First edition
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Geographic information — Schema for coverage geometry and functions —

Part 1: Fundamentals

Information géographique — Schéma de la géométrie et des fonctions de couverture —

Partie 1: Principes de base

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Foreword

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This document was prepared by Technical Committee ISO/TC 211, *Geographic information/Geomatics*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 287, *Geographic Information,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement), in collaboration with the Open Geospatial Consortium (OGC), and in collaboration with the IEEE GRSS Earth Science Informatics Technical Committee.

This first edition cancels and replaces ISO 19123:2005, which has been technically revised.

The main changes are as follows:

— the document has been renamed as “Part 1: Fundamentals”, since a new “Part 2: Coverage Implementation Schema” has been published;

— the text has been simplified for better understanding;

— concepts, while in principle unchanged, have been defined more rigorously and some errors have been corrected;

— the approach to standardization taken in this document has been changed. This edition of the document defines a high-level, generic concept of coverages with an interface definition from which many different (not necessarily interoperable) implementation structures can be derived. The previous edition of this document, ISO 19123:2005, defined a single generic data structure for coverages. The previous model remains valid as one of the many possible data structures that can implement the ISO 19123-1 interface. This data structure, which is defined in Annex D, supports backward compatibility. Standardization targets that referenced ISO 19123 can continue referencing those same classes, although new realizations are not encouraged to do so. It is noted, however, that the coverage definition terms in Clause 3 which are owned by other documents have been updated to refer to newer editions of the documents (including their definitions) where such newer editions are available;

— all operations except *evaluate*() have been removed, for simplification purposes. ISO 19123-3 now specifies the operations requirements;

— the Scope has been extended to include Mesh;

— the concept of discrete and continuous coverages has been generalized to achieve an improved conceptual basis and to allow for coverages which are discrete along some domain axes and continuous along other domain axes. This is achieved by using the coordinate reference system axes as the basis for the definitions so that any axis individually can be discrete or continuous. Since this is a generalization of the previous concept it is backward compatible. As a side effect, this reworking has greatly simplified the structure of this document;

— updates in ISO 19103 have been reflected, and corresponding adjustments have been made where necessary. The informative Annex on “UML notation” has been deleted since UML notation is now described in ISO 19103;

— all coordinate-related definitions are based on ISO 19111, and corresponding adjustments have been made to this document as necessary;

— the definition of image CRS has been moved from ISO 19111 to this document;

— the definition of interpolation is based on the interpolation definition of ISO 19107 in order to avoid duplicate and diverging definitions;

— the UML diagrams have been redrawn for clarity, in order to correct errors, and to follow the new conventions established in ISO/TC 211;

— the bibliography has been revised to include additional references and has been reformatted.

A list of all parts in the ISO 19123 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document defines, at a high, implementation-independent level, the notion of coverages as digital representations of space-time varying phenomena, corresponding to the notion of a field in physics. Such coverages can be discrete or continuous.

Historically, geographic information has been treated in terms of two fundamental data types called "vector data" and "raster data".

"Vector data" deals with discrete phenomena, each of which is conceived of as a feature. The spatial characteristics of a discrete real-world phenomenon are represented by a set of one or more geometric primitives (points, curves, surfaces or solids). Other characteristics of the phenomenon are recorded as feature attributes. Usually, a single feature is associated with a single set of attribute values. ISO 19107 provides a schema for describing features in terms of geometric and topological primitives.

"Raster data", on the other hand, deals with phenomena that vary over space and time, mathematically described by “fields”. It contains a set of values, each associated with one of the elements in an array of points or cells. Raster data is often associated with a method for interpolating values at spatial positions between the points or within the cells.

The coverage concept, originally adopted from the Abstract Specification of the Open Geospatial Consortium (OGC),[15] generalizes these and further data structures, such as point clouds, into a model for representing phenomena that vary continuously over space and time, and possibly over further dimensions such as spectral bands. Formally, a coverage is a function from a spatial (such as horizontal x and y and vertical height or depth), temporal, other (in ISO 19111:2019 nomenclature: parametric) domain or any combination thereof to values of some data type.

A coverage consists of a set of spatio-temporally extended geometric (often geographic) objects, each with associated attribute values. The spatio-temporal locations with which attribute values are associated are called “direct positions”.

Formally, a coverage itself is a subtype of a feature as defined in ISO 19101-1. The coverage feature is a set of features all sharing some key properties, such as the same attribute definition and coordinate reference system.

NOTE Direct positions can be of different dimensions. For example, in a raster image modelled as a coverage, the direct positions will be the grid points; in a multi-solid coverage a direct position is given by the interior of a 3D solid.

In practice, coverages encompass regular and irregular grids, point clouds and general meshes. Examples include raster data, point clouds, meshes such as triangulated irregular networks and polygon sets. Coverages are multi-dimensional, including examples such as 1D sensor timeseries, 2D satellite images, 3D x/y/t image timeseries and x/y/z geophysical voxel data, and 4D x/y/z/t climate and ocean data. Coordinate axes of such coverages can have spatial, temporal, or any other meaning, and they can be combined freely for *n*-dimensional coverages.

EXAMPLE The electromagnetic spectrum is an example of an axis with neither spatial nor temporal semantics. Such a spectral axis can be defined as a “parametric CRS” as established in ISO 19111.

A coverage which provides values only at the direct positions is called “a discrete coverage”. If interpolation information is added so that values can be obtained also between the coverage’s direct positions, such a coverage is called “a continuous coverage”.

Just as the concepts of discrete and continuous phenomena are not mutually exclusive, their representations as discrete coverages are not mutually exclusive. The same phenomenon can be represented as either a discrete feature or a coverage, depending on the particular context and requirements. A city can be viewed as a discrete coverage that returns a single value for each attribute, such as its name, area and total population, but it can also be represented as a continuous coverage that returns values such as population density, land value or air quality index for each location in the city.

A coverage, moreover, can be derived by bundling a collection of discrete features sharing a common attribute definition, the values of the coverage at each position being the values of the attributes of the feature located at that position. Conversely, a collection of discrete features can be derived from a coverage by extracting all direct positions with their associated attribute values.

The previous edition of this document, ISO 19123:2005, addressed coverage modelling on both a conceptual and (to some extent) an implementation level, effectively mixing both. Coverage modelling has now been split into two separate, but related documents: ISO 19123-1 (this document), which establishes an abstract, high-level coverage model, and ISO 19123-2, which establishes an implementation-level model ensuring interoperability, based on the concepts of ISO 19123-1. A corresponding high-level processing model for coverages is defined in ISO 19123-3.