

# Robot Curiosity in Human-Robot Interaction (RCHRI)

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**Abstract**—One of the fundamental modes of learning in children is through curiosity. Children (and adults) interact with new people, learn about novel objects, activities and other stimuli through curiosity and other intrinsic motivations. Creating autonomous robots that learn continually through intrinsic curiosity may result in breakthroughs in artificial intelligence. Such robots could continue to learn about themselves and the world around them through curiosity, thus improving their abilities over their ‘lifetime’. Although recent works on curiosity in different fields have produced significant results, most of these works have focused on constrained simulated environments which do not involve human interaction. However, in real-world applications such as healthcare, home-assistance etc., robots generally have to interact with humans on a regular basis. In these scenarios, it is imperative that curiosity is directed towards seeking out and learning important information from the humans when needed rather than simply learning in an unsupervised manner. Further, there is limited work on how humans perceive such curious robots and whether humans prefer curious robots that adapt over time to other robots that simply perform their assigned tasks. In this workshop, our goal is to bring together researchers and practitioners in different multidisciplinary fields to discuss the role of robot curiosity in real-world applications and its implications in human-robot interaction (HRI).

**Index Terms**—curiosity, intrinsic motivations, lifelong learning, human-robot interaction, active learning

## I. WORKSHOP OVERVIEW

The goal of this workshop is to provide a medium for researchers to present their research in progress and discuss topics related to curiosity-driven learning in robotics and HRI. The topics of interest for this workshop include, but are not limited to:

- Human perceptions of curious robots
- Long-term HRI studies with curious robots
- Tools and benchmarks for curiosity-driven learning
- Challenges in curiosity-driven learning in HRI
- Real-world applications of curious robots
- Metrics for evaluating curiosity-driven learning in HRI
- Curiosity-driven learning
- Self-supervised learning
- Intrinsic motivations

- Active learning
- Lifelong learning
- Lifelong (Long-Term) human-agent or multi-agent interactions
- Ethical and legal considerations for curiosity-driven learning in HRI

## A. Tentative Program

We plan to run a full-day event in which we expect 10-15 papers presented as pre-recorded talks, 5 invited talks and a panel discussion. We will invite authors to submit 2 page papers (with 2 extra pages for references and figures). The invited talks will be given by 5 invited speakers in areas relevant to the theme of the workshop. The panel discussion will be among 5 panelists from various fields related to curiosity in HRI. The tentative program of the workshop is shown as follows: (Final order of the speakers will be decided based on their schedule.)

Time	Program
9:00 AM - 9:10 AM	Opening
09:10 AM - 09:50 AM	Invited Talk 1: Edith Law
09:50 AM - 10:30 AM	Invited Talk 2: Georg Martius
10:30 AM - 10:45 AM	Coffee Break
10:45 AM - 11:45 AM	Paper Presentations
11:45 AM - 12:25 PM	Invited Talk 3: Maya Cakmak
12:25 PM - 01:05 PM	Invited Talk 4: Christoph Salge
01:05 PM - 02:00 PM	Lunch Break
02:00 PM - 03:00 PM	Paper Presentations
03:00 PM - 03:40 PM	Invited Talk 5: Goren Gordon
03:40 PM - 04:00 PM	Coffee Break
04:00 PM - 05:30 PM	Panel Discussion
05:30 PM - 05:40 PM	Closing Remarks

## B. Format of the workshop

Fully virtual: We expect to run the workshop remotely and synchronously through Zoom. University of Waterloo has a Zoom campus license which will allow us to run the workshop.

Hybrid: For the mixed in-person/virtual modality, we plan to follow the same program of the fully virtual tentative schedule. In this case we will make sure to stream the event online.

## II. ORGANIZERS AND SPEAKERS

### A. Organizers

**Dr. Ali Ayub** is a Postdoctoral Research Fellow at University of Waterloo, Canada researching in cognitive architectures and human-robot interaction, a natural continuation of his PhD dissertation titled, “Few-Shot Continual Learning of Visual Concepts”. Ali obtained his Master and PhD degrees from The Pennsylvania State University in 2017 and 2021, respectively. His research interests include curiosity and intrinsic motivations, lifelong learning, assistive robotics and human-robot interaction, which reflect his desire to develop robots that can be deployed in real-world environments.

**Dr. Marcus Scheunemann** is a postdoctoral researcher at the University of Hertfordshire, UK. His focus is on the fully autonomous behavior generation for robots to interact with humans based on information-theoretic measures. He entered this research avenue during his PhD, where he worked on the topic of “Autonomous and Intrinsically Motivated Robots for Sustained Human-Robot Interaction” on a PhD scholarship of Computer Science of the University of Hertfordshire. He currently investigates how behavior patterns a robot creates during exploration can be retained and reused. He further is an active member of the RoboCup community where his work is centered around machine learning for object recognition and locomotion, and on developing a general robot framework based on ROS 2.

**Dr. Christoforos Mavrogiannis** is a postdoctoral research associate in the Paul G. Allen School of Computer Science & Engineering at the University of Washington. He is broadly interested in algorithmic human-robot interaction with a particular focus on social robot navigation and expressive robot motion generation. He has been a best-paper award finalist at the ACM/IEEE International Conference on Human-Robot Interaction (HRI), and selected as a “Pioneer” in the HRI and RSS conferences. He has also led open-source initiatives such as MuSHR, and OpenBionics for which he was a finalist for the Hackaday Prize and a winner of the Robotdalen International Innovation Award. He holds M.S. and Ph.D. degrees from Cornell University, and a Diploma in mechanical engineering from the National Technical University of Athens.

**Dr. Jimin Rhim** is a Postdoctoral Research Fellow at McGill University. Her research include AI and robot ethics, human-robot interaction, affective robotics, and cross-cultural studies. As a human-centered roboticist, her research goal is to address the complete life cycle of robotics with social and ethical impacts on society. She investigates both conceptual and computational challenges in robotic acceptance, trust, and safety by using interdisciplinary research approaches to bridge the gap between theory and practical implementation. Further, her doctoral thesis entitled “Social-Value Embedded Ethical Decision-Making Framework of Autonomous Vehicles: A Cross-cultural Study” was selected as one of the top

research highlights of 2019 KAIST (Korea Advanced Institute of Science and Technology).

**Professor Kerstin Dautenhahn**, IEEE Fellow, is Canada’s 150 Research Chair in Intelligent Robotics at University of Waterloo in Ontario, Canada. She has a joint appointment with the Departments of Electrical and Computer Engineering and Systems Design Engineering, and is cross-appointed with the David R. Cheriton School of Computer Science. Before moving to Canada in 2018 she coordinated the highly successful Adaptive Systems Research Group at the University of Hertfordshire UK. Professor Dautenhahn is the director of the Social and Intelligent Robotics Research Laboratory (SIRRL). She has published widely in Human-Robot Interaction, Social Robotics, Assistive Technology, and Developmental and Cognitive Robotics.

**Professor Chrystopher Nehaniv** is a Mathematician, Computer Scientist, Complex Adaptive Systems Researcher, and, since August 2018, Full Professor in the Departments of Systems Design Engineering and of Electrical and Computer Engineering at the University of Waterloo in Ontario, Canada. He is also a visiting Professor with the University of Hertfordshire in the United Kingdom. He is founder of the Waterloo Algebraic Intelligence and Computation Laboratory (WAICL), and with Prof. Kerstin Dautenhahn, a co-founder of the University of Waterloo’s Social and Intelligent Robotics Research Laboratory (SIRRL). He has published widely in Human-Robot Interaction, Cognitive Architectures and Social Robotics.

**Professor Verena Hafner** is head of the Adaptive Systems Group at Humboldt-Universität zu Berlin in Germany. Before moving to Berlin, she worked as an associate researcher in the Developmental Robotics Group at Sony Computer Science Labs in Paris, France. She is part of the Programme Committee of the DFG Priority Programme The Active Self (SPP 2134) and PI in the DFG Cluster of Excellence “Science of Intelligence”. Her research interests include sensorimotor interaction and learning, joint attention, internal models, and exploration strategies.

**Professor Daniel Polani** is Professor of Artificial Intelligence, Director of the Centre for Computer Science and Informatics Research (CCSIR) and Head of the Adaptive Systems Research Group at the University of Hertfordshire. In 2017-2019 he was president of RoboCup Federation. His research interests are principles of cognition and intelligent decision-making, expressed in the language of information theory. The methods provide insights into the dynamics of cognition and models and tools to understand the structure of decision-making in agents, design intrinsic motivations, to model sensomotoric evolution and to investigate links between AI and biological intelligence.

### B. Invited Speakers and Panelists

All the speakers and panelists have **confirmed** to join and give an invited talk at the workshop.

**Professor Edith Law** is an Associate Professor at the David R. Cheriton School of Computer Science at University of

Waterloo. Her research focuses on designing and developing technologies that leverage the AI-people partnership to tackle more complex problems in business, science, education and medicine. In particular, she is interested in two lines of research: first, how people can enhance (e.g., human-in-the-loop systems, crowd-sourcing) and make sense of intelligent systems (e.g., issues related to transparency, engagement, trust and collaboration); and second, how intelligent systems can be designed to augment human abilities and virtues (e.g., curiosity, empathy, etc). She is part of the Human Computer Interaction Lab. Her work is funded by NSERC Discovery Grant, NSERC-CIHR Collaborative Health Research Project (CHRP) as well as the CFI-JELF program. She is a Graham Research Fellow for 2020-2022.

**Professor Maya Cakmak** is an Assistant Professor at the University of Washington, Computer Science & Engineering Department, where she directs the Human-Centered Robotics Lab. She holds a B.Sc. degree in Electrical & Electronics Engineering and a M.Sc. degree in Computer Engineering from the Middle East Technical University in Turkey. She received her Ph.D. in Robotics at the Georgia Institute of Technology in 2012, after working five years at the Socially Intelligent Machines Lab with Andrea L. Thomaz. Afterwards, she spent a year as a post-doctoral research fellow at Willow Garage, Inc. working with Leila Takayama. Her research interests are in human-robot interaction, end-user programming, and assistive robotics. She aims to develop robots that can be programmed and controlled by a diverse group of users with unique needs and preferences to do useful tasks.

**Dr. Georg Martius** is leading a research group on Autonomous Learning at the Max Planck Institute for Intelligent Systems in Tübingen, Germany. Before joining the MPI in Tübingen, he was a postdoc fellow at the IST Austria in the groups of Christoph Lampert and Gašper Tkačik after being a postdoc at the Max Planck Institute for Mathematics in the Sciences in Leipzig. He pursues research in autonomous learning, that is how an embodied agent can determine what to learn, how to learn, and how to judge the learning success. He is using information theory and dynamical systems theory to formulate generic intrinsic motivations that lead to coherent behavior exploration – much like playful behavior. With his research group, he is working on machine learning methods for robotics including reinforcement learning, intrinsic motivation, internal model learning, representation learning, and haptics.

**Dr. Christoph Salge** is a Senior Research Fellow at the University of Hertfordshire, with research interests in AI, intrinsic motivation, games and robotics. He recently completed a Marie-Curie Global Fellowship and is very interested to see how humans perceive and interact with artificial intelligence in games or robots. His talk will present both existing experimental work, and a future vision, for how to use coupled intrinsic motivation maximisation to create different social behaviours – based on the idea that the same algorithms that motivate reasonable single agent behaviour could be used to create reasonable agent-agent interaction.

**Dr. Goren Gordon** is a senior lecturer in the Department of

Industrial Engineering in Tel-Aviv University, Israel. He has a BSc, MSc in physics and MBA from Tel-Aviv University, Israel. He has one PhD in chemical physics on dynamical quantum decoherence control and another PhD in neurobiology on mathematical models of curiosity, both from Weizmann Institute of Science, Israel. He was a postdoc at the Personal Robots Group in the Media Lab, MIT, researching how curious robots interact with curious children, where he also obtained a teaching certificate. He now heads the Curiosity Lab in Tel-Aviv University, Israel. His research interests are computational models of curiosity; quantitative assessment tools for curiosity; and curious social robots that learn about other agents in their environment, all by themselves.

### III. ANTICIPATED TARGET AUDIENCE AND EXPECTED NUMBER OF PARTICIPANTS

#### A. Target Audience

We expect this workshop to be of interest to researchers from academia and industry. Curiosity-based learning has a huge potential in many real-world applications (e.g. robots in the homes, offices, hospitals, schools, etc.) and thus robotics companies can be expected to be highly interested in this field. We expect researchers from interdisciplinary backgrounds, such as HRI, cognitive robotics, social and affective robotics and computer vision to attend this workshop. Our goal is to encourage discussions and collaboration between research and real-world applications.

#### B. Number of Expected Participants

Based on the record of previous workshops on related topics that were organized in conferences such as ICRA, ROMAN and HRI, and the strong interest of the HRI community in curiosity-driven learning, we expect an attendance of around 70 people.

#### C. Approach for Recruiting Participants and Plans for Dissemination of the Workshop

We plan to use the mailing list robotics-worldwide as well as the HRI announcement list as the primary tools for recruiting participants. We will also circulate information about the workshop in relevant departments of different universities that we are associated with. We have created a website for our workshop as well (<https://sites.google.com/view/rchri/home>).

We will publish all the accepted papers on the workshop website. We will post the pre-recorded talks on our website if the speakers give us their permission. We also plan to organize a special issue in a journal such as Interaction Studies or IEEE Transactions on Cognitive and Developmental Systems, where we will invite authors of the contributed papers to send extended versions of their papers, as well as creating an open call for papers.