IEEE 2021

ICRA

May 30 to June 5, 2021

Xi'an 西安 China

Workshop

Semantic Representations for Robotics through Continuous Interaction and Incremental Learning

Tamim Asfour, Wolfram Burgard, Oier Mees, Fabian Paus, Rainer Kartmann, Fabian Peller

IEEE Advancing Technology for Humanity

IEEE Robotics & Automation Society

KIT Karlsruhe Institute of Technology

UNI FREIBURG

Organizers

Tamim Asfour

Wolfram Burgard

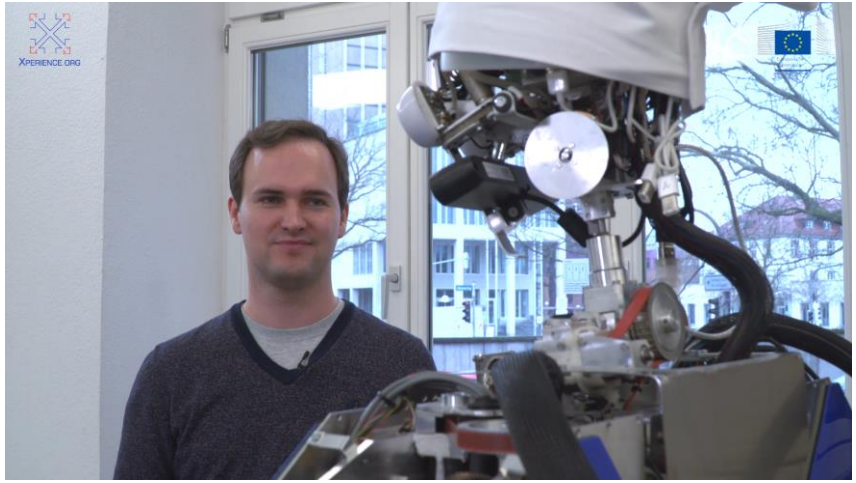
Oier Mees

Rainer Kartmann

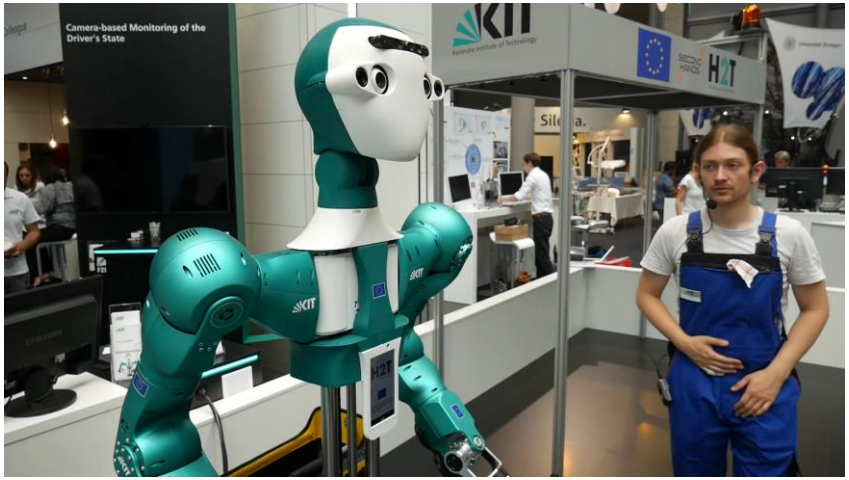
Fabian Paus

Fabian Peller

Motivation



ARMAR-3, please help me to prepare dinner for two people!



ARMAR-6, the conveyor belt is broken!

Learning of Semantic Representations for Robotics

- Research in embodied cognition is built on two central ideas:

1. Physical interaction with and exploration of the world allows an agent to acquire and extend intrinsically grounded, cognitive representations

2. Representations built from such interactions are much better adapted to guiding behaviour than human crafted rules or control logic.

- However, exploration and discriminative learning are relatively slow processes

Learning of Semantic Representations for Robotics

- Humans are able to **rapidly create new concepts** and react to unanticipated situations using experience.
  - “Imagining” and “internal simulation”, i.e. **generative mechanisms –** which rely on prior knowledge – are employed to **predict** the immediate future
  - Current cognitive robots systems are limited in this respect as they do not yet make efficient use of such generative mechanisms for the extension of their cognitive properties.

Learning of Semantic Representations for Robotics

- **Developmental approach:** Exploration of the world allows acquiring grounded and robust cognitive representations
  - **outside-in:** stimulus- and data-driven process
- **Human cognitive ability:** We are able to also use generative mechanisms based on experience for knowledge extension
  - **inside-out:** internally model-driven process and much faster!
- Outside-in and inside-out processes need to interact with each other at the earliest possible moment to drive cognitive development.

Challenges

- Learning semantic representations by combining exploration-based learning, and generative modelling
- Learning interpretable representations that are understandable by robots and humans
- Continual learning of such representations to rapidly create new concepts and react to unanticipated situations

Topics – Workshop Description

- Incremental learning and continuous adaptation of robot skills
- Learning of multimodal semantic representations for robotics
- Grounding natural language in action and perception
- Semantic action representation
- Verbalization of robot experience for human-robot interaction
- Combining human demonstrations, natural language and unsupervised/self-learning for robot skill learning and adaptation
- Semantic scene understanding based on object affordances and spatial and temporal relation
- Multimodal memory representations of robot experience
- Incremental learning for predicting scene dynamics and action effects
- Unsupervised and self-supervised learning to gain experience
- Reasoning about similarity between scenes, actions and tasks

Invited Speakers


Yiannis Aloimonos


Michael Beetz


Angelo Cangelosi


David Hsu


Giulio Sandini


Tetsunari Inamura


Karinne Ramirez-Amaro


Emre Ugur


Florentin Wörgötter

Program

11:00 – 11:10	**Welcome and Introduction** Tamim Asfour and Wolfram Burgard
11:10 – 11:30	**Tetsunari Inamura** – *National Institute of Informatics* Cloud-based VR gamification towards learning explanation of the daily-life activity
11:30 – 11:50	**David Hsu** – *National University of Singapore* Interactive Visual Grounding and Grasping in Clutter
11:50 – 12:10	**Angelo Cangelosi** – *The University of Manchester* Developmental Robotics for Language Learning, Trust and Theory of Mind
12:10 – 12:30	**Michael Beetz** – *University of Bremen* DTKR&R — a simulation-based predictive modelling engine for cognition-enabled robot manipula
12:30 – 13:00	**Contributed Talks (each 7 minutes)** – **Rodrigo Chacón Quesada** – *Imperial College London* Affordance Inference and Visualization for Assistive Robotics – **Rainer Kartmann** – *Karlsruhe Institute of Technology* Verbal Scene Manipulation based on Natural Language Instructions – **Iman Nematollahi** – *University of Freiburg* Deep Reinforcement Learning for Adapting Dynamical Systems
13:00 – 13:30	**Q&A + Panel Discussion 1** (Speakers and Participants)
13:30 – 14:00	**Break**
14:00 – 14:20	**Florentin Wörgötter** – *Georg-August University Göttingen* How Humans Recognize Actions: Behavioral and fMRI Experiments Support Robotic Action Grammar
14:20 – 14:40	**Karinne Ramirez-Amaro** – *Chalmers University of Technology* Robots that Reason – A Semantic Reasoning Method for the Recognition of Human Activities
14:40 – 15:00	**Emre Ugur** – *Bogazici University* Learning discrete representations from continuous self-supervised interactions: A neuro-symbolic robotics approach
15:00 – 15:20	**Yiannis Aloimonos** – *University of Maryland* The theory of Therbligs: A compositional approach to incremental robot learning
15:20 – 15:40	**Contributed Talks (each 7 minutes)** – **Alberto Olivares-Alarcos** – *Institut de Robòtica i Informàtica Industrial* Knowledge Representation for Collaborative Robotics and Adaptation – **Weiyu Liu** – *Georgia Institute of Technology* Combining Multimodal Interactive Perception and Semantic Reasoning – **Fabian Paus** – *Karlsruhe Institute of Technology* Extraction of Physically Plausible Support Relations – **Fabian Peller-Konrad** – *Karlsruhe Institute of Technology* Episodic Memory for Verbalization of Robot Knowledge
15:40 – 16:30	**Q&A + Panel Discussion 2** (Speakers and Participants)
16:30 – 17:00	**Concluding Remarks**

Slido and Slack

- Post your questions during the workshop on **Slido**:

  https://app.sli.do/event/ipot3thb

- **Slack:** for general communication
  https://join.slack.com/t/icra2021works-md33113/shared_invite/zt-r5vn5emo-pxOpCJ618Wq3_NQlBOQ5Jg

Workshop Material

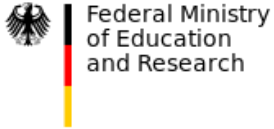
- Will be posted to the webpage
  https://h2t-projects.webarchiv.kit.edu/projects/SemanticRepresentationsWorkshopSeries

- This will include **slides** and/or **recordings of the talks**

Acknowledgement

Organic Machine Learning

ELLIS Program Robot Learning: Closing the Reality Gap!



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