

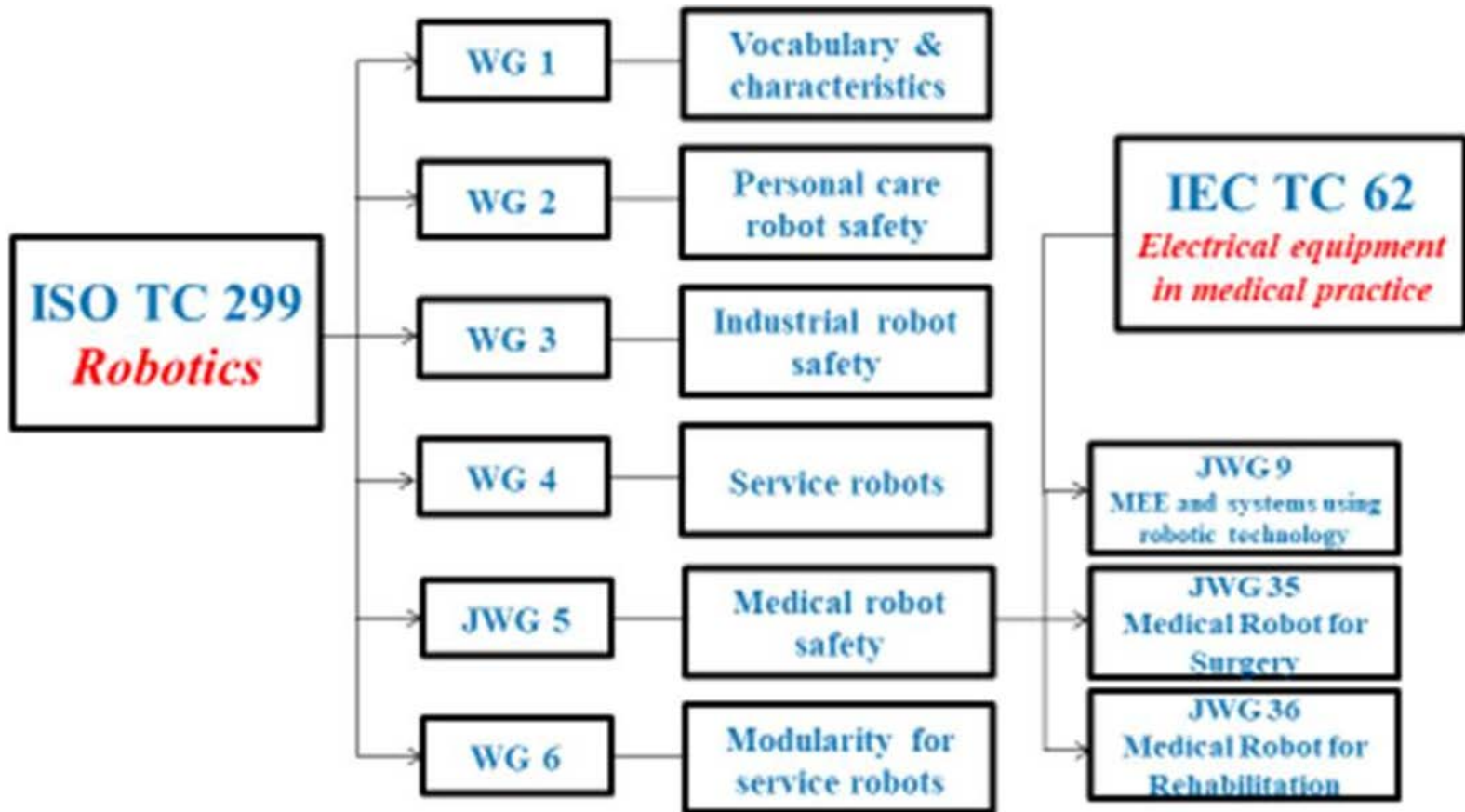


Status and Activities of ISO/TC 299 (Robotics) WG 1 (Vocabulary and characteristics)

Soon-Geul Lee



Organization of ISO TC 299





WG1 Structure

- Convenor: Soon-Geul Lee
- Number of registered experts: 43
- Number of participating countries: 12
- Scope:
 - Preparing a consistent vocabulary, including new service robots and a revision of the existing vocabulary for traditional robots (ISO 8373).
 - Definitions related common characteristic to facilitate for both applications in industrial environments, and the service robot development.





How does your group define terminology?

- Glossaries ...

How did you determine these definitions ?

- WG1 follows the official ISO standardization procedure.
 - Determine a next working item according to the ISO procedure.
 - The initial draft is obtained by consensus of WG1 members. But, WG1 have one more process of **discussion and coordination among WG's** before voting.



Definition related to the inquired terms in ISO 8373:2012



2.2

autonomy

ability to perform intended tasks based on current state and sensing, without human intervention

2.6

robot

programmed actuated mechanism with a degree of autonomy (2.2) to perform locomotion, manipulation or positioning

Note 1 to entry: A robot includes the control system (2.7) and interface of the control system.

Note 2 to entry: The classification of robot into industrial robot (2.9) or service robot (2.10) is done according to its intended application.

2.11

robotic device

actuated mechanism fulfilling the characteristics of an industrial robot (2.9) or a service robot (2.10), but lacking either the number of programmable axes (4.3) or the degree of autonomy (2.2)

EXAMPLES Power assist device; teleoperated device; two-axis industrial **manipulator** (2.1)

2.16

robotics

science and practice of designing, manufacturing, and applying robots (2.6)



Definition related to the inquired terms in ISO 8373:2012



4.2

pose

combination of position and orientation in space

NOTE 1 to entry: Pose for the manipulator (2.1) normally refers to the position and orientation of the end effector (3.11) or the mechanical interface (3.10).

NOTE 2 to entry: Pose for a mobile robot (2.13) can include the set of poses of the mobile platform (3.18) and of any manipulator (2.1) attached to the mobile platform, with respect to the world coordinate system (4.7.1).

5.3.10.1

automatic mode

operating mode (5.3.10) in which the robot control system (2.7) operates in accordance with the task program (5.1.1)

5.10

teleoperation

real-time control of motion of robot (2.6) or robotic device (2.8) from a remote site by a human

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



Summary of activities completed and documents published



- **ISO 8373** Robots and robotic devices — Vocabulary (Feb. 2010 ~ Jun 2012)
 - Revision of ISO 8373:1994 with developing new terminologies for service robots.
 - Existing 96 terms, 6 terms are removed, and 67 terms are introduced.
- **ISO 9787** Robots and robotic devices — Coordinate systems and motion nomenclatures (May 2011 ~ Apr. 2013)
 - Revision of ISO 9787:1999 by including mobile coordinate system for service robots.
 - Existing 5 coordinate systems and 3 coordinate systems are added. => 8 coordinate systems
 - Add with modification of “General rules for coordinate systems and motion nomenclature”



Summary of activities completed and documents published



- **ISO 19649** Mobile robots — Vocabulary (Mar. 2014 ~ Mar. 2017)
 - Scope: Terms used in relation with mobile robots which travel on a solid surface operating in both industrial robot and service robot applications.
 - ISO 8373 does not define terms relating to mobile robots fully. It defines terms used for describing mobility, locomotion and other topics relating to the navigation of mobile robots and mobile platforms.
 - Total 59 terms defined. (8 terms sourced from ISO 8373)





Work item under development

- **ISO 8373** Robotics – Vocabulary
 - Project leader: Soon-Geul Lee, Kyung Hee Univ., Korea
 - Systematic revision of ISO 8373:2012
- Purpose: keep consistent vocabularies and make harmonization between groups.
- Redefine basic vocabularies: autonomy, robot, robotics, etc.





Q&A

Thank you for your attention.





Appendix



ISO 8373:2012 Vocabulary



- **Robot**
- actuated mechanism programmable in two or more axes (4.3) with a degree of autonomy (2.2), moving within its environment, to perform intended tasks
 - NOTE 1 A robot includes the control system (2.7) and interface of the control system.
 - NOTE 2 The classification of robot into industrial robot (2.9) or service robot (2.10) is done according to its intended application.
- **Industrial robot:**
- automatically controlled, reprogrammable (2.4), multipurpose (2.5) manipulator (2.1), programmable in three or more axes (4.3), which can be either fixed in place or mobile for use in industrial automation applications
 - NOTE 1 The industrial robot includes:
 - the manipulator, including actuators (3.1);
 - the controller, including teach pendant (5.8) and any communication interface (hardware and software).
 - NOTE 2 This includes any integrated additional axes.



ISO 8373:2012 Vocabulary



- **Autonomy**
- ability to perform intended tasks based on current state and sensing, without human intervention

- **Robotic device**
- actuated mechanism fulfilling the characteristics of an industrial robot (2.9) or a service robot (2.10), but lacking either the number of programmable axes (4.3) or the degree of autonomy (2.2)
 - **EXAMPLES** Power assist device; teleoperated device; two-axis industrial manipulator (2.1)

ISO 8373:2012 Vocabulary



- **Service robot**
- robot (2.6) that performs useful tasks for humans or equipment excluding industrial automation applications
 - NOTE 1 Industrial automation applications include, but are not limited to, manufacturing, inspection, packaging, and assembly.
 - NOTE 2 While articulated robots (3.15.5) used in production lines are industrial robots (2.9), similar articulated robots used for serving food are service robots (2.10).
- **Personal service robot/Service robot for personal use**
- service robot (2.10) used for a non-commercial task, usually by lay persons
 - EXAMPLES Domestic servant robot, automated wheelchair, personal mobility assist robot, and pet exercising robot.
- **Professional service robot/Service robot for professional use**
- service robot (2.10) used for a commercial task, usually operated by a properly trained operator(2.17)
 - EXAMPLES Cleaning robot for public places, delivery robot in offices or hospitals, fire-fighting robot, rehabilitation robot and surgery robot in hospitals.



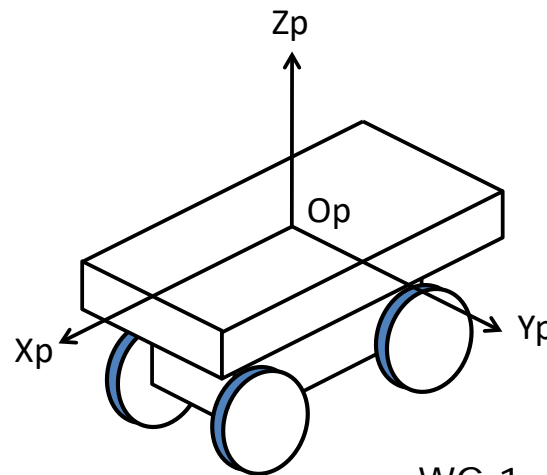
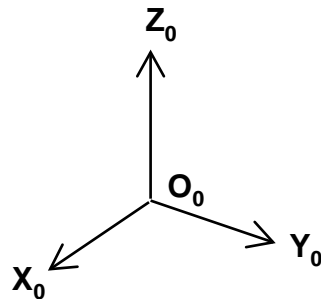
ISO 9787:2013 Coordinate systems and motion nomenclature (new coordinates)



- **mobile platform coordinate system**

$O_p - X_p - Y_p - Z_p$

coordinate system referenced to one of the components of a mobile platform (ISO 8373: 3.18 and 4.7.6). The origin of the mobile platform coordinate system, O_p , is the mobile platform origin (ISO 8373: 4.11). The $+X_p$ axis is normally taken in the forward direction of the mobile platform. The $+Z_p$ axis is normally taken in the upward direction of the mobile platform.



ISO 9787:2013 Coordinate systems and motion nomenclature (new coordinates)



- **task coordinate system**

$$O_k - X_k - Y_k - Z_k$$

coordinate system referenced to the site of the task

- **object coordinate system**

$$O_j - X_j - Y_j - Z_j$$

coordinate system referenced to the object

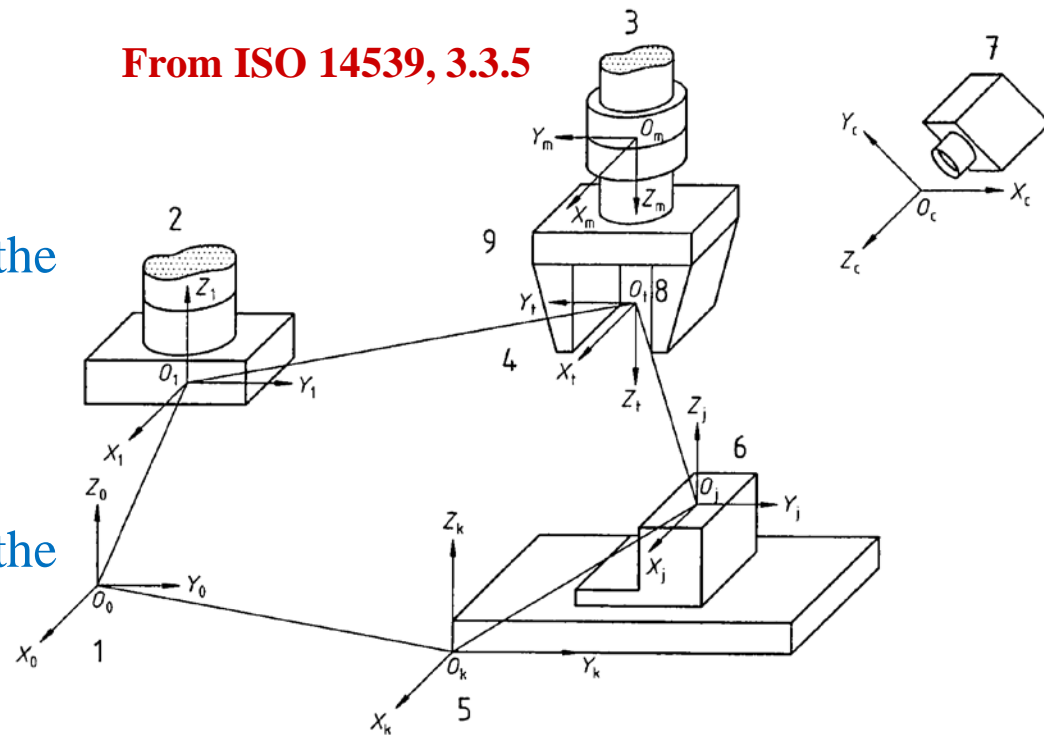
- **camera coordinate system**

$$O_c - X_c - Y_c - Z_c$$

coordinate system referenced to the sensor which monitors the site of the task

NOTE A vision system may be installed to detect the position and orientation of arbitrarily placed objects.

From ISO 14539, 3.3.5



ISO 19649:2017 Mobile robot – Vocabulary



- **alignment configuration**
special initial configuration (ISO 8373: 3.5) of the mobile platform defined by the manufacturer
EXAMPLE zero-steering configuration for a wheeled robot, stand-still configuration of a legged robot
- **ground contact area**
area of wheels, crawlers, or legs in contact with the travel surface (ISO 8373: 7.13)
- **support polygon**
minimum convex polygon that envelops all the ground contact areas
- **turning**
rotation, with or without translation, causing the change of direction of movement of mobile platform
- **centre of turning**
centre of the circular path of mobile platform origin
NOTE It is meant to be the centre of curvature.



ISO 19649:2017 Mobile robot – Vocabulary

- **turning radius**
radius of the circular path of mobile platform origin
- **pivot turn**
turning during which one wheel, crawler or leg is used for the centre of turning
- **spin turn**
in-place turning, or turning with the centre of turning at the mobile platform origin
- **gait**
cyclic motion of the leg in time for walking
- **stride**
travel distance of mobile platform origin for one cycle of gait
- **walking period**
time of one cycle of gait



ISO 19649:2017 Mobile robot – Vocabulary

- leg phase
ratio of time difference of the motion of a leg from the motion of the reference leg to the walking period
- support phase
stance phase
duration in which the leg is in contact with the travel surface
- swing phase
recovery phase
duration in which the leg is not in contact with the travel surface
- duty factor
ratio of the support phase of the leg to the walking period