Teknisk specifikation
SIS-ISO/TS 19159-2:2016

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Geografisk information – Kalibrering, validering och certifiering av fjärranalyssensorer och data – Del 2: Lidar

Geographic information – Calibration and validation of remote sensing imagery sensors and data – Part 2: Lidar

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This Technical Specification is not a Swedish Standard. This document contains the English version of ISO/TS 19159-2:2016.

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Dokumentet är framtaget av kommittén för Geodata, SIS/TK 323.

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Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 211 *Geographic information/Geomatics*.

ISO/TS 19159 consists of the following parts, under the general title *Geographic information — Calibration and validation of remote sensing imagery sensors and data*:

— Part 1: *Optical sensors* [Technical Specification]

— Part 2: *Lidar* [Technical Specification]

The following parts are planned:

— Part 3: *SAR/InSAR*

— Part 4: *SONAR*

Introduction

Imaging sensors are one of the major data sources for geographic information. The image data capture spatial and spectral measurements are applied for numerous applications ranging from road/town planning to geological mapping. Typical spatial outcomes of the production process are vector maps, Digital Elevation Models, and 3-dimensional city models. There are typically two streams of spectral analysis data, i.e. the statistical method, which includes image segmentation and the physics-based method which relies on characterisation of specific spectral absorption features.

In each of the cases the quality of the end products fully depends on the quality of the measuring instruments that has originally sensed the data. The quality of measuring instruments is determined and documented by calibration.

A calibration is often a costly and time consuming process. Therefore, a number of different strategies are in place that combine longer time intervals between subsequent calibrations with simplified intermediate calibration procedures that bridge the time gap and still guarantee a traceable level of quality. Those intermediate calibrations are called validations in this part of ISO/TS 19159.

The ISO 19159 series standardizes the calibration of remote sensing imagery sensors and the validation of the calibration information and procedures. It does not address the validation of the data and the derived products.

Many types of imagery sensors exist for remote sensing tasks. Apart from the different technologies the need for a standardization of the various sensor types has different levels of priority. In order to meet those requirements, the ISO 19159 series has been split into more than one part.

This part of ISO/TS 19159 covers the airborne land lidar sensor (light detection and ranging). It includes the data capture and the calibration. The result of a lidar data capture is a lidar cloud according to the ISO 19156:2011. The bathymetric lidar is not included in the ISO 19159 series.

ISO 19159-3 and ISO 19159-4 are planned to cover RADAR (Radio detection and ranging) with the subtopics SAR (Synthetic Aperture RADAR) and InSAR (Interferometric SAR) as well as SONAR (Sound detection and ranging) that is applied in hydrography.

Geographic information — Calibration and validation of remote sensing imagery sensors and data —

Part 2:
Lidar

1 Scope

This part of ISO/TS 19159 defines the data capture method, the relationships between the coordinate reference systems and their parameters, as well as the calibration of airborne lidar (light detection and ranging) sensors.

This part of ISO/TS 19159 also standardizes the service metadata for the data capture method, the relationships between the coordinate reference systems and their parameters and the calibration procedures of airborne lidar systems as well as the associated data types and code lists that have not been defined in other ISO geographic information international standards.

2 Conformance

This part of ISO/TS 19159 standardizes the metadata for the data recording and the calibration procedures of airborne lidar systems as well as the associated data types and code lists. Therefore conformance depends on the type of entity declaring conformance.

Mechanisms for the transfer of data are conformant to this part of ISO/TS 19159 if they can be considered to consist of transfer record and type definitions that implement or extend a consistent subset of the object types described within this part of ISO/TS 19159.

Details of the conformance classes are given in the Abstract test suite in Annex A.

3 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/TS 19130:2010, *Geographic information - Imagery sensor models for geopositioning*

ISO 19157:2013, *Geographic information — Data quality*

4 Terms and definitions

4.1
absolute accuracy
closeness of reported coordinate values to values accepted as or being true

Note 1 to entry: Absolute accuracy is stated with respect to a defined *datum* (4.11) or reference system.

Note 2 to entry: Absolute accuracy is also termed “external accuracy”.

4.2
attitude
orientation of a body, described by the angles between the axes of that body's coordinate system and the axes of an external coordinate system

Note 1 to entry: In photogrammetry, the attitude is the angular orientation of a camera (roll, pitch, yaw), or of the photograph taken with that camera, with respect to some external reference system. With *lidar* (4.19) and Interferometric Synthetic Aperature Radar (IFSAR), the attitude is normally defined as the roll, pitch and heading of the instrument at the instant an active pulse is emitted from the *sensor* (4.39).

[SOURCE: ISO 19116:2004, 4.2, modified — Note 1 to entry has been added.]

4.3
bare earth elevation
height (4.16) of the natural terrain free from vegetation as well as buildings and other man-made structures

4.4
boresight
calibration (4.6) of a *lidar* (4.19) *sensor* (4.36) system, equipped with an Inertial *Measurement* (4.20) Unit (IMU) and a Global Navigation Satellite System (GNSS), to accurately determine or establish its position and orientation

Note 1 to entry: The position of the lidar sensor system (x, y, z) is determined with respect to the GNSS antenna. The orientation (roll, pitch, heading) of the lidar sensor system is determined with respect to straight and level flight.

4.5
breakline
linear feature that describes a change in the smoothness or continuity of a surface

Note 1 to entry: A soft breakline ensures that known z-values along a linear feature are maintained (for example, elevations along a pipeline, road centreline or drainage ditch), and ensures that linear features and polygon edges are maintained in a *Triangulated Irregular Network (TIN)* (4.39) surface model, by enforcing the breaklines as TIN edges. They are generally synonymous with 3-D breaklines because they are depicted with series of x/y/z coordinates. Somewhat rounded ridges or the trough of a drain may be collected using soft breaklines.

Note 2 to entry: A hard breakline defines interruptions in surface smoothness, for example, to define streams, shorelines, dams, ridges, building footprints, and other locations with abrupt surface changes.

4.6
calibration
process of quantitatively defining a system's responses to known, controlled signal inputs

Note 1 to entry: A calibration is an operation that, under specified conditions, in a first step, establishes a relation between indications[with associated *measurement* (4.20) uncertainties] and the physical *quantity* (4.30) values (with measurement uncertainties) provided by measurement standards.

Note 2 to entry: Determining the systematic errors in a measuring device by comparing its measurements with the markings or measurements of a device that is considered correct. Airborne *sensors* (4.36) can be calibrated geometrically and radiometrically.

Note 3 to entry: An instrument calibration means the factory calibration includes radiometric and geometric calibration unique to each manufacturer's hardware and tuned to meet the performance specifications for the model being calibrated. Instrument calibration can only be assessed and corrected by the factory.

Note 4 to entry: The data calibration includes the lever-arm and *boresight* (4.4) calibration. It determines the sensor-to-GNSS-antenna offset vector (*lever arm*) (4.18) components relative to the antenna phase centre. The offset vector components are re-determined each time the sensor or aircraft GNSS antenna is moved or repositioned in any way. Because normal aircraft operations can induce slight variations in component mounting, field calibration is normally performed for each project, or even daily, to determine *corrections* (4.9) to the roll, pitch, yaw, instrument mounting alignment error and scale calibration parameters.

[SOURCE: ISO/TS 19101-2:2008, 4.2, modified — Notes 1 through 4 to entry have been added.]

4.7
calibration validation
process of assessing the validity of parameters

Note 1 to entry: With respect to the general definition of *validation* (4.41) the "dataset validation" only refers to a small set of parameters (attribute values) such as the result of a *sensor* (4.36) *calibration* (4.6).

[SOURCE: ISO/TS 19159-1:2014, 4.4]

4.8
check point
checkpoint
point in object space (ground) used to estimate the *positional accuracy* (4.29) of a geospatial dataset against an independent source of greater accuracy

4.9
correction
compensation for an estimated systematic effect

Note 1 to entry: See ISO/IEC Guide 98-3:2008, 3.2.3, for an explanation of 'systematic effect'.

Note 2 to entry: The compensation can take different forms, such as an addend or a factor, or can be deduced from a table.

[SOURCE: ISO/IEC Guide 99:2007, 2.53]

4.10
datum
parameter or set of parameters that define the position of the origin, the scale, and the orientation of a *coordinate system*

[SOURCE: ISO 19111:2007, 4.14]

4.11
digital elevation model
DEM
dataset of elevation values that are assigned algorithmically to 2-dimensional coordinates

[SOURCE: ISO/TS 19101-2:2008, 4.5]

4.12
digital surface model
DSM
digital elevation model (DEM) (4.11) that depicts the elevations of the top surfaces of buildings, trees, towers, and other features elevated above the bare earth

Note 1 to entry: DSMs are especially relevant for telecommunications management, air safety, forest management, and 3-D modelling and simulation.

4.13
digital terrain model
DTM
digital elevation model (DEM) (4.11) that incorporates the elevation of important topographic features on the land.

Note 1 to entry: DTMs are comprised of mass points and *breaklines* (4.5) that are irregularly spaced to better characterize the true shape of the bare-earth terrain. The net result of DTMs is that the distinctive terrain features are more clearly defined and precisely located, and contours generated from DTMs more closely approximate the real shape of the terrain.