IEEE RAS Standards Update

By Craig Schlenoff, Stephen Balakirsky, Howard Li, Francesco Amigoni, Signe Redfield, and Anthony Downs

On 19 May 2019, the Industrial Activities Board (IAB) of the IEEE Robotics and Automation Society (RAS) organized the second in a series of Standards Strategy Meetings at the IEEE International Conference on Robotics and Automation (ICRA) in Montréal. This was a followup meeting to one that was held the previous year in Madrid, Spain [1], in conjunction with the IEEE/RJS International Conference on Intelligent Robots (IROS) 2018. More information about this previous meeting can be found at https://www.ieee-ras.org/industry-government/standards/standards-strategy-meeting.

The focus of the Montréal meeting was on robot terminology harmonization among various standards organizations, one of the key strategic areas previously identified. Specific goals included

- determining the best mechanism(s) to implement, which will enable the various standards organizations to work together to address this issue
- determining the best approach to address the harmonization issue, whether it be a mapping between

Figure 1. Attendees of the Standards Strategy Meetings at ICRA 2019 in Montréal. Back row (from left): Seungbin Moon, Kwan-Woong Gwak, Gurvinder Virk, Koji Kamei, Roberta Nelson Shea, Signe Redfield, Pat Picarello, Stephen Balakirsky, Angel Guzman Rodriguez, Francisco Amigoni, Sebastian Bedacht, and Roger Bostelman. Front row (from left): Carole Franklin, Laurence Devillers, Chris Debrunner, Abdelghani Chibani, Craig Schlenoff, Edson Prestes, and Dominik Boesl.

terms, a common ontology, or something else
- working through a small set of terms/concepts that are common among the various standards to test to scope the problem.

A total of 27 people (some of whom are shown in Figure 1) attended the meeting, including many IEEE RAS working group chairs and representatives from the International Organization for Standardization (ISO), the Robotics Industries Association, American Society of Mechanical Engineers, American Society for Testing and Materials, and the Object Management Group as well as experts in various robotics fields including autonomous vehicles and industrial robotics. Detailed infor-

mation about the agenda and presentations can be found at https://www.ieee-ras.org/industry-government/standards/standards-strategy-meeting/meeting-2-19-may-2019.

Short presentations were given by nearly all of the attendees in the morning, focusing on the following three questions.
1) How does your group define terminology (e.g., ontologies, glossaries, or something else)?
2) How do you define the following terms (as appropriate): *robot, automated robot, teleoperated robot, environment*, and *pose*?
3) How did you determine these definitions (e.g., adopted from other standards, consensus among group members, or something else)?

In the afternoon, the IEEE Standards Association described various ways in which standards groups could work together, and then a discussion ensued, which determined the best way forward. During this discussion, there was a general consensus among all participants concerning the value of pursuing terminology harmonization. Specific recommendations/comments included the following.

The focus of the Montréal meeting was on robot terminology harmonization among various standards organizations.

1) There was agreement that the terms and their respective definitions are very specific and important to the various robotics fields. Especially for well-established standardization efforts, it would be difficult and likely counterproductive to change existing definitions and enforce their use. As such, it was suggested that we allow groups to maintain their current terms and definitions but provide a mechanism by which to map their terms to similar terms in other standards groups. The mechanism used for this should be the focus of the group's efforts.
2) ISO TC299 Working Group 1 (Vocabulary and Characteristics) started a similar effort, focusing on harmonizing terminology in the ISO TC299 working groups. It was suggested that we start with this effort and expand it to address terms in other standardization groups.
3) It was suggested that we start with a single term, i.e., *robot*, determine a core definition for it, and then perform the mapping to similar terms in existing standardization efforts. The feeling of the group was that simply determining a consensus definition for *robot* would be a significant and worthwhile feat.

4) A participant with a different point of view suggested that, instead of providing definitions for terms, we should supply a template with relevant attributes for each term, which an individual standards group can populate. For example, if we were doing this for the term *robot*, we may define attributes such as degrees of freedom, the components it is made of, load capacity, and so on.

There will be follow-up meetings at future IROS and ICRA conferences to continue this conversation. In the meantime, the IEEE RAS will set up a mailing list to allow ongoing discussion meetings. Please email craig.schlenoff@nist.gov if you are interested in joining.

In addition to the standards strategy meeting, individual IEEE RAS working and study groups had meetings in conjunction with ICRA 2019.

3D Map Data Representation Working Group Meeting
At the ICRA meeting, the 3D Map Data Representation Working Group nearly finalized the definition of the standard data formats that will be used to represent 3D maps exchanged between robot systems, possibly to be built by different developers. The data formats are based on JavaScript Object Notation (https://www.json.org), an open-standard, text-based file format that transmits data in a language-independent and human-readable way. The working group is not seeking solutions for the efficient processing of 3D maps but rather for inclusively representing different types of 3D maps and their properties, including grids (e.g., octrees), point clouds, and polygonal meshes. For more information about this working group, please contact Francesco Amigoni at francesco.amigoni@polimi.it.

Robot Task Representation Working Group Meeting
The Robot Task Representation Working Group (P1872.1), which also met during ICRA 2019, is striving to

define a standardized way of tasking intelligent robotic systems. The group's objective is to determine standard representations of items such as resources, constraints, tasks, and goals. Through this shared understanding, robotic systems from different developers will be able to cooperate to accomplish their missions. At the ICRA 2019 meeting, presentations and discussions were held on each subtopic under consideration for standardization. For more information about this working group, please contact Stephen Balakirsky at stephen.balakirsky@gtri.gatech.edu.

Autonomous Robot Working Group Meeting
The Autonomous Robotics Ontology Working Group (P1872.2) also met in Montréal during ICRA 2019. Nine members attended. This working group is a logical extension of IEEE 1872-2015, *Standard for Ontologies for Robotics and Automation*, and extends *Core Ontologies for Robotics Automation* by defining additional ontologies appropriate for autonomous robotics (AuR). The focus of the ICRA 2019 meeting was to discuss behaviors and capabilities. In addition, the working group reviewed the milestones and progress of
- the development of standard vocabularies
- the development of a functional ontology for AuR
- validation through case studies.

For more information about this working group, please contact Howard Li at howard.h.li@gmail.com.

Verification of Autonomous Systems Study Group Meeting
This study group is at the very beginning of its effort to develop guidelines and best practices for the verification of autonomous systems. The focus of this effort encompasses verification problems that extend from the specification and design stage through the development stage to final evaluation and testing to ensure

Region 8

- Italy
  - Politecnico Di Milano IEEE Robotics and Automation and Industrial Electronics Joint Societies Student Branch Chapter
- Turkey
  - Cankaya University, IEEE Power and Energy/Robotics and Automation/Computer/Industrial Applications/Aerospace and Electronic Systems Societies Joint Student Branch Chapter
  - Eastern Mediterranean University RAS Student Branch Chapter

Region 9

- Ecuador
  - Universidad Politecnica Salesiana—Quito RAS Student Branch Chapter in the Ecuador Section

Region 10

- India
  - Peoples Education Society University RAS Student Branch Chapter in the Bangalore Section
  - Saveetha Engineering College—Kancheepuram RAS Student Branch Chapter in the Madras Section
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More information may be found at https://www.ieee-ras.org/educational-resources-outreach/distinguished-lecturer-program

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that the system meets its specifications. During the ICRA meeting, members discussed the core best practices the guide will cover: terminology, how to build an assurance case, types of tools and techniques, and templates for verification processes. These best practices will support designers, developers, and their commercial partners as they transition autonomous systems from the lab to the rest of the world. For more information about this working group, please contact Signe Redfield at signe@ieee.org.

Robot Agility Study Group Meeting

The Robot Agility Study Group had its kickoff meeting at ICRA 2019. The meeting was attended by 10 people, and there was a very good discussion about the processes and procedures for the study group as well as forming a working group. The group also discussed the results of the recently completed Agile Robotics for Industrial Automation Competition, Year 3, and how the lessons learned from the competition can be used as the basis for the study group moving forward.

The meeting concluded with good suggestions for future work, including to make sure that the proposed future standard(s) and metric(s) be as general as possible and work across multiple applications. For more information about this working group, please contact Anthony Downs at anthony.downs@nist.gov.

Reference

[1] C. Schlenoff, "IEEE RAS standards update [Standards]," *IEEE Robot. Autom. Mag.*, vol. 26, no. 2, pp. 109–110, 2019. doi: 10.1109/MRA.2019.2910419.