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Robotics — Performance criteria and related test methods for service robots

Part 2: Navigation

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A list of organizations represented on this committee can be obtained on request to its committee manager.

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Part 2: Navigation

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Partie 2: Navigation

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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 document 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 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*.

This second edition cancels and replaces the first edition (ISO 18646-2:2019), which has been technically revised.

The main changes are as follows:

— Clauses 8 to 10 have been added for path deviation, narrow passage and mapping accuracy.

A list of all parts in the ISO 18646 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.

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Introduction

This document is intended to specify performance criteria and test methods for navigation of mobile service robots. It defines performance characteristics, describes how they are specified and recommends how to test them.

The characteristics for which test methods are given in this document are those considered to affect robot performance significantly. It is intended that the reader of this document selects which performance characteristics are to be tested, in accordance with the specific requirements.

The performance criteria specified in this document are not intended to be interpreted as the verification or validation of safety requirements.

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Robotics — Performance criteria and related test methods for service robots —

Part 2:
Navigation

1 Scope

This document describes methods of specifying and evaluating the navigation performance of mobile service robots. Navigation performance in this document is measured by pose accuracy and repeatability, ability to detect and avoid obstacles, path deviation, narrow passage, and mapping accuracy. Other measures of navigation performance are available but are not covered in this document.

The criteria and related test methods are applicable only to mobile platforms that are in contact with the travel surface. For evaluating the characteristics of manipulators, ISO 9283 applies.

This document deals with indoor environments only. However, the depicted tests can also be applicable for robots operating in outdoor environments, as described in Annex A.

This document is not applicable for the verification or validation of safety requirements. It does not deal with safety requirements for test personnel during testing.

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 7176-13, *Wheelchairs — Part 13: Determination of coefficient of friction of test surfaces*

3 Terms and definitions

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

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

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

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

3.1
robot
programmed actuated mechanism with a degree of autonomy to perform locomotion, manipulation or positioning

Note 1 to entry: A robot includes the control system.

Note 2 to entry: Examples of mechanical structure of robots are manipulator, *mobile platform* (3.3) and wearable robot.

[SOURCE: ISO 8373:2021, 3.1]

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3.2
mobile robot
robot (3.1) able to travel under its own control

Note 1 to entry: A mobile robot can be a *mobile platform* (3.3) with or without manipulators.

Note 2 to entry: In addition to autonomous operation, a mobile robot can have means to be remotely controlled.

[SOURCE: ISO 8373:2021, 4.15]

3.3
mobile platform
assembly of the components which enables locomotion

Note 1 to entry: A mobile platform can include a chassis which can be used to support a *load* (3.6).

Note 2 to entry: A mobile platform can provide the structure by which to affix a manipulator.

Note 3 to entry: Mobile platform following a predetermined *path* (3.14) indicated by markers or external guidance commands, typically used for logistic tasks in industrial automation is also referred to as Automated Guided Vehicle (AGV) or Driverless Industrial Truck. Standards for such vehicles are developed by ISO/TC 110.

[SOURCE: ISO 8373:2021, 4.16]

3.4
service robot
robot (3.1) in personal use or professional use that performs useful tasks for humans or equipment

Note 1 to entry: Tasks in personal use include handling or serving of items, transportation, physical support, providing guidance or information, grooming, cooking and food handling, and cleaning.

Note 2 to entry: Tasks in professional use include inspection, surveillance, handling of items, person transportation, providing guidance or information, cooking and food handling, and cleaning.

[SOURCE: ISO 8373:2021, 3.7]

3.5
navigation
process which includes path planning, *localization* (3.17), *mapping* (3.18), and providing the direction of travel

Note 1 to entry: Navigation can include path planning for pose-to-pose travel and complete area coverage.

[SOURCE: ISO 8373:2021, 8.6]

3.6
load
force, torque or both at the mechanical interface or *mobile platform* (3.3) which can be exerted along the various directions of motion under specified conditions of velocity and acceleration

Note 1 to entry: The load is a function of mass, moment of inertia, and static and dynamic forces supported by the *robot* (3.1).

[SOURCE: ISO 8373:2021, 7.2]

3.7
rated load
maximum *load* (3.6) that can be applied to the mechanical interface or *mobile platform* (3.3) in *normal operating conditions* (3.9) without degradation of any performance specification

Note 1 to entry: The rated load includes the inertial effects of the end effector, accessories and workpiece, where applicable.

[SOURCE: ISO 8373:2021, 7.2.1]

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3.8
rated speed
maximum speed of *mobile platform* (3.3) equipped with *rated load* (3.7) in *normal operating conditions* (3.9)

[SOURCE: ISO 18646-1:2016, 3.11]

3.9
normal operating conditions
range of environmental conditions and other parameters within which the *robot* (3.1) is expected to perform as specified by the manufacturer

Note 1 to entry: Environmental conditions include temperature and humidity.

Note 2 to entry: Other parameters include electrical supply instability and electromagnetic fields.

[SOURCE: ISO 8373:2021, 7.1]

3.10
task program
set of instructions for motion and auxiliary functions that define the specific intended task of the *robot* (3.1) or robot system

Note 1 to entry: This type of program is generated by the task programmer.

Note 2 to entry: An application is a general area of work; a task is specific within the application.

[SOURCE: ISO 8373:2021, 6.1]

3.11
pose
combination of position and orientation in space

Note 1 to entry: Pose for the manipulator normally refers to the position and orientation of the end effector or the mechanical interface.

Note 2 to entry: Pose for a *mobile robot* (3.2) can include the set of poses of the *mobile platform* (3.3) and of any manipulator attached to the mobile platform, with respect to the mobile platform coordinate system.

Note 3 to entry: For mobile robots in contact with a flat surface, orientation is typically a scalar angle about the normal to the flat surface, with respect to a reference direction.

[SOURCE: ISO 8373:2021, 5.5, modified —Note 3 to entry has been added.]

3.12
command pose
programmed pose
pose (3.11) specified by the *task program* (3.10)

[SOURCE: ISO 8373:2021, 5.5.1]

3.13
attained pose
pose (3.11) achieved by the *robot* (3.1) in response to the *command pose* (3.12)

[SOURCE: ISO 8373:2021, 5.5.2]

3.14
path
route that connects an ordered set of *poses* (3.11)

[SOURCE: ISO 8373:2021, 5.5.4]

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