

Autonomous Robotics Ontology

WG P1872.2 Ontologies for Autonomous Robotics

ICRA, Montreal, Canada

May 19, 2019

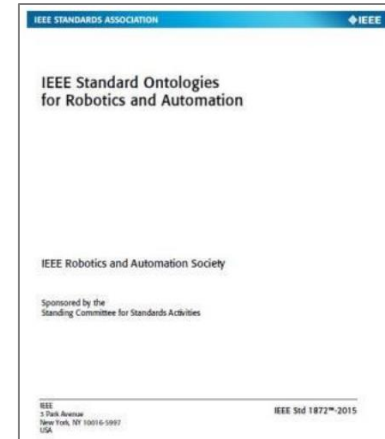
<http://www.ieee-ras.org/industry-government/standards/autonomous-robotics-group>

OUTLINE

- AuR Ontology
- Motivation
- Stakeholders
- Group Activities
- Publications
- Current Progress
- Proposed Ontological Framework
- Future Plan

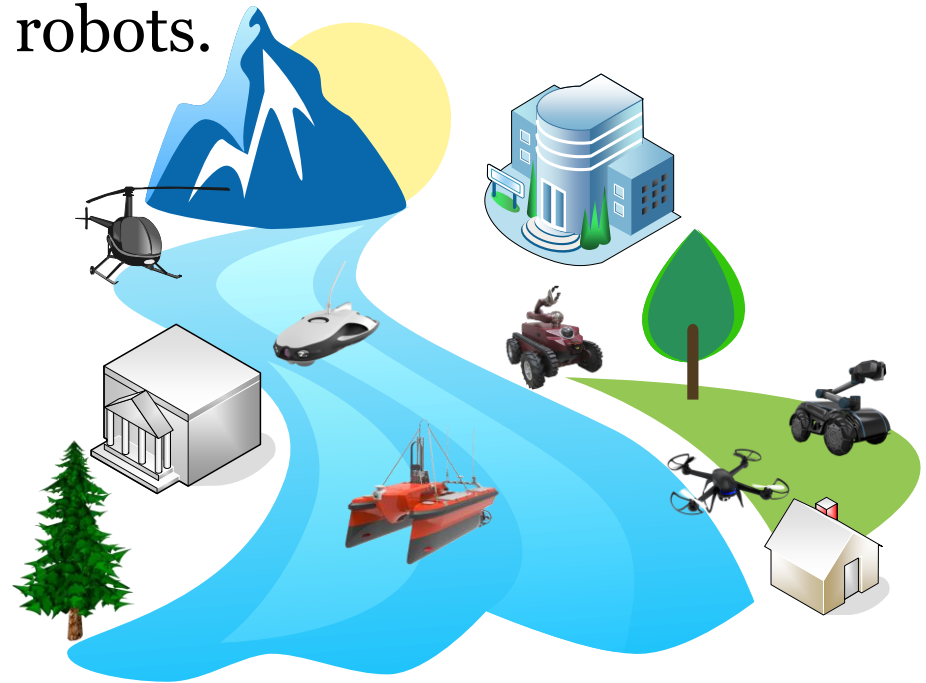
- **Autonomous Robotics (AuR) Ontology**

This standard is a logical extension to **IEEE 1872-2015 Standard Ontologies for Robotics and Automation**, focusing on **autonomous robotics**.



1. General **ontological concepts and domain-specific axioms** for AuR; and
2. General **use cases and/or case studies** for AuR.

- Knowledge needed to build autonomous systems comprised of robots that can operate in all classes of **unstructured environments** - including, but not limited to, aerial, ground, surface, underwater, and space robots.
- Allows for **unambiguous identification** of the basic **hardware and software components** necessary to provide a robot, or a group of robots, with **autonomy** (i.e. endow robots with the ability to perform desired tasks in unstructured environments **without continuous explicit human guidance**).



Application Domains

Cloud Robotics

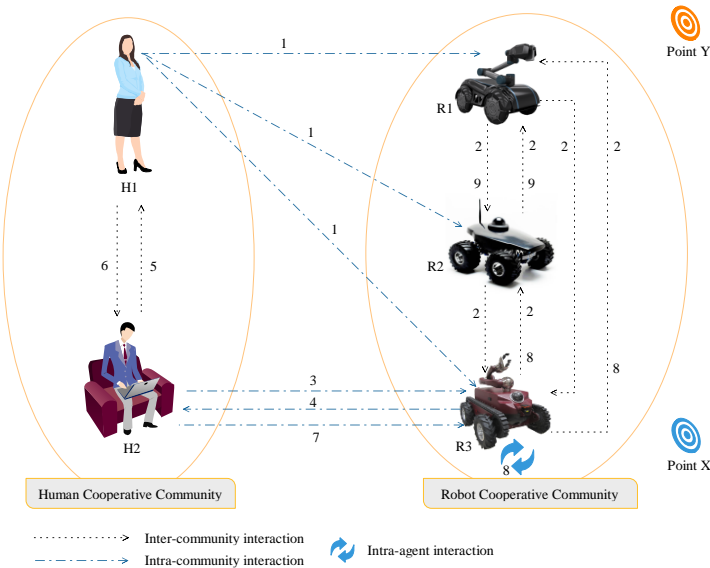
Autonomous Cars

Service Robots

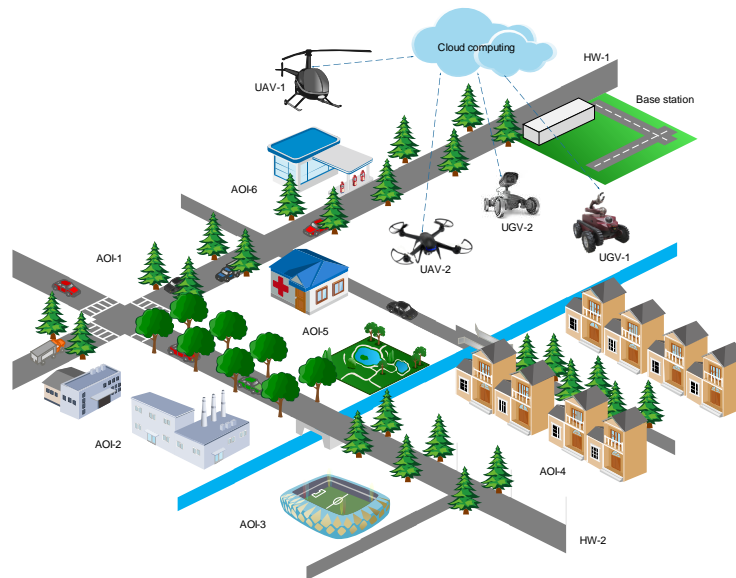
Industry 4.0

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- Robot designers and builders
- Robotics researchers
- Robot industry experts
- Robot users
- Policy makers



HRI Scenario in “Ontology for Autonomous Robots,” IEEE International Symposium on Robot and Human Interactive Communication, Lisbon, Portugal, 2017

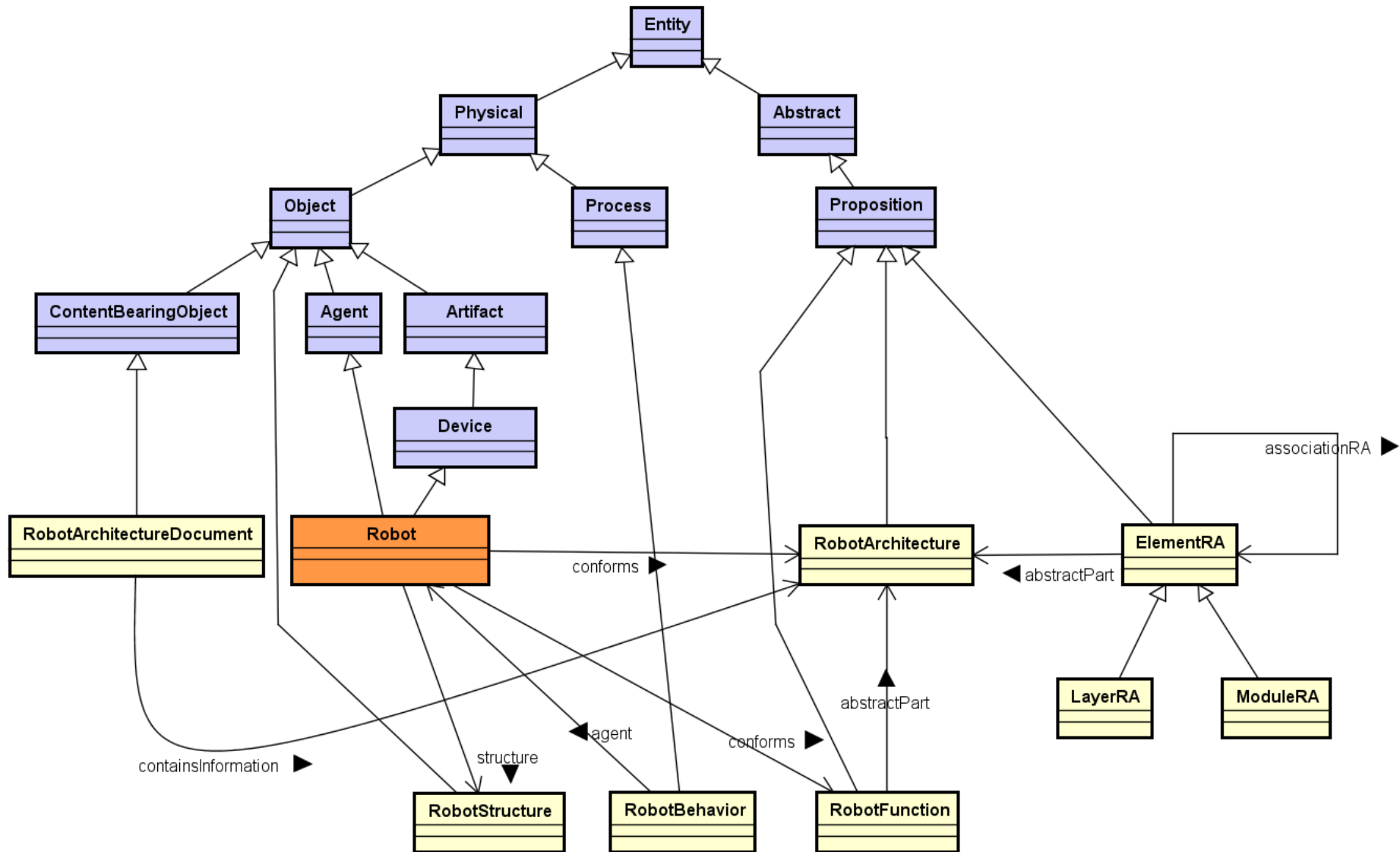


Law Enforcement Scenario in “Requirements for building an ontology for autonomous robots,” Industrial Robot: An International Journal, vol. 43, no. 5, pp. 469–480, 2016.

- Group members are from a cross-section of **industry, academia, and government** that represents over twenty countries and six continents.
- **Weekly tele-conference meetings** started in 2011.
- Workshop and working group kick-off meeting at **IEEE International Symposium on Robot and Human Interactive Communication**, Lisbon, Sept 2017.
- **Working group committee:** Joel Carbonera, Sandro Fiorini, Paulo Goncalves, Alberto Olivares, Veera Ragavan, Howard Li.

- “A suite of ontologies for robotics and automation,” IEEE Robotics and Automation Magazine, 2017.
- “Ontology for Autonomous Robots,” IEEE International Symposium on Robot and Human Interactive Communication, Lisbon, Portugal, 2017.
- “Requirements for building an ontology for autonomous robots,” Industrial Robot: An International Journal, vol. 43, no. 5, pp. 469–480, 2016.
- “Extensions to the core ontology for robotics and automation,” Robotics and Computer-Integrated Manufacturing, vol. 33, pp. 3–11, 2015, special Issue on Knowledge Driven Robotics and Manufacturing.
- “Towards an ontology for autonomous robots”, in IEEE/RSJ Int. Conf. on Intelligent Robots and Systems, 2012, pp. 1359–1364.

- **Architecture development:** function, behavior, structure models.
- **Vocabulary development:** entity, relationship, property, attribute.
- Due to difficulties in representing concepts in SUMO, it was decided to have SUMO as an option. The Group will try to **develop equivalent ontological concepts to represent autonomous robots at the upper level.**



Proposed Ontological Framework for Autonomous Robotics Architecture

Finish the four steps in **3 years by 2020**, then revise/update the architecture and vocabulary **by 2021** to finalize the standard

- 1. Development of standard vocabularies** for architectural concepts in IEEE1471 and IEC42010.
- 2. Development of a functional ontology** for R&A.
- 3. Checking/validation of relationship** using functions as a basis for relationship checking.
- 4. Using developed vocabularies and ontology** for conceptual design of robotic applications.

Thank you for your attention!

More information: <http://www.ieee-ras.org/industry-government/standards/autonomous-robotics-group>