DRAFT INTERNATIONAL STANDARD
ISO/DIS 23150

ISO/TC **22**/SC **31** Secretariat: **DIN**

Voting begins on: **2020-05-22**

Voting terminates on: **2020-08-14**

Road vehicles — Data communication between sensors and data fusion unit for automated driving functions — Logical interface

Véhicules routiers - Communication de données entre capteurs et unité de fusion de données pour les fonctions de conduite automatisée - Interface logique

ICS: 43.040.15

This document is circulated as received from the committee secretariat.

Reference number
ISO/DIS 23150:2020(E)

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Foreword

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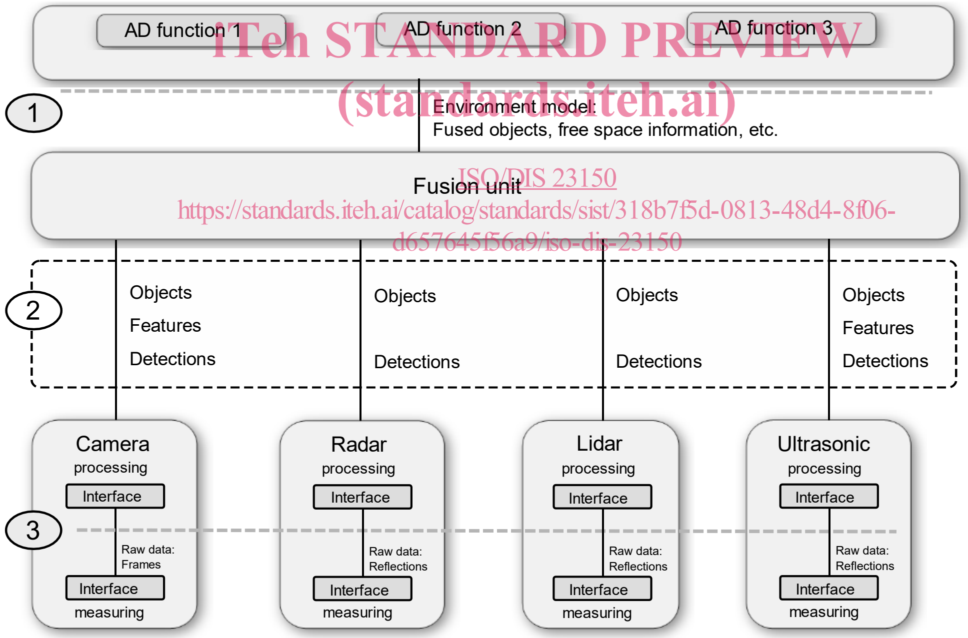
This document was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 31, *Data communication*.

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

Highly automated driving (AD) functions for road vehicles require an all-over recognition of the surroundings of the vehicle and a preferably comprehensive scene understanding. For the fast and reliable recognition of real-world objects, a set of high-performance sensors is necessary to provide information for the fusion unit. Utilization of different sensor technologies like radar, lidar, camera and ultrasonic with different detection capabilities is indispensable to ensure both complementary and redundant information. The fusion unit analyses and evaluates the different sensor signals and finally generates a dynamic surround model with a good scene understanding.

While current partly automated function utilize only particular objects (e.g. vehicles, pedestrians, road markings) to generate a simple surround model, it is necessary for future highly automated driving functions to merge not only the recognized objects but also to include other sensor specific features and characteristics of these objects for the generation of a coherent model of the surrounding. To minimize the development efforts for the sensors and the fusion unit and to maximize the re-usability of development and validation efforts for the different functions a standardized logical interface layer between sensor systems and fusion unit is worthwhile and beneficial for both the sensor- and the system supplier.



Key

1: Logical interface layer between the fusion unit and automated driving functions

2: Logical interface layer between a single sensor and the fusion unit. This logical interface layer addresses:

- Encapsulation of technical complexity
- Objects, features and detections to enable object level, feature level and detection level fusion

3: Interface layer on raw data level of a sensor

Figure 1 — Architecture: sensors – fusion unit – automatic driving functions

Road vehicles — Data communication between sensors and data fusion unit for automated driving functions — Logical interface

1 Scope

This document is applicable to road vehicles with automated driving functions. The document specifies the logical interface between in-vehicle surround sensors (e.g. radar, lidar, camera, ultrasonic, etc.) and the fusion unit which generates a surround model and interprets the scene around the vehicle based on the sensor data. The interface is described in a modular and semantic representation and provides information on object level (e.g. potentially moving objects, road objects, static objects, etc.) as well as information on feature- and detection level and on sensor technology specific information.

This standard does not provide electrical and mechanical interface specifications. Raw data interfaces are also excluded.

2 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.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1 Architectural components

3.1.1
fusion
act of uniting two or more *sensors* (3.1.4) *interfaces* (3.1.3) and *signals* (3.3.1) to create a united model of the vehicle's surrounding

3.1.2
fusion unit
computing unit where the *fusion* (3.1.1) is performed

3.1.3
interface
logical interface between *sensor* (3.1.4) and the *fusion unit* (3.1.2)

Note 1 to entry: Logical means a semantic description of the interface.

Note 2 to entry: Mechanical and electrical interface is excluded.

3.1.4
sensor
on-board component which detects entities external of the vehicle with pre-processing capabilities that at least includes detection algorithms providing *interfaces* (3.1.3)

Note 1 to entry: A sensor may use one or more sensing elements.

3.2 Level of detail

3.2.1
detection
sensor technology specific entity represented in the *sensor coordinate system* (3.7.19) based on a *single measurement* (3.4.1) of a *sensor* (3.1.4)

Note 1 to entry: A small amount of history can be used for some *signals* (3.3.1), e.g. model-free filtering may be used in track-before-detect algorithms.

3.2.2
detection level
set of sensor technology specific *interfaces* (3.1.3) which provide *detections* (3.2.1)

3.2.3
feature
sensor technology specific entity represented in the *vehicle coordinate system* (3.7.17) based on a *single measurement* (3.4.1) of a *sensor* (3.1.4)

Note 1 to entry: A small amount of history can be used for some *signals* (3.3.1).

3.2.4
feature level
set of sensor technology specific *interfaces* (3.1.3) which provide *features* (3.2.3)

3.2.5
object
representation of a real-world entity with defined boundaries and characteristics in vehicle coordinate system

Note 1 to entry: Geometric description of the object is in *vehicle coordinate system* (3.7.17).

Note 2 to entry: Object *signals* (3.3.1) are basically sensor technology independent. Sensor technology specific object *signals* (3.3.1) may extend the object.

Note 3 to entry: An object could be e.g. a *potentially moving object* (3.6.1), a *static object* (3.6.6) or a *road object* (3.6.2).

3.2.6
object level
set of *interfaces* (3.1.3) which provide *objects* (3.2.5)

3.3 Structure

3.3.1
signal
an entity consisting of one or more values and which is part of an *interface* (3.1.3)

3.3.2
logical signal group
a grouping of *signals* (3.3.1) that have a logical relationship and a name for the grouping

3.3.3
classification
attribute based differentiation

Note 1 to entry: An attribute is defined by a list of enumerators.

3.4 Measurement

3.4.1
single measurement
measuring and processing for one *measurement cycle* (3.4.2)

3.4.2
measurement cycle

time period from the start of a data acquisition event to the start of the next data acquisition event

Note 1 to entry: One measurement cycle is a consistent view of the situation and not overlapping in time.

3.4.3
accuracy
closeness of agreement between a measured quantity value and a true quantity value of a measurand

Note 1 to entry: The concept measurement accuracy is not a quantity and is not given a numerical quantity value. A measurement is said to be more accurate when it offers a smaller measurement error.

Note 2 to entry: The term measurement accuracy should not be used for measurement trueness and the term measurement precision should not be used for measurement accuracy, which, however, is related to both these concepts.

Note 3 to entry: Measurement accuracy is sometimes understood as closeness of agreement between measured quantity values that are being attributed to the measurand.

[SOURCE: ISO/IEC Guide 99:2007, 2.13]

3.4.4
trueness
closeness of agreement between the average of an infinite number of replicate measured quantity values and a reference quantity value

Note 1 to entry: Measurement trueness is not a quantity and thus cannot be expressed numerically, but measures for closeness of agreement are given in ISO 5725.

Note 2 to entry: Measurement trueness is inversely related to systematic measurement error, but is not related to random measurement error.