SVENSK STANDARD
SS-ISO 22166-1:2021

Robotik – Modularitet för servicerobotar –
Del 1: Allmänna krav (ISO 22166-1:2021, IDT)

Robotics — Modularity for service robots —
Part 1: General requirements (ISO 22166-1:2021, IDT)

Svenska Institutet för Standarder

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Svenska Institutet för Standarder

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Standarden är framtagen av kommittén för Robotik, SIS/TK 278.

Har du synpunkter på innehållet i den här standarden, vill du delta i ett kommande revideringsarbete eller vara med och ta fram andra standarder inom området? Gå in på www.sis.se - där hittar du mer information.

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Den internationella standarden ISO 22166-1:2021 gäller som svensk standard. Detta dokument innehåller den officiella engelska versionen av ISO 22166-1:2021.

The International Standard ISO 22166-1:2021 has the status of a Swedish Standard. This document contains the official English version of ISO 22166-1:2021.

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LÄSANVISNINGAR FÖR STANDARDER

I dessa anvisningar behandlas huvudprinciperna för hur regler och yttre begränsningar anges i standardiseringsprodukter.

Krav
Ett krav är ett uttryck i ett dokuments innehåll som anger objektivt verifierbara kriterier som ska uppfyllas och från vilka ingen avvikelse tillåts om efterlevnad av dokumentet ska kunna åberopas.
Krav uttrycks med hjälpverbet ska (eller ska inte för förbud).

Rekommendation
En rekommendation är ett uttryck i ett dokuments innehåll som anger en valmöjlighet eller ett tillvägagångssätt som bedöms vara särskilt lämpligt utan att nödvändigtvis nämna eller utesluta andra.
Rekommendationer uttrycks med hjälpverbet bör (eller bör inte för avrådanden).

Instruktion
Instruktioner anges i imperativ form och används för att ange hur något görs eller utförs. De kan underordnas en annan regel, såsom ett krav eller en rekommendation. De kan även användas självständigt, och är då att betrakta som krav.

Förklaring
En förklaring är ett uttryck i ett dokuments innehåll som förmedlar information. En förklaring kan uttrycka tillåtelse, möjlighet eller förmåga. Tillåtelse uttrycks med hjälpverbet får (eller motsatsen behöver inte). Möjlighet och förmåga uttrycks med hjälpverbet kan (eller motsatsen kan inte).

READING INSTRUCTIONS FOR STANDARDS

These instructions cover the main principles for the use of provisions and external constraints in standardization deliverables.

Requirement
A requirement is an expression, in the content of a document, that conveys objectively verifiable criteria to be fulfilled, and from which no deviation is permitted if conformance with the document is to be claimed. Requirements are expressed by the auxiliary shall (or shall not for prohibition).

Recommendation
A recommendation is an expression, in the content of a document, that conveys a suggested possible choice or course of action deemed to be particularly suitable, without necessarily mentioning or excluding others. Recommendations are expressed by the auxiliary should (or should not for dissuasion).

Instruction
An instruction is expressed in the imperative mood and is used in order to convey an action to be performed. It can be subordinated to another provision, such as a requirement or a recommendation. It can also be used independently and is then to be regarded as a requirement.

Statement
A statement is an expression, in the content of a document, that conveys information. A statement can express permission, possibility or capability. Permission is expressed by the auxiliary may (its opposite being need not). Possibility and capability are expressed by the auxiliary can (its opposite being cannot).

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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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 299, *Robotics*.

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 has been developed for the rapidly evolving service robotics sector. At present this robotics market covers many small and niche sectors for which it is difficult to develop the specific and wide-ranging components needed. The market sizes and applications are expected to grow significantly, and the number and range of their functions are also increasing. To enable wide-spread and interoperable development of service robots, a common approach for building service robots is needed. This document lays out such common requirements.

On one side, the manufacturer-dependent architectural approaches currently adopted for designing service robots makes design and development difficult and substitution and reuse of modules in upgrading robot products is virtually impossible. On the other side, the research community has developed a vast knowledge base in robot modular design and continues to develop new methods for realising modular approaches, but none have the widespread appeal needed to make significant impact. In these conditions, this document can assist the service robotics manufacturers to produce the quality products at affordable cost demanded by the markets and new approaches are urgently needed to help the markets evolve to meet the global challenges.

An International Standard on robot modularity and robot module interoperability focusing on main issues of safety, security, connectivity (from both hardware and software perspectives) and functionality is pivotal to change the service robotics landscape and speed up the development of the new service robot market sectors. The robot modularity issues in this document are classified into basic modules with hardware and/or software aspects and composite modules. Requirements and guidelines are formulated so that module-based design approaches can be realised allowing application specific service robots and service robot systems meeting customer's requirements to be easily configured. The issues are classified into (a) safety and security, and (b) interoperability guidelines. In addition, the open modular approach realised has to enable modules to be easily substituted by other modules having the same interface specifications but perhaps with enhanced functionalities as needed.

Safety requirements specified in existing safety standards (e.g. ISO 13482, ISO 10218-1, ISO 10218-2, ISO/TS 15066) apply on the system level as well as on the level of a single module. The safety guidelines at the module level of this document are formulated to ensure compliance with the C-type standards for robot system safety. Security issues are also important when adopting an open modularity approaches and hence have been included in this document (e.g. to align with emerging IEC/TC 44 and IEC/TC 65 security related work projects).

Future parts of the ISO 22166 series are intended to include more specific requirements on particular types of robot modules, e.g., basic and composite modules with hardware and/or software aspects, and for particular types of service robots, e.g., mobile servant robots, physical assistant robots, person carrier robots, and service robots in professional environments.

Robotics — Modularity for service robots —

Part 1: General requirements

1 Scope

This document presents requirements and guidelines on the specification of modular frameworks, on open modular design and on the integration of modules for realising service robots in various environments, including personal and professional sectors.

The document is targeted at the following user groups:

— modular service robot framework developers who specify performance frameworks in an unambiguous way;

— module designers and/or manufacturers who supply end users or robot integrators;

— service robot integrators who choose applicable modules for building a modular system.

This document includes guidelines on how to apply existing safety and security standards to service robot modules.

This document is not a safety standard.

This document applies specifically to service robots, although the modularity principles presented in this document can be utilized by framework developers, module manufacturers, and module integrators from other fields not necessarily restricted to robotics.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 9787, *Robots and robotic devices — Coordinate systems and motion nomenclatures*

ISO 12100:2010, *Safety of machinery — General principles for design — Risk assessment and risk reduction*

ISO/TR 22100-4, *Safety of machinery — Relationship with ISO 12100 — Part 4: Guidance to machinery manufacturers for consideration of related IT-security (cyber security) aspects*

ISO/IEC 27032, *Information technology — Security techniques — Guidelines for cybersecurity*

IEC 61076-1, *Connectors for electronic equipment-Product requirements — Part 1: Generic specification*

IEC 61984, *Connectors — Safety requirements and tests*

IEC/TS 62443-1-1, *Industrial communication networks — Network and system security — Part 1-1: Terminology, concepts and models*

IEC 62443-2-1, *Industrial communication networks — Network and system security — Part 2-1: Establishing an industrial automation and control system security program*

IEC 62443-3-3, *Industrial communication networks — Network and system security — Part 3-3: System security requirements and security levels*

NIST SP 800-154, *Guide to data-centric system threat modelling*

NIST SP 800-160 vols 1 and 2, *Systems security engineering considerations for a multidisciplinary approach in the engineering of trustworthy secure systems*

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:

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

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

3.1 General terms

3.1.1
abstraction layer
interface to the system that allows some or all of the capabilities of the system to be accessed in a different and generally more abstract manner

Note 1 to entry: An abstraction layer for a module is the same in the case where the system is the module.

3.1.2
connector
physical mechanism that enables connection and disconnection between parts of the system

EXAMPLE Communication, powering, mechanical linking.

3.1.3
electrical interface
combination of connectors and the electrical properties for transmitting power, analogue or digital signals

3.1.4
execution life cycle
finite state machine defining all stages of execution of a part's function

3.1.5
error
discrepancy between a computed, observed or measured value or condition, and the true, specified or theoretically correct value or condition

[SOURCE: IEC 60050-192:2015, 192-03-02]

3.1.6
failure
loss of ability to perform as required

[SOURCE: IEC 60050-192:2015, 192-03-01]

3.1.7
fault
inability to perform as required, due to an internal state

[SOURCE: IEC 60050-192:2015, 192-04-01]

3.1.8
function
defined objective or characteristic action of a system or component or module

[SOURCE: ISO/IEC/IEEE 24765, 3.1206-5 — modified.]

3.1.9
functional safety
part of the overall safety relating to the equipment under control (EUC) and the EUC control system that depends on the correct functioning of the electrical, electronic and programmable electronic (E/E/PE) safety-related systems and other risk reduction measures

[SOURCE: IEC 61508-4:2010, 3.1.12]

3.1.10
hardware abstraction layer
HAL
abstraction layer for a component/module that contains hardware aspects, with the abstraction layer providing control of the component/module via a software interface

Note 1 to entry: The purpose of a HAL is usually so that different module implementations can be accessed through the same software interface.

3.1.11
information model
abstraction and representation of the entities in a managed environment, their properties, attributes and operations, and the way that they relate to each other

Note 1 to entry: The information model is independent of any specific repository, usage of software aspects, protocol, or platform.

3.1.12
security
combination of confidentiality, integrity, and availability

[SOURCE: ISO/TR 17522:2015, 3.19]

3.2 Terms related to component

3.2.1
component
part of something that is discrete and identifiable with respect to combining with other parts to produce something larger

Note 1 to entry: Component can be either software or hardware. A component that is mainly software or hardware can be referred to as a software or a hardware component respectively.

Note 2 to entry: Component does not need to have any special properties regarding modularity.

Note 3 to entry: Component and module have been used interchangeably in general terms, but to avoid confusion the term module is used to refer to a component that meets the guidelines presented in this document.

Note 4 to entry: A module is a component, whereas a component does not need to be a module.

3.2.2
software component
component whose implementation consists of a computer programmed algorithm

3.2.3
hardware component
component whose implementation consists of physical elements and possibly any embedded software necessary for its operation