Imagery, Gridded and Coverage Data

- Imagery and gridded data is the dominant form of geographic information.

- This has led to the development of a number of standards that are well used for the storage, encoding, manipulation and exchange of geographic imagery, gridded and coverage data – from satellite imagery to undersea bathymetry to elevation grids.

- ISO TC211 has developed 8 standards, Technical Specifications, and Technical Reports and has 2 new standards and one revision in work.
Standards Development

Published standards

ISO/TR 19120:2001 Geographic information - Functional standards
ISO 19115-2:2009 Geographic information - Metadata - Part 2: Extensions for imagery and gridded data
ISO/TS 19129:2009 Geographic information - Imagery, gridded and coverage data framework
ISO/TS 19130:2010 Geographic information - Imagery sensor models for geopositioning
ISO/TS 19130-2 Geographic information - Imagery sensor models for geopositioning - Part 2: SAR, InSAR, lidar and sonar
ISO/TS 19159-1 Geographic information - Calibration and validation of remote sensing imagery sensors - Part 1: Optical sensor

Under preparation

WI 19159-2 Geographic information - Calibration and validation of remote sensing imagery sensors - Part 1: Lidar
WI 19130-1 Geographic information - Imagery sensor models for geopositioning (Revision of ISO/TS 19130:2010)
WI 19163 Geographic information - Content components and encoding rules for imagery and gridded data

Related

ISO 19123:2005 Geographic information -- Schema for coverage geometry and functions
What is Imagery?

- Most people are familiar with the images they get from their cameras or cell phones. They have a sense that pixels are the little dots that make up an image and that the number of megapixels in an image determines how sharp the image is. This seems simple.

- Beyond the initial apparent simplicity imagery gets much more complex.
Cov�rances and Metadata

- There are 2 areas of complexity:
  - Metadata; and
  - Coverage geometry.

- Extensive metadata is needed to describe remote sensing imagery. This is addressed in several of the TC211 standards.

- In addition coverage geometry views imagery and other similar types of data as mathematical fields that can manipulated and transformed.

- The basic coverage geometry is addressed in ISO 19123 - Schema for coverage geometry and functions.

- The framework that links the coverage geometry and metadata is addressed in ISO 19129 - Imagery, gridded and coverage data framework.

- The overall structure is defined in ISO 19101-2 – Reference Model Part 2 Imagery
Coverages Concept

- An image is not just a set of picture elements (Pixels), but rather the underlying visual surface represented by the set of pixels.
- An interpolation function can operate on this underlying surface to generate intermediate values between the pixels.
- One set of pixels can be converted to another of a different density or geometry.
- For example a satellite image can be orthorectified to adjust it to be spatially referenced to the earth.
Satellite Imagery

- Raw satellite imagery may be viewed but it is not directly usable until it is processed. It needs to be orthorectified and georeferenced.

Spot Image 4 satellite image over part of Quebec Canada.

Geometric distortions must be mathematically adjusted for, and the image must be referenced to the earth.
Coverage Types

- **ISO Standard 19123 - Coverage Geometry and Functions** defines a number of different types of coverages.

A Quadrilateral Grid is the most common type of coverage. The example is a Linear Scan Quadrilateral Grid in Row then Column order.

There are many other types of grid traversal methods. The example shows a Morton order traversal. This order is useful in that it supports non-uniform grid cells such as in a quad-tree.
Coverage Types

- There are a number of other coverage types familiar to a user.

A grid of elevation values supporting a Digital Elevation Model (DEM) is illustrated. A DEM is an ordered array of ground elevations at regularly spaced intervals.

Another way to represent an elevation surface is a Triangular Irregular Network (TIN) coverage. A TIN is a coverage defined by irregularly distributed nodes with three-dimensional coordinates (x, y, and z) that are arranged in a network of non-overlapping triangles.
Coverage Types

The point set is well used in ocean hydrography to represent depth soundings. Closely related is the Thiessen polygon coverage which divides an area into a set of polygon areas by forming the set of direct positions that are closer to that point than to any other point in the defining set.

A vector field coverage is used for the representation of flows such as river currents or winds.
The fundamental metadata standard ISO 19115:2003 – Metadata includes metadata for coverage data in general.

ISO 19115-2:2009 Metadata -- Part 2: Extensions for imagery and gridded data adds to the metadata standard by defining the schema required for describing imagery and gridded data.

It provides information about:
- the properties of the measuring equipment used to acquire the data,
- the geometry of the measuring process employed by the equipment, and
- the production process used to digitize the raw data.

This extension deals with metadata needed to describe the derivation of geographic information from raw data.
ISO 19130 Metadata Part 2 Extensions for Imagery

- **ISO/TS 19130 Imagery sensor models for geopositioning** identifies the information required to determine the relationship between the position of a remotely sensed pixel in image coordinates and its geoposition.

- It supports exploitation of remotely sensed images.

- It defines the metadata to be distributed with the image to enable user determination of geographic position from the observations.

- **Line Scan Satellite Imager**
ISO/TS 19159 defines the calibration and validation of airborne and spaceborne remote sensing imagery sensors. The term "calibration" refers to geometry, radiometry, and spectral, and includes the instrument calibration in a laboratory as well as in situ calibration methods. The validation methods address validation of the calibration information.

This standard is in several parts:
- Part 1 – Optical Sensors (completed)
- Part 2 – Lidar (in work)
- Part 3 – Radar SAR, InSAR (planned)
- Part 4 – Lidar Sonar (planned)
The standardization of an approach to handle the multiple encoding formats for imagery and gridded data has been a goal since 2004.

The standard 19163 classifies imagery and regularly-spaced gridded thematic data into types based on attribute property, sensor type, and spatial property, and defines an encoding-neutral content model for the required components for each type of data.

It also specifies logical data structures and the rules for encoding the content components in the structures.

Additional parts to this standard are planned to provide examples on how to bind the logical data structures to selected commonly-used physical data formats. It does not define any new physical data formats.
ISO 19139-2 defines Geographic Metadata for imagery and gridded data encoding.

This complements the ISO 19139 XML schema corresponding to the fundamental ISO 19115 Metadata standard.

This is an XML Schema implementation derived from ISO 19115-2.
Evolution of the Standards

- All standards evolve to address additional needs and to correct deficiencies.
- One of the Imagery, Gridded and Coverage Data standards is in the process of revision (ISO 19130).
- This is related to the evolution of several standards.