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**Special Robot-Terms**

特种机器人术语

*(English Translation)*

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**National Standard of the People’s Republic of China**

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Foreword

SAC/SWG 13 is in charge of this English translation. In case of any doubt about the contents of English translation, the Chinese original shall be considered authoritative.

This standard is drafted in accordance with the rules given in GB/T 1.1-2009 Directives for standardization—Part 1: Structure and drafting of standards.

This standard was proposed and prepared by SAC/SWG 13 (Standardization Working Group 13 on Special Task Robots of Standardization Administration of China).

Special Robot Terms

1Scope

This standard defines the basic terms, terminologies and definitions related to special robots.

This standard is applicable to the design, production, after-sales, scientific research, teaching, management and other fields of special robots.

2General Terms

2.1

Basic General Terms

2.1.1

special robot，professional service robot

robot used in professional fields and generally operated or used by specially trained person to assist and/or replace humans in performing tasks

NOTE: Special robots generally refer to professional service robot other than industrial robots, public service robots and personal service robots.

2.1.2

operational space，operating space

portion of the restricted space that is actually used while performing all motions commanded by the task program for special robots with manipulators

NOTE: Rewrite GB/T 12643-2013, definition 4.8.3.

2.1.3

working space

a set of target points that can be reached by the actuator or manipulator of a special robot

2.1.4

constraint space

reduced working space of a robot due to environmental constraints imposed on the robot itself

2.1.5

restricted space

portion of the maximum space restricted by limiting devices that establish limits which will not be exceeded

NOTE: For mobile platforms, this volume can be limited by special markers on floors and walls, or by software limits defined in the internal map.

[GB/T 12643-2013，definition 4.8.2]

2.1.6

safeguarded space

space defined by the perimeter safeguarding

[GB/T 12643-2013，definition 4.8.5]

2.1.7

collaborative working

state in which purposely designed robots work in direct cooperation with a human within a defined workspace

NOTE: Rewrite GB/T 12643-2013, definition 2.27.

2.1.8

mobile platform

assembly of all components of the mobile robot which enables locomotion

2.1.9

guard

physical barriers or virtual barriers that provide protection for robots or operating objects

NOTE: Physical barriers include physical barriers, electronic barriers, etc.

2.2

Perception

2.2.1

perception

ability of the robot to recognize and evaluate the state of itself and the surrounding environment based on the acquired information from various sensing technologies

2.2.2

visual sense

ability to perceive the environment through optical information

2.2.3

tactile sense

ability to perceive the force distribution, shape, texture, sliding and temperature of an object through direct contact

2.2.4

force sense

ability to perceive the interaction force and torque between a robot and an object

2.2.5

auditory sense

ability to receive and perceive sound

2.2.6

olfaction

ability to perceive and distinguish the components of gaseous substances or to identify odors such as aromas and odors

2.2.7

taste

ability to perceive and distinguish the components of solid and liquid substances or distinguish the tastes such as sweet, sweet, bitter and spicy

2.2.8

slip sensor

sensor that senses the degree of slippage between two objects in contact with each other through direct contact

2.2.9

image transducer/sensor

sensor that senses optical image information and converts it into a usable output signal

[GB/T 7665-2005, definition 3.2.3.14]

2.2.10

ultrasonic transducer/sensor

sensor that senses ultrasonic waves and converts them into usable output signals

[GB/T 7665-2005, definition 3.2.6.3]

2.2.11

sensor fusion

process to obtain improved information by merging information from multiple sensors

[GB/T 12643-2013, definition 7.9]

2.2.12

laser detection and ranging ，laser range finder

radar using a laser beam to detect targets

[GB/T 3784-2009, definition 2.1.3.49]

2.2.13

millimeter-wave radar

radar operating in the millimeter wave band. The working frequency is usually in the range of 30 GHz-300 GHz

2.2.14

inertial surveying system

inertial system using sensors to establish and maintain a reference coordinate system and determine the orientation, three-dimensional coordinates or measure the vertical line according to the requirements of use

[GJB 585A-1998, definition 3.2.1.11]

2.2.15

inertial measurement unit（IMU）

device composed of inertial sensors and related electronic equipment, and can measure the linear and angular motion of the carrier relative to the inertial space

[GJB 585A-1998, definition 3.2.1.22]

2.2.16

gyro（gyroscope）

device using the moment of momentum (usually generated by a spinning rotor) to sense the move of the shell relative to the inertial space around one or two axes orthogonal to the rotation axis

NOTE 1: This definition does not include more complex systems, such as stable platforms with gyroscopes.

NOTE 2: Some devices (such as laser gyroscopes) that do not use moment of momentum perform the same function are also defined as gyroscopes.

NOTE 3: Gyroscopes for special robots generally refer to angular rate sensors.

NOTE 4: Rewrite GJB 585A-1998, definition 3.3.1.3.

2.2.17

integrated navigation

navigation technique that combines some or all of the navigation equipment on the carrier into an integrated system to improve accuracy and reliability, and to possess comprehensive functions

[GJB 585A-1998, definition 3.1.1.10]

2.2.18

differential GPS (DGPS)

technique that improves the positioning and timing accuracies of satellites by setting a satellite-positioning-reference receiver at a known location to determine satellite positioning errors, based on which error correction values are obtained and supplied to differential satellite positioning user devices in real time or afterwards, allowing user devices to receive and use the correction values to improve their positioning accuracies

NOTE 1: Satellite positioning systems include Global Satellite Positioning System (GPS), Beidou Satellite Positioning System (BD), etc.

NOTE 2: Rewrite GB/T 19391-2003, definition 2.81.

2.3　Control

2.3.1

navigation

function deciding on and controlling the locomotion direction based on localization and the environment map

NOTE 1: Navigation can include path planning for pose-to-pose locomotion and area coverage.

NOTE 2: Rewrite GB/T 12643-2013, definition 7.6.

2.3.2

localization

recognizing or distinguishing the pose of mobile robots on environment maps

[GB/T 12643-2013, definition 7.2]

2.3.3

guidance

control method receiving external commands and moving along specified paths

2.3.4

trajectory planning

calculating the expected motion trajectory of manipulators or mobile platforms based on the requirement of tasks

2.3.5

mapping

map building

map generation

constructing the environment map with its geometrical and detectable features, landmarks and obstacles

NOTE: Rewrite GB/T 12643-2013, definition 7.5.

2.3.6

simultaneous localization and mapping

SLAM

constructing and updating maps and positionings simultaneously and independently in unknown environments

2.3.7

control and guide

procedure taking the selected flight routes as references to guide and control the course of carriers

NOTE: Rewrite GJB 585A-1998, definition 3.1.1.13.

2.3.8

master-slave control

control method where the motion of a primary device (master) is reproduced on secondary devices (slaves)

2.3.9

pose-to-pose control

control procedure whereby the user can only impose that the robot pass by the command poses without fixing the path to be followed between the poses

NOTE: Rewrite GB/T 12643-2013, definition 5.3.1.

2.3.10

continuous path control

control procedure whereby the user can impose on the robot the path to be followed between command poses

[GB/T 12643-2013, definition 5.3.2]

2.3.11

trajectory control

[GB/T 12643-2013，定义5.3.3]

control procedure along a continuous path control with a programmed velocity profile

[GB/T 12643-2013, definition 5.3.3]

2.3.12

sensory control

control method whereby the robot motion or force is adjusted in accordance with outputs of exteroceptive sensors

[GB/T 12643-2013, definition 5.3.5]

2.3.13

learning control

control strategy whereby the experience obtained during previous cycles is automatically used to change control parameters and/or algorithms

[GB/T 12643-2013, definition 5.3.7]

2.3.14

robust control

closed-loop control in which satisfactory operation is performed in spite of large variations in process parameters

[GB/T 2900.56-2008, definition 351-26-39]

2.3.15

fuzzy control

closed-loop control in which the control algorithm is expressed by fuzzy logic using facts, inference rules and quantifiers based on experience and intuition

[GB/T 2900.56-2008, definition 351-26-50]

2.3.16

compliance

flexible behaviors of a robot or any associated tool in response to external forces exerted on it

[GB/T 12643-2013, definition 5.3.9]

2.3.17

collaborative operation

state in which purposely designed robots work in direct cooperation with a human within a defined workspace

NOTE: Rewrite GB 11291.1-2011, definition 3.4.

2.3.18

teleoperation

real-time control of motion of robot or robotic device from a remote site by a human

Examples: Robotic operations of bomb disposal, space station assembly, underwater inspection and surgery.

2.3.19

protective stop

type of interruption of operation that allows a cessation of motion for safeguarding purposes and which retains the program logic to facilitate a restart

[GB/T 12643-2013, Definition 5.17]

2.3.20

internal state sensor

proprioceptive sensor

robot sensor intended to measure the internal state(s) of a robot

Examples: Encoder; potentiometer; tachometer generator; inertial sensor such as accelerometer and gyroscope.

[GB/T 12643-2013，Definition 7.11.1]

2.3.21

external state sensor

exteroceptive sensor

robot sensor intended to measure the states of a robot's environment or interaction of the robot with its environment

Examples: GPS; vision sensor; distance sensor; force sensor; tactile sensor; acoustic sensor.

[GB/T 12643-2013，Definition 7.11.2]

2.3.22

dead reckoning，trajectory reckoning

method of obtaining the pose of a mobile robot using only internal measurements from a known initial pose

[GB/T 12643-2013, Definition 7.8]

2.3.23

automatic mode

operation mode in which the robot control system operates in accordance with the task program

[GB/T 12643-2013, Definition 5.3.10.1]

2.3.24

manual mode

operating mode in which the robot can be operated by, for example, pushbuttons or a joystick and that excludes automatic operation

[GB/T 12643-2013, definition 5.3.10.2]

2.4　Implementation

2.4.1

special robot operator

specially trained personnel who operate special robots

2.4.2

actuator

devices used to drive the robot

2.4.3

end-effector

device specifically designed for attachment to the mechanical interface to enable the robot to perform its task

Examples: such as manipulator claws, suction cups, grippers, cleaning blades, strippers, nut breakers, bolt tighteners, cameras mounted on special robots, etc.

2.4.4

execution system

device executing tasks in accordance with task instructions automatically

Example: Special actuators such as electromagnetic drive actuators, inertial impact actuators, etc.

2.4.5

manipulator

device with multiple degree-of-freedom formed by series or parallel connection of moving components for mounting an end effector

NOTE 1: A manipulator can be controlled by an operator, a programmable electronic controller, or any logic system (for example cam device, wired).

NOTE 2: Rewrite GB/T 12643-2013, definition 2.1.

2.4.6

load

force and/or torque at the mechanical interface or mobile platform which can be exerted along the various directions of motion under specified conditions of velocity and acceleration

NOTE 1: The load is a function of mass, moment of inertia, and static and dynamic forces supported by the robot.

NOTE 2: Rewrite GB/T 12643-2013, definition 6.2.1.

2.4.7

rated load

maximum load that can be applied to the mechanical interface or mobile platform in normal operating conditions without degradation of any performance specification

NOTE: The rated load includes the inertial effects of the end effector, accessories and workpiece, where applicable.

[GB/T 12643-2013, Definition 6.2.2]

2.4.8

limiting load

maximum load stated by the manufacturer that can be applied to the mechanical interface or mobile platform without any damage or failure to the robot mechanism under restricted operating conditions

[GB/T 12643-2013, definition 6.2.3]

2.5

human-robot interaction (HRI)

2.5.1

human-robot interaction (HRI)

information and action exchanges between human and robot to perform a task using a user interface

NOTE: Because of possible confusion, it is advisable not to use the acronym “HRI” for human-robot interface when describing user interface.

[GB/T 12643-2013, definition 2.29]

2.5.2

operation control unit

device realizing the operation and control of robots by the information interaction between operators and the robots

NOTE: Including a hand-held controller.

2.6

artificial intelligence

2.6.1

intelligent decision

solution for completing specific tasks through the establishment of domain expert knowledge base, problem solving subsystem and machine learning methods

2.6.2

environmental cognition

comprehensive understanding of external environment obtained by robots through multi-sensor information fusion

2.6.3

situation awareness

acquiring, understanding, and predicting of elements that can cause changes in system states in a large-scale system environment

2.6.4

pattern recognition

identification, by a functional unit, of physical or abstract patterns, and of structures and configurations

[GB/T 5271.28-2001, definition 28.01.13]

2.6.5

image recognition

perception and analysis, by a functional unit, of an image; its constituent objects, their properties, and their spatial relationships

NOTE: Image recognition includes scene analysis.

[GB/T 5271.28-2001, definition 28.01.14]

2.6.6

speech recognition

perception, analysis, and understanding, by a functional unit, of the information carried by human voice

NOTE 1: The information to be recognized can be a word in a predefined sequence of words, or a phoneme in a predefined language. Sometimes the speaker’s speech waveform can reflect the speaker’s physiological and behavioral characteristics, and carry out biological characteristics. Logo.

NOTE 2: Rewrite GB/T 5271.28-2001, definition 28.01.15.

2.6.7

natural-language understanding，natural-language comprehension

the extraction of information, by a functional unit, from text or speech communicated to it in a natural language, and the production of a description for both the given text or speech, and what it represents

[GB/T 5271.5271.28-2001, definition 28.01.18]

2.7　Environment

2.7.1

work environment

physical, chemical, biological, social, and cultural factors surrounding robots

2.7.2

hazardous environment

environment that may cause harm to people and/or protected organisms

2.7.3

extreme environment

environment that closes to the physiological critical environment that humans can tolerate

NOTE: Extreme environments generally include acceleration extreme environment, speed extreme environment, vacuum state extreme environment, ambient temperature extreme environment, altitude extreme environment, radiation extreme environment, bearing extreme environment, deep sea extreme environment, etc.

2.7.4

structured environment

environment where feature information is knowable and modellable

2.7.5

unstructured environment

environment where feature information is unknowable and difficult to model

2.7.6

underwater environment

working environment where the robot is all immersed below the water surface and directly contacts with the water, including conditions that the robot body contacts with and without the bottom

2.7.7

water-surface environment

working environment where a part of the robot directly contacting with the water and the other above the water

2.7.8

micro-gravity environment

gravitational environment where the tiny acceleration generated by gravity gradient and other disturbances is less than 1×10-3g (gravitational acceleration on the ground)

NOTE 1: g refers to standard acceleration.

NOTE 2: Rewrite GB/T 32452-2015, definition 3.2.3.

2.7.9

low-gravity environment

gravitational environment where the tiny acceleration generated by gravity gradient and other disturbances is greater than 1×10-3g and less than 1g

NOTE 1: g refers to standard acceleration

NOTE 2: Rewrite GB/T 32452-2015, definition 3.2.4.

2.7.10

high-temperature environment

environment where the robot cannot work normally without implementing special cooling design, special materials, special components or other measures

2.7.11

low-temperature environment

environment where the robot cannot work normally without implementing special heating design, special materials, special components or other measures

2.7.12

hyperbaric environment

environment where the robot cannot work normally without implementing special pressure-resistant design, special materials, special components or other measures

2.7.13

low-atmospheric pressure environment

environment where the robot cannot work normally without implementing special voltage-boosting design, special materials or special components or other measures

2.7.14

explosive atmosphere

environment where a mixture of combustible substances with air in the form of gas, vapor, dust, fibers or fly flocs can maintain self-propagating combustion after being ignited under atmospheric conditions

[GB 3836.1-2010, definition 3.22]

2.7.15

confined space

limited space that is relatively isolated from the outside world, and have restricted import and export, poor natural ventilation, and is not suitable for long-term work or difficult to reach

NOTE 1: E.g., furnace, tower, kettle, tank car and pipe, flue, tunnel, sewer, ditch, pit, well, pool, culvert, cabin, underground warehouse, storage room, cellar, barn, etc.

NOTE 2: Rewrite GBZ/T 205-2007, definition 3.3.

2.7.16

radiation environment

environment with electromagnetic radiation and/or ionizing radiation, where people or equipment will be injured or damaged

NOTE: Please refer to GB 8702-2014 for the protection level in radiation working environments.

3　Specialized Robot

3.1

agricultural robot

robot used in production procedures in agricultural fields (including plantation, forestry, animal husbandry, agriculture and sideline industries, fishery and other industries)

3.2

electric power robot

robot used in the power industry for power production, transmission, utilization and other procedures

3.3

construction robot

robot used in the construction industry for engineering construction, decoration, repair, inspection and other procedures

3.4

logistics robot

robot used in warehousing, logistics, and transportation industries for cargo transportation, sorting, inspection and other operations

3.5

medical robot

robot used in the medical and health field for diagnosis, treatment, surgery, medical training and other various processes

3.6

rehabilitation robot

robot used to assist people with human dysfunction or disability to perform rehabilitation assessment and rehabilitation training to realize the recovery, reconstruction, and enhancement of human functions

3.7

nursing robot

robot used to help or assist in caring for patients, the elderly, children, the handicapped, and sub-healthy people in daily life

3.8

security and defense robot

robot used in security, police, fire protection, and other safety protection fields for patrol, investigation, explosion removal, emergency handling, fire extinguishing, smoke exhaust, demolition, decontamination, search and rescue, and transportation

3.9

military robot

robot used in national defense and military to perform multiple combat tasks such as battlefield reconnaissance, armed strike, combat material transportation, communication relay and electronic interference, nuclear, biological and chemical and explosives processing, precise guidance and damage assessment

3.10

rescue robot

robot used to assist or replace rescuers in completing tasks such as survivor search and rescue and environmental detection in environments where it is dangerous or difficult for rescuers to carry out rescue operations

3.11

space robot

robot used in space for experiments, operations, and detection activities

3.12

flying robot

robot with autonomous or auxiliary operation capabilities that adopts motion methods using fixed wings, rotary wings, flapping wings or others

3.13

nuclear robot

robot used in nuclear technology applications, nuclear fuel cycles and other nuclear industry applications for inspection, maintenance, emergency handling, and decommissioning

3.14

mining robot

robot used in mining production for geological survey, mine (field) construction, mining, transportation, washing and other production procedures, and for safety inspection, disaster rescue and other operations

3.15

petrochemical and chemical robot

robot used in the fields of petroleum processing, chemical industry, and others to serve the production, storage, transportation, inspection, and cleaning

3.16

municipal engineering robot

robot used in the construction and maintenance of municipal projects for the installation, overhaul, maintenance, and inspection of equipment and facilities

3.17

other special robot，other professional service robot

special robots that do not belong to the above-mentioned 3.1 to 3.16 categories.

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