Designation: F3200 – 23

Standard Terminology for Robotics, Automation, and Autonomous Systems[1]

This standard is issued under the fixed designation F3200; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This terminology covers terms associated with robotic, automation, and autonomous systems. By providing a common and consistent lexicon, the purpose of this terminology is to facilitate communication between individuals who may be involved in the research, design, deployment, and use of robotic, automation, and autonomous systems, including but not limited to, for manufacturing, distribution, security, healthcare, response, etc. The terminology covers, but is not limited to, terms used in performance test methods of for example: robot arms, automatic guided vehicles (AGVs), autonomous mobile robots, and all other automatic or autonomous industrial systems.

1.2 For the terminology to be harmonious with the practices in the field, definitions have been drawn from the literature or other public sources when possible. When no definition is available, is similar but requires change for use within standards produced by Committee F45, or in dispute, a consensus-based approach will be used to resolve definitions and add them to the lexicon. The development of this terminology is taking place in close coordination with corresponding efforts in all Committee F45 subcommittees to ensure comprehensive and consistent coverage.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

F3244 Test Method for Navigation: Defined Area

F3499 Test Method for Confirming the Docking Performance of A-UGVs

2.2 *ANSI/ITSDF Standard:*[3]

ANSI/ITSDF B56.5 Safety Standard for Driverless, Automatic Guided Industrial Vehicles and Automated Functions of Manned Industrial Vehicles

2.3 *ISO Standards:*[4]

ISO 8373 Robots and Robotic Devices – Vocabulary

ISO 12100 Safety of machinery – General principles for design – Risk assessment and risk reduction

3. Terminology

3.1 Terminology is delineated into multiple sub-sections of terms and definitions beginning with general definitions that may be useful across all robotic, automation, and autonomous systems areas. Following are sub-sections for specific areas within robotic, automation, and autonomous systems areas. Each F45 standard includes a statement in the Terminology section referencing the sub-section(s) and term(s) within this standard. F45 standards may include terminology from one or more sections. For example, A-UGV terms within A-UGV-specific Test Methods F3244 and F3499 include terms within General and A-UGV Definition sections.

3.2 *General Definitions:*

adaptive control, *n*—control scheme whereby the control system parameters are adjusted from conditions detected during the process.

aisle, *n*—in a facility, the passageway between locations where temporary or permanent obstructions may exist.

ambient temperature, *n*—temperature of the atmosphere surrounding equipment.

[1] This terminology is under the jurisdiction of ASTM Committee F45 on Robotics, Automation, and Autonomous Systems and is the direct responsibility of Subcommittee F45.91 on Terminology.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from Industrial Truck Standards Development Foundation, 1750 K St., NW, Suite 460, Washington, DC 20006, http://www.itsdf.org.

[4] Available from International Organization for Standardization (ISO), ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, http://www.iso.org.

ampere-hour capacity, *n*—amount of electrical energy that can be delivered from an energy storage unit at a specified discharge rate under specified conditions.

authorized person, *n*—trained or qualified personnel approved or assigned to perform a specific duty or duties.

automatic data capture, *n*—identification and direct collection of data into a computer system or other microprocessor-controlled device without using a keyboard (for example, technologies that support the function are: barcode, radio frequency data communication, radio frequency identification, and other emerging technologies).

DISCUSSION—Other similar terms are *automatic data collection* or *automatic identification*.

axis of motion, *n*—axis along which the robotic joint or A-UGV moves.

barcode, *n*—system of printed patterns that represent alphanumeric data that are able to be read optically.

barcode reader, *n*—device used to read a barcode.

benchmarking, *v*—measurement process that can be used for comparison against best industry practices or established goals, operating targets, and performance expectations.

braking, *v*—any processor or actuator used to slow or stop the robotic system (for example, robot, A-UGV).

bumper, physical, *n*—surface designed to absorb or withstand impact.

clearance, *n*—additional margin, beyond the contour area, that is defined for uninterrupted system operation. See Fig. 1.

collision prevention, *n*—use of sensors to detect the presence of obstacles and, through the use of integrated controls, prevent a collision from occurring; *see* **obstacle avoidance**.

commissioning, *v*—sequence of actions of setting up and checking the robotic system (for example, robot, A-UGV) followed by the verification of the robotic system functions after installation.

DISCUSSION—Sometimes called *acceptance*.

configuration, *n*—all hardware, software, and settings needed to operate the robotic system (for example, robot, A-UGV) as specified.

contour area, *n*—area that includes the physical boundaries of an object or system (for example, A-UGV, robot) including payload, onboard equipment, trailer, or combinations thereof with respect to a referenced viewpoint (for example, A-UGV, robot vision system, from above).

controls and **control system,** *n*—hardware and software required to operate the robotic system (for example, robot, A-UGV) and communicate with the environment (equipment and users).

cycle, single, *n*—single execution of a task program.

DISCUSSION—A repetition may contain one or more cycles; *see* **repetition**.

cycle time, *n*—time required to perform a cycle.

defined areas, *n*—space constrained by test method boundaries for robotic system (for example, robot, A-UGV) operation.

distance accuracy, *n*—difference between a command distance and the attained distance over a set of points.

drift, *n*—movement from the designated hold point because of the system's inability to maintain a fixed position.

echo, *n*—time elapsed between signal emission and reception that is used to determine target position in a sensor.

emergency stop (E-stop), *n*—function which is intended to:
(1) avert arising or reduce existing hazards to persons, damage to machinery or to work in progress, and
(2) be initiated by a single human action. **ISO 12100**

environment map or **environment model,** *n*—map or model that describes an environment with its distinguishable features. **ISO 8373**

DISCUSSION—Examples are grid map, geometrical map, topological map, and so forth.

exteroceptive sensor or **external state sensor,** *n*—robotic system (for example, robot, A-UGV) sensor intended to

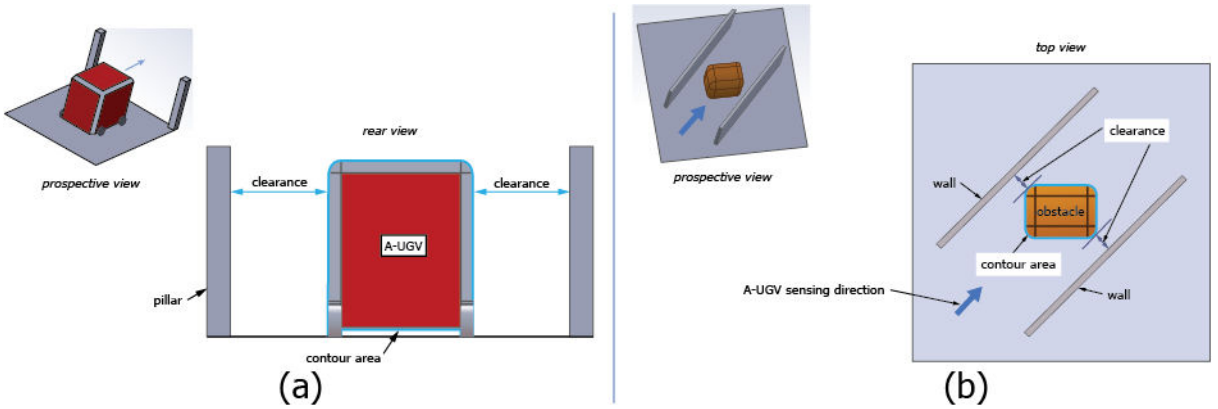

FIG. 1 Contour area and Clearance
(a) Between an A-UGV and Infrastructure and
(b) Between an Obstacle and Infrastructure

measure the state of a system's environment or interaction of the system with its environment.

DISCUSSION—Examples are global positioning system (GPS), vision sensor, distance sensor, force sensor, tactile sensor, and acoustic sensor.

globalization, *n*—ability of the robotic system (for example, robot, A-UGV) to articulate its pose within a specified reference frame.

human-machine interaction, HMI, *n*—information and action exchanges between human and robotic system (for example, robot, A-UGV) to perform a task by means of a user interface.

impairment(s), *n*—an object, feature, or quality of the situation that is utilized to disrupt intended robotic system (for example, robot, A-UGV) operation, such as the inclusion of obstacles or communication failures during task performance.

infrastructure, *n*—the parts and features of the facility and its environment that are not intended to be moved or changed (for example, walls, hills, doorways).

integration, *n*—act of combining a robotic system (for example, robot, A-UGV) with other software or hardware, or both.

integrator, *n*—party that installs and commissions robotic, automated, and/or autonomous systems into the environment where it will be operating.

DISCUSSION—Also called *implementer*.

intended path/trajectory, *n*—heading of a robot or A-UGV at a given instant in time dictated by the control logic, recognizing that the heading is a dynamic property and can change at any instant in time depending on conditions in the operating environment (for example, the decision for a robot to change goals or an A-UGV to navigate around an obstacle); *see* **path deviation**.

interlock, *v*, *n*—method to limit or prevent the operation of machine functions under specified conditions of the system.

joystick, *n*—manually controlled input device whose variable positions and orientations or applied forces are measured and result in commands to the robotic control system.

load-bearing surface, *n*—actual area of material in contact with and supporting a unit load.

manual mode, manual control, manual operation, *n*—operating mode in which the complete robotic system (for example, robot, A-UGV) is under control of an operator.

manufacturer, *n*—party that designs, makes, and/or sells robotic, automated, and/or autonomous systems.

mapping or **map building** or **map generation,** *n*—constructing the environment map to describe the environment with its geometrical and detectable features, landmarks, and obstacles. **ISO 8373**

master-slave control, *n*—control method in which the motion of a primary device (master) is reproduced on secondary devices (slaves). **ISO 8373**

DISCUSSION—Master-slave control is typically used for manual control.

maximum force or **maximum thrust,** *n*—force (thrust), excluding any inertial effect, that can be continuously applied without causing any permanent damage.

maximum moment or **maximum torque,** *n*—moment (torque) excluding any inertial effect that can be continuously applied without causing any permanent damage.

non-contact sensing device, *n*—device used to sense the presence, location, or other characteristics of objects without physical contact.

non-restricted area, *n*—area in which the robotic system (for example, robot, A-UGV) may operate and is shared with personnel.

normal operating conditions, *n*—range of conditions that can influence robotic system (for example, robot, A-UGV) performance (such as electrical supply instability, electromagnetic fields) within which the performance of the robotic system specified by the manufacturer is valid.

DISCUSSION—This could also include environmental conditions, for example, temperature and humidity.

object, *n*—anything in the environment that is not infrastructure.

object detection, *n*—use of sensors to identify the presence of an object.

obstacle, *n*—static or moving object that obstructs the intended movement.

obstacle avoidance, *n*—autonomously avoiding impact with obstacles (for example, stopping, driving around).

operator control unit (OCU), *n*—device linked (wireless or wired) to the control system with which a robotic system (for example, robot, A-UGV) can be programmed or moved; *see* **pendant**.

operating mode or **operational mode,** *n*—state of the control system.

operator, *n*—person designated to start, monitor, and stop the intended operation of a robotic system (for example, robot, A-UGV).

path deviation, *n*—measurement derived from the robotic system (for example, robot, A-UGV) control logic and guidance reference information that enables the robotic system to know whether it is wandering off the current intended path such that, when specified deviation tolerances are exceeded, appropriate action can be taken; *see* **intended path**.

path velocity fluctuation, *n*—difference between the minimum and maximum velocities along the complete path that result from traversing a given command path with a given command velocity and not from external interferences. **ISO 8373**