future of the ISO 19129 "Imagery, gridded and coverage data framework" is unclear. A standard on calibration and validation is planned. All imagery standards belong to the ISO/TC 211 Working Group 6 "Imagery".

The Open Geospatial Consortium (OGC) has also focuses its work on standards for imagery. However, their "Sensor Web Enablement" has a wider scope and includes sensors in motion and in-situ sensors.

The International Society for Photogrammetry and Remote Sensing (ISPRS) and the European Spatial Data Research (EuroSDR) undertake major efforts to forward the calibration and orientation of new sensors such as for digital aerial cameras.

2. ISO STANDARDIZATION FOR GEOSPATIAL IMAGERY

2.1 Overview

The ISO 19101-2 contains the reference model for all other imagery standards. Though some parts of the present version are considered not to be sufficiently generic the necessary changes can be easily applied. For instance the clause on airborne laserscanning should be moved to another imagery standard, the ISO 19130 "Sensor data models for imagery and gridded data". The project team members expect a completed version in the near future.

As all ISO 19100 standards the reference model for imagery is written in the Unified Model Language (UML).

The ISO 19115-2 contains the metadata for imagery. It is an extension of the existing ISO 19115 "Metadata". As this widely used standard contains many metadata elements for imagery already, the imagery metadata will be spread across both standards, the ISO 19115 and the ISO 19115-2, in the future. The orientation data for imagery may be considered as metadata as well. However, ISO decided to put those into a separate standard, the ISO 19130.

Many domain-specific metadata are not a part of either of the two standards. The comments received on the Committee Draft of ISO 19115-2 in 2006 listed many additional required metadata elements. Some of those elements were accepted to become a part of the ISO 19115-2. However, most of them could be derived from existing elements by specialization or new terminology.

The ISO/TC 211 has defined a means to merge domain-specific requirements with ISO 19100 standards. This is the standard ISO 19135 "Registry". An ISO registry is an information system that associates ISO elements with domain-specific elements run by an approved registration authority. Photogrammetry and Remote Sensing are domains which could well justify an ISO register in the future.

2.2 ISO Standard for Georeferencing of Geospatial Imagery

2.2.1 History

The standardization project ISO 19130 "Sensor data models for imagery and gridded data" started in March 2001 and ended in March 2006. It was deleted by the ISO central secretariat because the maximum development time of 5 years had expired. This was partly caused by the early start of the standardization work in 2001, well before the more fundamental standards, the reference model and the metadata (ISO 19101-2 and ISO 19115-2), were launched. After the due date in March had passed the document was still completed with all comments on the last Committee Draft answered.

2.2.2 Present status

During the ISO/TC 211-meeting in spring 2006 the participants considered the ISO 19130 as strongly needed for many applications. Therefore the WG 6 decided to go forward in two steps.
Step 1: Working Group 6 in cooperation with the ISO/TC 211 secretariat will start a New Work Item Proposal (NWIP) to publish the completed document of ISO 19130 almost unchanged as a Technical Specification (ISO/TS 19130). Based on the completed document the procedure only requires one further vote in order to complete an ISO deliverable.
Step 2: As soon as possible a second NWIP for a modernized version of the ISO 19130 shall be launched. This NWIP shall include new digital sensors according to the works of EuroSDR and ISPRS, potentially more complete chapters on other sensors such as radar and sonar (hydrography), a precise alignment with other imagery standards such as the ISO 19115-2, and a more compact structure of the document.

The U.S. is willing to sponsor a project leader that is a member of Seicorp Company which is a contractor of the NGA (National Geospatial Intelligence Agency, ex NIMA, ex DMA). The Seicorp Company is a supporter of Transducer Model Language (TML) which is a modeling language similar to the Sensor Model Language.

2.2.3 Content of the existing ISO 19130

The existing ISO 19130 contains two methods for the georeference of imagery, a rigorous solution with the use of a sensor model and an approximate solution with a functional fit model.

The sensor model consists of components that are individually standardized. Those components are optics, corrections such as distortion, exterior orientation, and measurements. For the purpose of illustration the ISO 19130 lists the most common sensor types of today such as the pushbroom scanner, the frame camera, and Radar.

The functional fit model distinguishes between polynomial model, ratios of polynomials and grid interpolation. The image-georeference using ground control points and their related image points may be considered as a special case of the functional fit model.

3. SENSOR WEB ENABLEMENT

The Sensor Web Enablement (SWE) initiative is focused on developing standards to enable the discovery, exchange, and processing of sensor observations, as well as the tasking of sensor systems (OpenGIS 2006). Presently the work is documented in OpenGIS Specifications that deal with the Sensor Model Language (SensorML), the Transducer Model Language (TML), Observations and Measurements (O&M), the Sensor Observation Service (SOS), and the Sensor Planning Service (SPS). There is still a long way to go because it is not easy to develop a common model for the numerous existing sensors. In the future a closer cooperation between the OGC-activities, e.g. SensorML, and the ISO-works (ISO 19130) is desirable.

4. EUROSDR AND ISPRS

The ISPRS and the EuroSDR have organized the joint EuroCOW workshop in January 2006 in Castelldefels, Spain. EuroCOW stands for “European Calibration and Orientation Workshop”. As the technical discussions on the new digital sensors have reached maturity the experts expected the related standard to be completed “as soon as possible”. The outcome of the workshop should be a major contribution to the new version of the ISO 19130.

The present challenge is the integration of the many new sensors such as digital aerial cameras, Global Navigation Satellite Systems (GNSS), Inertial Measurement Units (IMU), Airborne Laser Scanning (ASL), high resolution satellite imagery, and radar. During the midterm symposium of the ISPRS Commission 1 in July 2006 in Marne-la-Vallée near Paris first results of new co operations were presented, in particular for Direct Georeferencing. (Kresse et al., 2006).

5. FUTURE

The future of the imagery standards is partly open. The ISO reference model for imagery and the ISO metadata for imagery (ISO 19101-2 and ISO 19115-2) can be considered as fairly stable. They will be publicly available in one or two years. The future of the orientation standard (ISO 19130) and the planned calibration standard still depends on decisions of the ISO/TC 211 and its national member bodies.

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OpenGIS Sensor Web Enablement, Architecture document, OGC 06-021r1, discussion paper, 2006

BIOGRAPHICAL NOTES

Academic experience: Dipl.-Ing. Geodesy and Dr.-Ing. Cartography, both Universität Bonn, Germany

Current position: Professor for photogrammetry and GIS, Hochschule Neubrandenburg, Germany
Practical experience: Software development for photogrammetry and GIS at Carl Zeiss, Oberkochen, Germany

International experience: Sabbatical at the Canada Centre for Remote Sensing, Ottawa

Activities in home and international relations:
Member of the German DIN Working Groups for Photogrammetry and GIS, 1996 - today
Chair, German DGPF Working Group on International Standards, 2003 - today
Chair, EuroSDR Intercommission Working Group on Standards, 2004 - today
Chair, ISPRS Ad-hoc Group on Standard, 2000 - today
Editor, project ISO 19130, 2001 - 2004

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