KY TO 2022 ON Intelligent Robots and Systems

October 23–27, 2022, Kyoto International Conference Center, Japan





2022 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2022) October 23–27, 2022, Kyoto International Conference Center, Japan

Conference Digest

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The Institute of Electrical and Electronics Engineers, Inc.

IROS 2022 Conference App

IROS 2022 Conference program and proceedings are available on the InfoVaya platform accessible from a desktop or mobile device. To access the program and papers through the app and/or the InfoVaya platform at **https://events.infovaya.com/event?id=106**, please log in or register using the email address used for the conference registration.



Internet Access

Free WiFi is available during the conference at the entire Kyoto International Conference Center. The login details are:

SSID: ICCK_Public_WiFi **Password:** not required.

SSID: IROS2022 Password: kyoto2022

Greetings

The IROS 2022, in the 35th-anniversary event of its history, aims to move robotics technology one step further with the theme "Embodied AI for Symbiotic Society" by providing an international forum for the global robotics community to explore the frontier of science and technology in intelligent robots and systems.

The IROS 2022 host city, Kyoto, founded in 794, has flourished as the capital of Japan for over a millennium. The city has preserved its refined culture, historical sites, and innumerable Shinto shrines and Buddhist temples, continuing to fascinate visitors worldwide. Kyoto has always been a center of culture and technological innovation in the city's long history, where 47 universities, numerous research institutions, and forward-thinking corporations proudly uphold Kyoto's tradition of innovation on the world stage. Holding IROS 2022 in Kyoto reflects a fantastic confluence between the rapid growth in the field, the best services to our society, and the SDGs (the Sustainable Development Goals).

For this year's IROS conference, we received a total of 3579 paper submissions, including 2288 regular paper submissions and 1291 submissions to Robotics and Automation Letters (RA-L) with the IROS option, from 57 countries and regions. Upon a careful review of the papers, 1716 papers were accepted into the IROS program representing an acceptance rate of 47.9%. In addition, 128 abstract-only submissions for late-breaking results posters and 80 workshop and tutorial submissions were submitted. The final program shall include 1765 papers, including 49 papers from Journal publications of TRO, TASE, and RAM, for oral presentation in 205 technical sessions over three days, 124 late-breaking results posters, and 43 workshops and tutorials.

The IROS 2022 technical program is anchored by three plenary talks and fifteen keynote presentations on topics focusing on the conference theme and representing the latest in intelligent robotics and systems research. To celebrate 35 years of IROS conferences by highlighting some significant contributions, two plenary speeches on the philosophy of "Robot Research and Development" and two keynotes on "Future Autonomous Systems" and "Assistive and Social Robots" will also be provided by world-recognized pioneers in the field. We believe and wish IROS has years to succeed in our mission to deliver benefits to the scientific and engineering communities and society at large.

Affected by the COVID-19 pandemic, we have not gathered in person for two years. We recognize the importance and value of the onsite meetings, which bring us together to meet physically, especially for newcomers to the IROS community. The IROS 2022 organizing committee then decided to hold the IROS as a traditional in-person conference. Virtual attendance will also be an option for those who have travel restrictions by their organization or do not feel comfortable participating in large gatherings, with the recognition that the conference cannot be experienced fully while remote. We strive to make the in-person event fruitful and memorable while following safety precautions as warranted.

On behalf of the organizing committee, we cordially welcome you to IROS 2022 and let us meet in Kyoto to explore a historical, cultural, and innovative city while we share and celebrate the latest developments in the robotics community.



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 $^{^{*1}\,}$ This program is supported by a subsidy from Kyoto City and the Kyoto Convention & Visitors Bureau.

^{*&}lt;sup>2</sup> The Japan Tourism Agency supported the IROS2022 financially to perform the demonstration project for holding international conventions by onsite & online hybrid.





COVID-19 & Health Information

Supervised by Prof. Miki Nagao, Graduate School of Medicine, Kyoto University Kyoto University Hospital (As of Sep. 19, 2022)

Health and Safety

Maintaining the health and safety of our conference attendees is our top priority. For that purpose, IROS 2022 will be following the venue-specific standards and local and national guidelines to host the event safely and effectively. Please cooperate with us in implementing the countermeasures described below to prevent the spread of COVID-19 infections.

General guidelines

Please take the following countermeasures to prevent the spread of the infection.

- Wear a face mask and take caution to protect others from getting infected.
- Sanitize your hands thoroughly and wash them frequently.
- Avoid the three Cs (closed spaces, crowded places, close-contact settings).
- Discourage greetings involving physical contacts such as handshakes, high fives, fist or elbow bumps, and hugs.
- Take your body temperature before leaving home and avoid coming to the conference venue if it is 37.5 °C or above.
- Refrain from discarding masks at the venue.

In case of symptoms or suspecting a close-contact

If you develop Covid-like symptoms during your stay in Kyoto, please contact:

 Kyoto Novel Coronavirus (COVID-19) Medical Consultation Center https://www.pref.kyoto.jp/kentai/corona/foreigntourists/medicalinenglish.html
 Tel: 075-414-5487
 Operating hours: 24 hours a day (Everyday including weekends and holidays)
 Multilingual support: 10:00–20:00

While anywhere else in Japan, please contact:

 MHLW Call Center - Ministry of Health, Labor and Welfare, Japan <u>https://www.mhlw.go.jp/stf/covid-19/inquiry.html</u> Tel: 0120-565-653 Operating hours: 24 hours a day (Everyday including weekends and holidays) Multilingual support: 9:00–21:00





Inform them of the region(s) you had stayed in most recently and visit the specified medical institution.

If tested Covid-positive

If you test Covid positive upon or after arrival in Japan, please cooperate with the active epidemiological investigations in accordance with the <u>Article 15</u>*³ of Act on the Prevention of Infectious Diseases and Medical Care for Patients with Infectious Diseases conducted by public health centers and other facilities with the help of local and/or national authorities.

Notice: It is important to note that the law mandates the cooperation of individuals with the relevant authorities to prevent the outbreak of an infectious disease or when clarifying the status of outbreaks, progress, and the cause of outbreaks. According to <u>MHLW guidelines</u>^{*4}, this includes promptly sharing your passport number and location information saved on your smartphone or other devices after arriving in Japan.

Alternate COVID-19 consultation desk (off-site)

 Japan Visitor Hotline - Japan Tourism Agency <u>https://www.japan.travel/en/plan/hotline/</u> Tel: 050-3816-2787
 Operating hours: 24 hours a day (Everyday including weekends and holidays) Multilingual support: Available

Policy on Registration Cancellation due to Travel/COVID-19 Restrictions

We encourage all attendees to register for in-person attendance only after receiving the travel authorization from your sponsor. Once you register, the conference anticipates your participation and incurs financial liabilities for your participation. If a change in your sponsoring organization's travel policy or travel restrictions imposed by the immigration/health authorities necessitate cancellation after you have registered and paid, standard conference cancellation policies^{*5} will apply.

We deeply appreciate your cooperation in preventing the spread of infection.



^{*&}lt;sup>3</sup> https://www.japaneselawtranslation.go.jp/en/laws/view/2830#je_toc

^{*4} https://www.mhlw.go.jp/content/11120000/000947350.pdf

^{*5} https://iros2022.org/registrationvisa/registration/

COVID-19 & Health Information for IROS2022 Onsite Participants

(As of Sep. 19, 2022)

IMPORTANT: Depending on the Covid-19 situation and Japanese govt. regulations, this notice might change without a prior notice. Therefore, all on-site conference attendees are requested to make sure that they follow the latest version. In addition, be sure to check the <u>Health & Safety page</u> on the IROS2022 conference website!

Keeping in view the prevailing situation of COVID-19 infections globally, the IROS2022 Stop COVID-Spread Countermeasure (SC2) Committee requests ALL ONSITE conference attendees including their accompanying persons, irrespective whether they are local or visiting from abroad, to strictly observe the following rules:

Get a PCR or antigen test before attending the IROS2022

If you test Covid positive, you cannot attend IROS2022 onsite. In addition, please cooperate with the active epidemiological investigations in accordance with <u>Article 15*3</u> of the Act on the Prevention of Infectious Diseases and Medical Care for Patients with Infectious Diseases conducted by public health centers and other facilities with the help of local and/or national authorities. Your personal information will be notified to the public health center by a physician who diagnosed you with COVID-19. If you did rapid antigen testing at home or hotel and obtained a positive band on the kit, please stay where you are and contact the <u>Kyoto Novel</u> <u>Coronavirus Medical Consultation Center</u> for further instructions.

 Kyoto Novel Coronavirus (COVID-19) Medical Consultation Center https://www.pref.kyoto.jp/kentai/corona/foreign- tourists/medicalinenglish.html Tel: 075-414-5487 Operating hours: 24 hours a day (Everyday including weekends and holidays) Multilingual support: 10:00–20:00



Book single or double rooms for conference stay

It is advisable for attendees to book single or double rooms (for two people) during their stay in Kyoto rather than living together in large groups.

Requests to participants from Kyoto International Conference Center (ICC Kyoto):

- Take your body temperature every day before leaving home or hotel.
- Wear masks and observe the coughing etiquettes (e.g., cough under your elbow).



- Thoroughly disinfect your hands and wash them regularly.
- Refrain from participating if you meet any conditions mandating admission restriction.
- Refrain from discarding masks on the conference venue.

Criteria to determine a Close-Contact during Group Dining

When a participant becomes infected, other dinner members will be considered as close contacts even if one of the following items was not observed:

When planning a dinner party:

- Check and observe guidelines for drinking/eating (QR Code →) by Kyoto Pref. Govt. while planning the dinner event.
- Choose eating-alone style such as course meal, multi-course Japanese dinner(Kaiseki), and set meal (not for sharing).





During a dinner party:

- Wear a non-woven mask, take off the strap only when eating or drinking, and do not touch the mask surface.
- Start speaking after everyone has taken on their masks.
- Do not talk while eating (eat silently).
- Coughing and sneezing without a mask breach the above criteria.



If you have a question on COVID-19, please do not hesitate to send an email to sc2@iros2022.org.

If you are infected with COVID-19, please send a report email to sc2@iros2022.org

Special Lecture

Oct. 23, 17:00-18:00@Main Hall (Presentation: 17:00-17:30, Q&A: 17:30-18:00)

Overcoming COVID-19 Pandemic through Collaboration between Academia and Local Government



Miki Nagao

Department of Clinical Laboratory Medicine, Kyoto University Graduate School of Medicine

Department of Clinical Laboratory, Department of Infection Prevention, Kyoto University Hospital

Abstract: The COVID-19 pandemic revealed the weakness of

molecular diagnostic systems at medical institutions in Japan. In addition, various issues including the medical delivery system for emerging infectious diseases and the shortage of human resources specializing in infection prevention were identified. Since the beginning of the pandemic, our group has concluded comprehensive agreements with Kyoto City, Osaka Prefecture, and related hospitals to tackle with COVID-19, and has promoted cooperation in COVID-19 testing and infection control. First, we established a large-scale molecular diagnostic system for mass testing and have been providing supports for infection control measures in elderly care facilities. Using mass testing system, we conduct administrative testing that exceeds the capacity of local governments and whole genome analysis which accounts for 20% of the total number of whole genome analysis in Japan at our hospital alone. Next, Kyoto City Public Health Center and Kyoto University collaborated to digitize the public health center's investigation of close contacts and developed an application that can centrally manage COVID-19 cases from identification to release from quarantine.

Overcoming the COVID-19 pandemic requires the collaboration of various technologies and experts, and these responses are expected to inform countermeasures against further emerging infectious diseases.

Bio: Miki Nagao is a professor of Clinical Laboratory Medicine at Kyoto University Graduate School of medicine. She also serves as a director of infection control team and clinical laboratory department at Kyoto University Hospital. She is a physician specializing in infectious diseases and clinical microbiology and is responsible for antimicrobial stewardship program in KUH. She also serves as a chief in COVID-19 research project organized by Kyoto University and local government in Kyoto. The principal areas of her research are infection prevention strategy for nosocomial pathogens, molecular epidemiology of multi-drug resistant pathogens and development of novel diagnostic tools.

Conference Venue

Kyoto International Conference Center (ICC Kyoto)

Takaragaike, Sakyo-ku, Kyoto 606-0001 Japan



How to get there?

- 5-minute walk from **Kokusaikaikan** Station on the **Karasuma Subway Line**. Exit the ticket gate and walk through the underground passage to **Exit 4-2**. Take the Karasuma Subway Line from Kyoto Station to Kokusaikaikan Station in 20 minutes.
- 5-minute walk from the **Kokusaikaikan-eki-mae** bus stop on the Kyoto City Bus and Kyoto Bus lines.



Transportation within Kyoto

Kyoto is a compact city, which makes transportation between hotels, meeting facilities, and other locations fast and easy. For information about transportation within Kyoto, please see "Getting Around Kyoto" from the QR-code.



Floorplan and Movement Lines

Please avoid crowding at the corridors.





Social Events

Following the regulations of the local government and the venue, we are not allowed to have dinner together in a large crowd. Therefore, the organizing committee needs to **cancel all such large gatherings: we will not hold a welcome reception, conference banquet, or farewell party**.

Instead, the IROS conference will **provide you with nice lunch boxes** on three technical session days and the opportunity to mingle with each other during lunchtime in numerous separate places while avoiding the large crowds. Please take this advantage to enjoy the meeting, network with each other, say hello to your old friends, and chat with new friends. The IROS conference also **provides a virtual room for networking after the day's technical sessions**. You can then chat with each other wherever you are staying in your hotel room or at a restaurant while preventing infection.

The IROS organizing committee, working with the local organizing team, will **provide a Japanese Drum Performance**, **"WADAIKO," and the fireworks display on the evening of Oct. 26** to show appreciation to all our participants and celebrate the success of the conference. We will also offer **other Japanese cultural experiences** and many **technical activities**.

We will update the event information on the conference website. Please check it.



Exhibition

IROS 2022 Exhibitions are located at Annex Hall and Event Hall. Exhibit hours are as follows:

Oct. 24 (Mon)	9:00 - 17:00
Oct. 25 (Tue)	9:00 - 17:00
Oct. 26 (Wed)	9:00 - 17:00

Technical Tours

RSJ-SICE-Technical Tour -OMRON, NAIST, NTT, ATR, Riken

The technical tour is sponsored by RSJ and SICE. Advance registration is required at the dedicated website (https://amarys-jtb.jp/iros2022/). 20 people limitation.

Schedule: Oct. 27, 9:00-18:00

- 9:00 Start from Kyoto International Conference Center
- 10:00 OMRON
- 11:30 Lunch@NAIST
- 12:30 NAIST
- 14:00 NTT
- 15:10 ATR/Riken

17:00-18:00 Transportation to The Prince Kyoto Takaragaike with drop-off points * using a charter bus during the tour

Number of possible participants: 20 people

Fees: 2,000 JPY (tax included)

Including a menu-controlled lunch box, a drink, and transportation.

Automatic inclusion of special guarantee provisions handled by the travel agency.

Cancellation policy:

No fee: 11 or more days before; 30%: 8 to 10 days before; 20%: 2 to 7 days before; 40%: the day before; 50%: on the day; 100%: after the start of the tour.

Lab Visit

The laboratories listed here are open to visitors. If you would like to visit, please contact the laboratory of your interest on your own.

Kyoto University

- Human-Robot Interaction Lab
- Mechanism and Motion Engineering Lab
- Matsuno Mechatronics Lab.

Kyoto University of Advanced Science (KUAS)

- Intelligent Systems & Advanced Robotics Laboratory
- Mechanical Systems Control Laboratory
- Computer Vision & Robotics Laboratory
- Nanomechatronics Laboratory
- Solid-State Power Processing Laboratory
- Energy & Communication Science Laboratory
- Electrical Machines and Drive Systems Laboratory

Ritsumeikan University

Lab Tour of Some Robotics-related Labs

RIKEN: Institute of Physical and Chemical Research

Guardian Robot Project







Program

Program at a Glance



Monday, October 24

	IROS 2022 Technical Program														
Main Ha ll	Rm1 (A)	Rm2 (B-1)	Rm3 (B-2)	Rm4 (C-1)	Rm5 (C-2)	Rm6 (D)	Rm7 (E)	Rm8 (F)	Rm9 (G)	Rm10 (H)	Rm11 (I)	Rm12 (J)			
					9:	00-09:50	Main Ha	all							
					Pl	enary 1:	The Rob	otics Pa	rt of Mic	ro and N	lano Rol	oots,			
					9.5	0-11:30 Re	egular Sess	sions							
	MoA-1	MoA-2	MoA-3	MoA-4	MoA-5	MoA-6	MoA-7	MoA-8	MoA-9	MoA-10	MoA-11	MoA-12			
10:00- 12:00 WiE Forum	Award Session 1	Learning 1	Service Robotics	Manipu- lation Systems 1	Computer Vision for Transpor- tation	Aerial Systems 1	Medical Robots & Systems 1	Mecha- nism Design 1	Object Detection, Segmen- tation & Categori- zation 1	Haptics	Human Factors & Human- In-The- Loop	Visual Learning			
	11:30-12:30 Lunch Break														
	12:30-14:00 MoKN-112:30-14:00 MoKN-2Main HallRm1 (Room A)Keynote Session 1Keynote Session 2														
	[14:00-14	:10 Break								
					14:1	0-15:40 Re	egular Sess	sions							
	MoB-1	MoB-2	MoB-3	MoB-4	MoB-5	MoB-6	MoB-7	MoB-8	MoB-9	MoB-10	MoB-11	MoB-12			
14:00- 17:00 Indus- trial	Award Session 2	Learning 2	Grasping 2	Manipu- lation Systems 2	Naviga- tion Systems 1	Aerial Systems 2	Medical Robots & Systems 2	Mecha- nism Design 2	Object Detection, Segmen- tation & Categori- zation 2	Force & Tactile Sensing	Human- Robot Co ll abo- ration	Visua l Servoing			
Forum					15	5:40 - 16:00	Coffee Bre	eak							
					16:0	0-17:30 <u>R</u> e	egular S <u>es</u> s	sions							
	MoC-1	MoC-2	MoC-3	MoC-4	MoC-5	MoC-6	MoC-7	MoC-8	MoC-9	MoC-10	MoC-11	MoC-12			
	Award Session 3 Award Session 4 Award 5 a spin 4 Session 3 Award 5 a spin 4 Session 3 Award 5 a spin 4 Award														
					17:30- Openi	18:00 Ma ng & We	ain Hall elcome								

Oct	ober 2	24 (M	on), 20	022							
Rm13 (K)	Rm14 (501)	Rm15 (509)	Rm16 (510)	Rm17 (553)	Rm18 (554)	Rm19 (555)	Rm20 (104)	Rm21 (on-line)	Rm22 (on -l ine)	Rm23 (on-line)	RmPO (Swan)
Bra	d Nelsor	n, ETH Zi	irich, Sw	itzerlan	d						
				10	9:50-1 00-11:30	0:00 Break Regular Se	ssions				
MoA-13	MoA-14	MoA-15	MoA-16	MoA-17	MoA-18	MoA-19	MoA-20	MoA-OL1		MoA-OL3	
Mapping 1	Human- Centered Robotics 1	Locali- zation 1	Represen- tation Learning	Automa- tion & Robotics at Micro- Nano Scales	Motion & Path Planning 1	Biologi- cally- Inspired Robots 1	Formal Methods in Robot- ics & Automa- tion	SLAM 1	-	Grasping 1	-
				11	:30-12:30) Lunch E	Break				
						12:3 Rn Key	0-14:00 M n2 (Roon vnote Se	MoKN-3 n B-1) ssion 3			
					14:00-1	14:10 Brea	k				

				14	:10-15:401	Regular Se	ssions				
MoB-13	MoB-14	MoB-15	MoB - 16	MoB-17	MoB-18	MoB-19	MoB-20	MoB-OL1	MoB-OL2	MoB-OL3	MoB-PO
Mapping 2	Human- Centered Robotics 2	Sensor Fusion 1	Reinforce- ment Learning 1	Micro/ Nano Robots	Motion Control	Biologi- cally- Inspired Robots 2	Factory Automa- tion & Logistics	SLAM 2	Locali- zation 2	Motion & Path Planning 2	Late Breaking Results Poster 1

15:40-16:00 Coffee Break

				16	:00 - 17:30	Regular Se	ssions				
MoC-13	MoC-14	MoC-15	MoC-16	MoC-17	MoC-18	MoC-19	MoC-20	MoC-OL1	MoC-OL2	MoC-OL3	
Mapping 3	Human- Centered Robotics 3	Sensor Fusion 2	Reinforce- ment Learning 2	Space Robotics & Automa- tion	Model Learning for Control	Biologi- cally- Inspired Robots 3	Failure Detection & Recovery	SLAM 3	Locali- zation 3	Motion & Path Planning 3	-
				1	7:30-18:	00 Main	Hall				
				С	pening	& Welc	ome				

Tuesday, October 25

							IR	OS 202	2 Tec	hnica	l Prog	ram
Main Ha ll	Rm1 (A)	Rm2 (B-1)	Rm3 (B-2)	Rm4 (C-1)	Rm5 (C-2)	Rm6 (D)	Rm7 (E)	Rm8 (F)	Rm9 (G)	Rm10 (H)	Rm11 (I)	Rm12 (J)
		•				09:00-	09:50 Ma	ain Hall			•	
						Plena	r <mark>y 2:</mark> Nav	vigation R	obot for	the Vis	ually Imp	aired,
					9: 10:0	50-10:00 E 0-11:30 Re	Break Pgular Ses	sions				
	TuA-1	TuA-2	TuA-3	TuA-4	TuA-5	TuA-6	TuA-7	TuA-8	TuA-9	TuA-10	TuA-11	TuA-12
	Award Session 5	Award Session 6	Grasping 4	Manipu- lation Systems 4	Naviga- tion Systems 3	SLAM 4	Virtual Reality & Interfaces	Tendon Driven Mecha- nisms	Planning under Uncer- tainty	Robot Safety	Human & Humanoid Motion Analysis & Synthesis	Vision
					11:30-1	2:30 Lur	ich Break	¢				
	Tup 1	THE 2	T. D. 2	Tup 4	12:3	0-14:00 R	egular Ses	sions	TUD 0	TuD 10	T. D. 11	Tup 12
	Award	Brain- Machine Interfaces	Telero- botics & Teleoper-	Calibra- tion &	Naviga- tion	SLAM	Medical Robots &	Robotics & Automa- tion in	Recog-	Safety	Humanoid & Bipedal	Computer Vision for
12:30- 15:30	7	Language Interaction	ation 1	cation	4	-	5	& Construc tion 1			tion	tion 2
IROS						14:00 - 14	l:10 Break					
35th					14:1	0-15:40 Re	egular Ses	sions				
Anniv. Forum	TuC-1	TuC-2	TuC-3	TuC-4	TuC-5	TuC-6	TuC-7	TuC-8	TuC-9	TuC-10	TuC-11	TuC-12
	Aerial Systems 4	Learning from Demon- stration 2	Telero- botics & Teleoper- ation 2	Manipu- lation Systems 6	Naviga- tion Systems 5	SLAM 6	Medical Robots & Systems 6	Collision Avoidance	Simula- tion & Anima- tion	Social HRI	Humanoid Robot Systems	RGB-D Percep- tion
					15:40-	16:00 Cof	ree Break					
				16 IR(:00-18:00 OS 35th / Tips t A Cul) Main H Anniver to Creato ture of I	lall sary For e Robots Robotics	um (Plena that Con Research	ary) itribute 1,	to Socie	ty and Sc	ience,

19:00-20:00 New Hall (Invited only) Gala Event

Oct	ober 2	25 (Tu	ie), 20	22									
Rm13 (K)	Rm14 (501)	Rm15 (509)	Rm16 (510)	Rm17 (553)	Rm18 (554)	Rm19 (555)	Rm20 (104)	Rm21 (on- l ine)	Rm22 (on- l ine)	Rm23 (on-line)	RmPO (Swan)		
Chie	eko Asak	awa, IBI	M Resea	rch, CMl	J, Miraik	an							
					9:50-1	0:00 Brea	k						
				10	:00-11:30	Regular Se	essions						
TuA-13	TuA-14	TuA-15	TuA-16	TuA-17	TuA-18	TuA-19	TuA-20	TuA-OL1	TuA-OL2				
Mapping 4	Soft Robot Materials & Design 1	Loca li- zation 4	Reinforce- ment Learning 3	Climbing & Wheeled Robots	Motion & Path Planning 4	Biologi- cally- Inspired Robots 4	Distribut- ed Robot Systems	Medical Robots & Systems 4	Computer Vision for Automa- tion 1	-	-		
	11:30-12:30 Lunch Break												
				12	:30-14:00	Regular Se	essions						
TuB-13	TuB-14	TuB-15	TuB-16	TuB-17	TuB-18	TuB-19	TuB-20	TuB-OL1	TuB-OL2	TuB-OL3			
Marine Robotics 1	Soft Robot Materials & Design 2	Locali- zation 5	Reinforce- ment Learning 4	Fie l d Robots	Motion & Path Planning 5	Swarm Robotics	Industrial & Parallel Robots	Learning from Demon- stration 1	Manipu- lation Systems 5	Biologi- cally- Inspired Robots 5	-		
					14:00-	14:10 Brea	l						
				14	:10-15:40	Regular Se	essions						
TuC-13	TuC-14	TuC-15	TuC-16	TuC-17	TuC-18	TuC-19	TuC-20	TuC-OL1	TuC-OL2		TuC-PO		
Marine Robotics 2	Soft Robot Applica- tions	Loca li- zation 6	Imitation Learning	Field & Marine Robotics	Motion & Path Planning 6	Control for Legged Robot	Intelli- gent & Flexible Manufac- turing	Robotics & Automa- tion in Agriculture & Construc tion 2	Reinforce- ment Learning 5	-	Late Breaking Results Poster 2		
	15:40-16:00 Coffee Break												

-- Shigeo Hirose, Tokyo Institute of Technology, Hyper-Environmental Robots (HERO) Laboratory, Japan -- Marc Raibert, Boston Dynamics, USA

> 19:00-20:00 New Hall (Invited only) Gala Event

Wednesday, October 26

							IROS	5 2022	. Tech	nnical	Prog	ram
Main Hall	Rm1 (A)	Rm2 (B-1)	Rm3 (B - 2)	Rm4 (C-1)	Rm5 (C-2)	Rm6 (D)	Rm7 (E)	Rm8 (F)	Rm9 (G)	Rm10 (H)	Rm11 (I)	Rm12 (J)
						9:00-	09:50 Ma	ain Hall				
						Plen	ary 3: To	wards C	ollective	e Artifici	al Intellig	gence,
					9:5	50-10:00 E	Break	scion				
	WeA-1	WeA-2	WeA-3	WeA-4	WeA-5	WeA-6	WeA-7	WeA-8	WeA-9	WeA-10	WeA-11	WeA-12
10:00- 11:50 Ethics Forum	Special Session: Computa- tional Advances in HRI 1	Special Session: Robotics in Agricul- ture & Livestock Farming Systems	Special Session: Robot Audition	Machine Learning for Robot Control 1	Soft Robot Modeling & Control 1	SLAM 7	Medical Robots & Systems 7	Compli- ance & Imped- ance Control 1	Software, Middle- ware & Program- ming Environ- ments 1	Wearable Robotics	Intention Recogni- tion	Semantic Scene Under- standing 1
				12:00-1	3:30 Ma Awa	in Hall 8 rds Lunc	Rm1 (R heon	oom A)				
		13	3:30-14:3	0 WeKN	-1					13:30	-14:30 W	eKN-2
			Mair	n Hall						Rm	n1 (Room	A)
		ŀ	eynote	Session	4	20.4.4.40	Dural			Keyr	note Sess	ion 5
					14:.	30-14:40 0-16:10 R	Break egular Ses	ssion				
	WeB-1	WeB-2	WeB-3	WeB-4	WeB-5	WeB-6	WeB-7	WeB-8	WeB-9	WeB-10	WeB-11	WeB-12
14:30- 17:30 Big Chal-	Special Session: Computa tional Advances in HRI 2	Learning from Demon- stration 3	Deep Learning for Visual Percep- tion 2	Machine Learning for Robot Control 2	Soft Robot Modeling & Control 2	SLAM 8	Rehabili- tation Robotics	Compli- ance & Imped- ance Control 2	Software, Middle- ware & Program- ming Environ- ments 2	Whole- Body Motion Planning & Control	Intelli- gent Transpor- tation Systems 1	Semantic Scene Under- standing 2
Forum					16 16:20	:10-16:20)-17:50 R	Coffee Bi egular Se	reak ssion				
- G. GITT	WeC-1	WeC-2	WeC-3	WeC-4	WeC-5	WeC-6	WeC-7	WeC-8	WeC-9	WeC-10	WeC-11	WeC-12
	Aerial Systems 7	Learning from Experi- ence	Deep Learning Methods	A l- Enabled Robotics	Soft Robot Modeling & Control 3	Cellular, Modular & Coopera- ting Robots	Prosthet- ics & Exo- skeletons 2	Robust/ Adaptive Control	Calibra- tion & Robot Safety	Multi- Contact Whole- Body Motion Planning & Control	Intelli- gent Transpor- tation Systems 2	Data Sets for Robotic Vision

18:00-19:00 Japanese Garden Farewell Activity

Oct	ober	26 (W	′ed), 2	022							
Rm13	Rm14	Rm15	Rm16	Rm17	Rm18	Rm19	Rm20	Rm21	Rm22	Rm23	RmPO
(K)	(501)	(509)	(510)	(553)	(554)	(555)	(104)	(on-line)	(on-line)	(on -l ine)	(Swan)

-- Radhika Nagpal, Princeton University, USA

					9:50-1	0:00 Brea	ak				
				10	:00-11:30	Regular S	Session				
WeA-13	WeA-14	WeA-15	WeA-16	WeA-17	WeA-18	WeA-19	WeA-20	WeA-OL1	WeA-OL2	WeA-OL3	
Multi- Robot Systems 1	Soft Sensors & Actuators 1	Path Planning for Multi Mobile Robots & Agents 1	Transfer Learning	Assembly & Additive Manufac- turing	Motion & Path Planning 7	Legged Robots 1	Art & Entertain- ment & Manipu- lation	Aerial Systems 5	Navigation Systems 6	Deep Learning for Visual Percep- tion 1	-

	12:00-13:30 Main Hall & Rm1 (Room A) Awards Luncheon												
						13:3 Rn Key	0-14:30 V n2 (Room note Ses	VeKN-3 n B-1) ssion 6					
					14:30-	14:40 Bre	ak						
				14	:40 - 16:10	Regular S	ession						
WeB-13	WeB-14	WeB-15	WeB-16	WeB-17	WeB-18	WeB-19	WeB-20	WeB-OL1	WeB-OL2	WeB-OL3			
Mu l ti- Robot Systems 2	Soft Sensors & Actuators 2	Path Planning for Multi Mobile Robots & Agents 2	Optimiza- tion & Optimal Control 1	 Bimanual & Motion & Path Hand Manipu- Itaion Aerial Aerial Systems Systems F Aerial Systems Systems F Prosthetics & Exostel Systems F Prosthetics & Exostel Systems F F Prostentics & Exostel Systems F F									
					16:10-16:2	20 Coffee	Break						
				16	:20-17:50	Regular S	ession						
WeC-13	WeC-14	WeC-15	WeC-16	WeC-17	WeC-18	WeC-19	WeC-20	WeC-OL1	WeC-OL2				
Autono- mous Agents	Actuation & Joint Mecha- nisms	Sensor Systems	Optimiza- tion & Optimal Control 2	Behavior- Based Systems	Motion & Path Planning 9	Legged Robots 3	Con- strained Motion Planning	Multi- Robot Systems 3	Path Planning for Multi Mobile Robots & Agents 3	-	-		

18:00-19:00 Japanese Garden Farewell Activity

Plenary Speakers

Plenary 1 Oct. 24, 9:00-9:50@Main Hall

The Robotics Part of Micro and Nano Robots



Brad Nelson

ETH Zürich, Switzerland

Abstract: Micro and nano robots have made great strides since becoming a focused research topic over two decades ago. Much of the progress has been in material selection, processing, and fabrication, and paths forward in developing clinically relevant biocompatible and biodegradable micro and nano robots are becoming clear. Our group, as well as others, maintain that using biocompatible magnetic composites with externally generated

magnetic fields and field gradients is perhaps closest to clinical application. One of the most challenging aspects of the field is in the development of the magnetic navigation system (MNS) that generates the fields and field gradients needed for microrobot locomotion. In this talk, I will present an overview of MNSs and show how these systems are fundamentally robotic in the way they must be designed and controlled. Decades of work in robotic manipulation can be brought to bear on this problem as we move forward in bringing MNS technology to the clinic. I will also look at recent efforts in creating more intelligent micro and nano robots that exhibit increasingly complex behaviors, some of which can even be programmed *in situ*. The field appears to be on the cusp of realizing the fantastic voyage.

Bio: Brad Nelson is the Professor of Robotics and Intelligent Systems at ETH Zürich and has recently become the Chief Scientific Advisor of *Science Robotics*. He has over thirty years of experience in the field and has received a number of awards in robotics, nanotechnology, and biomedicine. He serves on the advisory boards of a number of academic departments and research institutes across North America, Europe, and Asia. Prof. Nelson has been the Department Head of Mechanical and Process Engineering at ETH twice, the Chairman of the ETH Electron Microscopy Center, and a member of the Research Council of the Swiss National Science Foundation. He also serves on boards of three Swiss companies and is a member of the Swiss Academy of Engineering (SATW). Before moving to Europe, Nelson worked as an engineer at Honeywell and Motorola and served as a United States Peace Corps Volunteer in Botswana, Africa. He has also been a professor at the University of Minnesota and the University of Illinois at Chicago.

Plenary 2 Oct. 25, 9:00-9:50@Main Hall

Navigation Robot for the Visually Impaired



Chieko Asakawa

IBM Research, CMU, Miraikan

Abstract: Blind people face many difficulties when they navigate and explore unfamiliar places alone. In general, sighted people use visual information to find a destination and to avoid collisions. Blind people, however, must rely on non-visual information, such as haptic information from a white cane or ambient sounds. Recent technologies, such as AI and robotics, have great possibilities to offer new solutions to interpret visual

information to a non-visual medium, and guide blind people in a safe, socially compliant way in public spaces. In this talk, I will address our recent work concerning a suitcase-shaped navigation robot for the blind. It is equipped with motors and several sensors for autonomous navigation. On the top of the suitcase, it has LiDAR for localization and obstacle detection, and an RGB-D camera for detecting pedestrians to avoid collisions. The handle has buttons to control its movement, and vibrotactile devices to provide non-visual information. I will share recent experimental results in real-world environments, such as an airport, and a shopping mall. I will also talk about new challenges for the blind in the recent pandemic situation, and introduce possible solutions. Finally, I will discuss how we can accelerate the implementation of new technologies into our society.

Bio: Chieko Asakawa is an IBM Fellow, working in the area of accessibility. Her initial contribution to the field started from braille digitalization and moved onto the Web accessibility, including the world's first practical voice browser. Today, Chieko is focusing on real world accessibility to help the visually impaired understand their surroundings and navigate the world by the power of AI. She has been serving as an IBM Distinguished Service Professor at Carnegie Mellon University since 2014. She started to concurrently serve as Chief Executive Director of the Japanese National Museum of Emerging Science and Innovation (Miraikan) since April 2021. In 2013, the government of Japan awarded the Medal of Honor with Purple Ribbon to Chieko for her outstanding contributions to accessibility research. She was elected as a foreign member of the US National Academy of Engineering in 2017, inducted into the National Inventors Hall of Fame (NIHF) in 2019. She also received American Foundation for the Blind 2020 Helen Keller Achievement Award.

Plenary 3 Oct. 26, 9:00-9:50@Main Hall

Towards Collective Artificial Intelligence



Radhika Nagpal

Princeton University, USA

Abstract: In nature, groups of thousands of individuals cooperate to create complex structure purely through local interactions — from cells that form complex organisms, to social insects like termites and ants that build nests and self-assemble bridges, to the complex and mesmerizing motion of fish schools and bird flocks. What makes these systems so fascinating to scientists and engineers alike, is that even

though each individual has limited ability, as a collective they achieve tremendous complexity. What would it take to create our own artificial collectives of the scale and complexity that nature achieves? In this talk I will discuss several ongoing projects that use inspiration from biological self-assembly to create robotic systems: The Kilobot swarm inspired by cells, the Termes and EcitonR robots inspired by the 3D assembly of termites and army ants, and the BlueSwarm project inspired by fish schools. There are many challenges for both building and programming robot swarms, and we use these systems to explore decentralized algorithms, embodied intelligence, and methods for synthesizing complex global behavior. Our theme is the same: can we create simple robots that cooperate to achieve collective complexity?

Bio: Radhika Nagpal is a Professor of robotics at Princeton University, joint between the departments of Mechanical Engineering and Computer Science, where she leads the Self-organizing Swarms & Robotics Lab (SSR). Nagpal is a leading researcher in swarm robotics, bio-inspired algorithms, and self-organized collective intelligence. Projects from her lab include bio-inspired multi-robot systems such as the Kilobot thousand-robot swarm (Science 2014), the Termes robots for collective construction (Science 2014), and the Blueswarm underwater robots (Science Robotics 2021), as well as models of biological collective intelligence (Nature Communications 2022). In 2017 Nagpal co-founded ROOT Robotics, an educational robotics company aimed at democratizing Al and robotics through early education, recently acquired by iRobot. Nagpal is also known for her Scientific American blog article ("The Awesomest 7 Year Postdoc", 2013) advocating academic cultural change and she received the Anita Borg Early Career Award (2010) and McDonald Mentoring Award (2015). Nagpal is an ACM Fellow and AAAI fellow (2020), and was an invited TED speaker in 2017. Nagpal was named by Nature magazine as one of the top ten influential scientists and engineers of the year (Nature10 award, Dec 2014).

Keynote Speakers

Keynote Session1

Oct. 24, 12:30-14:00@Main Hall



Launching Socially-Aware Mobile Manipulation Robots in Hospitals

Vivian Chu CTO and Co-Founder, Diligent Robotics, USA

Toward Scalable Autonomy



Aleksandra Faust

Senior Staff Research Scientist, Google Research, Mountain View, USA



The Future of Intelligent Machines: Combining the Safety of Model-based Design with the Scalability of Data-Driven Algorithms

James Kuffner

Chief Digital Officer, Member of the Board of Directors, Operating Officer, Toyota Motor Corporation, Japan CEO, Woven Planet Holdings, Inc., Japan

Keynote Session 2

Oct. 24, 12:30-14:00@Rm1 (Room A)



Responsible & Empathetic Human Robot Interactions

Pascale Fung

Professor, Department of Electronic & Computer Engineering and Department of Computer Science & Engineering, The Hong Kong University of Science & Technology (HKUST)



Wearable Robotics with Smart Fluid Devices: Progress and Possibilities

Modar Hassan

Assistant Professor, Department of Intelligent and Mechanical Interaction Technologies, University of Tsukuba, Japan



Sensorimotor Control Meets Surgical Robotics – A Model of the Surgeon Can Benefit Patients

llana Nisky

Associate Professor, Department of Biomedical Engineering, Ben-Gurion University of the Negev, Israel

Keynote Session 3

Oct. 24, 12:30-14:00@Rm2 (Room B-1)



Anticipatory Control of Human-Robot Interaction: Towards Autonomous yet Truly Collaborative Robots

Arash Ajoudani

Director of HRI2 Laboratory, Istituto Italiano di Tecnologia, Genova, Italy



Robot-Assisted Remote Minimally Invasive Surgery: The Fusion of 5G and AI

Shuxin Wang Professor, Tianjin University, China



Inventing Robotic Mechanisms

Kenjiro Tadakuma Associate Professor, Tohoku University, Japan

Keynote Session 4

Oct. 26, 13:30-14:30@Main Hall



Al-Robotic Systems for Scientific Discovery -Role of Robotic Technologies

Kanako Harada

Associate Professor, Center for Disease Biology and Integrative Medicine (CDBIM), Graduate School of Medicine, The University of Tokyo, Japan



Swarms for People

Sabine Hauert

Associate Professor in Swarm Engineering, University of Bristol, UK

Keynote Session 5

Oct. 26, 13:30-14:30@Rm1 (Room A)



Shaping Robotic Assistance through Structured Robot Learning

Georgia Chalvatzaki Assistant Professor, TU Darmstadt, Germany



Advances in High-Power-Density Dielectric Elastomer Artificial Muscles and their Applications

Huichan Zhao

Associate Professor, Department of Mechanical Engineering, Tsinghua University, China

Keynote Session 6 Oct. 26, 13:30-14:30@Rm2 (Room B-1)



Robust Localization and Mapping toward Long-term Navigation

Ayoung Kim

Associate Professor, Department of Mechanical Engineering, Seoul National University, Korea



Safe Learning in Robotics

Angela Schoellig

Professor, Technical University of Munich & University of Toronto

IROS 35th Anniversary Forum

Oct. 25, 12:30-18:00@Main Hall

To highlight the contributions and celebrate the achievements and impacts of IROS's past 35 years!

sponsored by RSJ and SICE



Program:

Opening Introduction

Session 1: Autonomous Systems

12:45-13:30 (45 minutes with Q&A included) Session Chair: Christian Laugier, Research Director, Inria, France





Flying Robots – From basic flight capabilities to autonomous navigation and in-flight interactions

Roland Siegwart

Professor of Autonomous Systems Lab, ETH Zurich / Wyss Zurich, Switzerland

Session 2: Assistive and Social Robots

13:45-14:30 (45 minutes with Q&A included) Session Chair: Aude G. Billard Head of the LASA laboratory Swiss Institute of Technology Lausanne (EPFL), Switzerland





A Robot Just for You: Personalized Human-Robot Interaction and the Future of Work and Care

Maja J Matarić

Chan Soon-Shiong Distinguished Professor, University of Southern California, USA

Session3: Women in Robotics Engineering and Science

14:45-15:30 (45 minutes)

Session Chairs: Fumio Harashima Tokyo Metropolitan University, Japan

> Toshio Fukuda Nagoya University, Japan





Session 4: Robot Research and Development (Plenary Session)

16:00-17:30 (90 minutes with Q&A included) Session Chair: Shugen Ma IROS 2022 General Chair Ritsumeikan University, Japan





Tips to Create Robots that Contribute to Society and Science

Shigeo Hirose

Professor Emeritus of Tokyo Institute of Technology / Director of the Hyper-Environmental Robots (HERO) Laboratory, Japan



A Culture of Robotics Research

Marc Raibert

Chairman of Boston Dynamics, USA

Special Forums

WiE Forum

Oct. 24, 10:00-12:00@Main Hall

Women in engineering and their contribution to robotics: still unexploited potential?

Style: Panel discussion Organizers: Cecilia Laschi (NSU) & Yukie Nagai (University of Tokyo)

Moderator: Takako Hashimoto (Chiba University Commerce, IEEE Japan Council Chair) **Speakers:** Kanako Harada (University of Tokyo)

> Yu Jun Tan (National University of Singapore (NUS)) Jamie Paik (École polytechnique fédérale de Lausanne (EPFL)) Conception A. Monje Micharet (Universidad Carlos III de Madrid) Marwa ElDiwiny (Vrije University Brussel) Hong Qiao (Chinese Academy of Science)

Industry Forum Oct. 24, 14:00-17:00@Main Hall

IROS sponsor companies working toward a symbiotic society.

Style: Presentation

Organizers: Kensuke Harada (Osaka University), Ryuta Ozawa (Meiji University), Yantao Shen (University of Nevada, Reno) and Chao Ren (Tianjin University)

Regular presentation:

Florian Fuchs (Al Engineer, <u>Sony Al</u>) Shigeo Hirose (Professor Emeritus, Tokyo Institute of Technology, <u>HERO Lab. (Hakusan Corporation)</u>) Sunardi Tay (Chief Technology Officer, <u>LionsBot International</u>) Eric Pairet (Lead Researcher, <u>Technology Innovation Institute</u>) Kiki Ren (General Manager of VisionNav Japan, <u>VisionNav Robotics</u>)

Short presentation:

Govind Thattai (Principal Applied Scientist, <u>Amazon Science</u>) Jeff Cardenas (CEO, <u>Apptronik</u>) Robbie Edwards (Director of Technology, <u>Clearpath Robotics</u>) Felix von Drigalski (Lead Product Engineer, <u>Mujin</u>)

Video presentation:

Biomimetic Intelligence and Robotics, Bosch, Dubai Future Foundation, Khalifa University, KUKA, Mech-Mind Robotics Technologies, Mitsubishi Electric, ROBOTIS, THK, Woven Planet Holdings, Honda R&D, Toyota Frontier Research Center, Zebra Technologies/Fetch Robotics

Ethics Forum Oct. 26, 10:00-11:50@Main Hall

Can Robots be Human Centric? Opportunities & Challenges on the way towards a Symbiotic Society in the Age of AI

Style: Presentation and panel discussion **Organizers:** Toshie Takahashi (Waseda University) & Kristiina Jokinen (AIST)

Speakers:Malcolm Fisk (De Montfort University)
Randy Gomez (Honda Research Institute)
Yuko Harayama (RIKEN)
Yukiko Nakano (Seikei University)
Satoshi Narihara (Kyushu University)

Big Challenge Forum Oct. 26, 14:30-17:00@Main Hall

With the background of the rapid development of AI technology, the development of robot systems that can work in various situations has attracted worldwide attention. This forum aims to bring together these challenging international projects related to such robots for discussion and future international collaboration.

Style: Presentation and real robot demonstration **Organizer:** Tetsuya Ogata (Waseda University)

Speakers: Toshio Fukuda (Nagoya University)

Project Director of the Moonshot Research and Development Program, Goal 3

Tetsuya Ogata (Waseda University)

Project Investigator of Smart Robot that is Close to One Person for a Lifetime in the Moonshot

Tadahiro Taniguchi (Ritsumeikan University)

Project Investigator of Co-evolution of Human and Al-Robots to Expand Science Frontiers in the Moonshot

Tetsunari Inamura (National Institute of Informatics)

Project Investigator of Adaptable AI-enabled Robots to Create a Vibrant Society in the Moonshot

Takamitsu Matsubara (NARA Institute of Science and Technology)

Project Investigator of Innovation in Construction of Infrastructure with Cooperative AI and Multi-Robots Adapting to Various Environments in the Moonshot

Michael Littman (Brown University) Online

Division Director, Information and Intelligent Systems (IIS), Computer and Information Science and Engineering Directorate (CISE), National Science Foundation (NSF)

Cecile Huet (European Commission) Online

Head of Unit Robotics & Artificial Intelligence Innovation and Excellence–A1, European Commission, European Union

Robot Demonstration:

AIREC robot, i-Centipot-Hose, AI-robot scientists -platform-, Robotic Nimbus

Workshops and Tutorials



Sunday, October 23

- Horizons of an Extended Robotics Reality (XR2)
 a Converging Future of XR and Robotics (Full Day@Rm1 (Room A))
- Mobile Manipulation and Embodied Intelligence (MOMA): Challenges and Opportunities (Full Day@Rm2 (Room B-1))
- Tutorial: Practical Mesh Networking in Field Robotics (AM@Rm3 (Room B-2))
- Robotic Systems Integration for Supply Chain Workflows: Design, Deploy, Execute (PM@Rm3 (Room B-2))
- Computational Design of Soft Robots (Full Day@Rm4(Room C-1))
- Large-Scale Robotic Skin: Perception, Interaction, and Control (Full Day@Rm5 (Room C-2))
- RoboTac 2022 Visuo-Tactile Predictive Coding and Active Inference for Grasp and Manipulation: New Advances in Tactile Sensation, Interactive Perception, and Learning in Robotics (Full Day@Rm6 (Room D))
- 13th Workshop on Planning, Perception and Navigation for Intelligent Vehicles (Full Day@Rm7 (Room E))
- Tutorial: Riemann and Gauss meet Asimov: A Tutorial on Geometric Methods in Robot Learning, Optimization and Control (Full Day@Rm8 (Room F))
- Robotics for Nuclear Environments Exploration and Decommissioning: Challenges and Emerging Techniques (Full Day@Rm9 (Room G))
- Ergonomic Human-Robot Collaboration: How Cognitive and Physical Aspects Come Together (Full Day@Rm10 (Room H))
- 3rd workshop on RObotic MAnipulation of Deformable Objects: challenges in perception, planning and control for Soft Interaction (ROMADO-SI) (Full Day@Rm11 (Room I))
- Evaluating Motion Planning Performance: Metrics, Tools, Datasets, and Experimental Design (Full Day@Rm12 (Room J))

- 5th Workshop on Proximity Perception Towards Next-Generation Multi-Modal Sensing in Soft Structures (Full Day@Rm13 (Room K))
- Assistive Robots in the Real World: Supporting Health Care Professional to Leverage Autonomous Assistive Devices (AM@Rm14 (Room 501))
- 2nd Workshop on Perceptive Locomotion (PM@Rm14 (Room 501))
- Advanced Robotics and Visualization for Ophthalmic Surgery. IROS – ARVOS (Full Day@Rm15 (Room 509))
- Tutorial: Ethical, Legal and User Perspectives on Robots and Systems (ELAUPORAS) (Full Day@Rm16 (Room 510))
- Computer-integrated Surgery: Intelligent Robotic Systems of the Future (Full Day@Rm17 (Room 553))
- RL-CONFORM: Reinforcement Learning meets Human-Robot Interaction, Control, and Formal Methods (Full Day@Rm18 (Room 554))
- Life-long Learning of High-level Cognitive and Reasoning Skills (Full Day@Rm19 (Room 555))
- Tutorial: ROS4HRI Tutorial: From Zero to Multi-Modal Interactive Dialogue for Robots (Full Day@Rm20 (Room 104))

Thursday, October 27

- Probabilistic Robotics in the Age of Deep Learning (Full Day@Rm1 (Room A))
- A Panacea or an Alchemy?—Benefits and Risks of Robot Learning in Medical Applications (Full Day@Rm2 (Room B-1))
- Software and Control Architecture for Robotics (Full Day@Rm3 (Room B-2))
- Tutorial: Tactile Servoing (AM@Rm4 (Room C-1))
- Tutorial: Open and Trustworthy Deep Learning for Robotics (PM@Rm4 (Room C-1))
- Perception and Navigation for Autonomous Robotics in Unstructured and Dynamic Environments (Full Day@Rm5 (Room C-2))

- Workshop on Animal-Robot Interaction (Full Day@Rm6 (Room D))
- Behavior-driven Autonomous Driving in Unstructured Environments (Full Day@Rm7 (Room E))
- Workshop on Social and Cognitive Interactions for Assistive Robotics (SCIAR) (Full Day@Rm8 (Room F))
- Artificial Intelligence for Social Robots Interacting with Humans in the Real World (Full Day@Rm9 (Room G))
- Cloud and Fog Robotics in the Age of Deep Robot Learning (Full Day@Rm10 (Room H))
- Trends and Advances in Integrating Machine Learning and Automated Reasoning for Intelligent Robots and Systems (Full Day@Rm11 (Room I))
- Miniature Robot Platforms for Full Scale Autonomous Vehicle Research (Full Day@Rm12 (Room J))
- Workshop on Human Theory of Machines and Machine Theory of Mind for Human Agent Teams (Full Day@Rm13 (Room k))
- Assistive Robotic Systems for Human Balancing and Walking: Emerging Trends and Perspectives (Full Day@Rm14 (Room 501))
- Decision Making in Multi-Agent Systems (Full Day@Rm15 (Room 509))
- The Role of Uncertainty and How It is Tackled in Robotic Grasping and Manipulation (Full Day@Rm16 (Room 510))
- Agile Robotics: Perception, Learning, Planning, and Control (Full Day@Rm17 (Room 553))
- Human-Multi-Robot Systems: Challenges for Real World Applications (Full Day@Rm18 (Room 554))
- Soft Robots for Humanity (Full Day@Rm19 (Room 555))
- Robot Trust for Symbiotic Societies (Full Day@Rm20 (Room 104))

Competition



Onsite Competition

WRS FCSC Trial Competition @ IROS 2022

– Stock and Disposal Task

Oct. 24–26@Event Hall

Organizers: Kazuyoshi Wada (Tokyo Metropolitan Univ.) & Kenichi Ohara (Meijo Univ.)

This challenge aims to develop technologies to automate the stocking of products and the collection of expired items in a convenience store. Participants in this competition will develop a robot system that autonomously moves and performs these tasks, as well as the infrastructure they deem necessary to install inside the convenience store.

Dialogue Robot Competition 2022

Oct. 25-26@Event Hall

Organizers: Ryuichiro Higashinaka (Nagoya Univ.), Takashi Minato (RIKEN), etc.

Dialogue robot competition 2022 is the first international competition for the communication capability of conversational robots. A very human-like android robot is used. The competition has two rounds, a preliminary round and the final round. At IROS, the top teams in the preliminary round will compete to decide the winning team

Interactive Service Robot Competition in Cyberspace Oct. 24–25@Event Hall

Organizers: Tetsunari Inamura (NII) & Yoshiaki Mizuchi (Tamagawa Univ.)

This competition evaluates how well intelligent robots can engage in natural and friendly communication with users and achieve various support behaviors in daily-life environments. The competition is designed based on the SIGVerse simulator, which enables robots to make embodied and social interactions in virtual reality (VR) environments.

Robotic Grasping and Manipulation Competitions

Oct 24-25@Lobby of Annex Hall

Organizers: Yu Sun (Univ. of South Florida), Yasuyoshi Yokokohji (Kobe Univ.), etc.

This competition consists of two tracks, a service robotics track and a manufacturing robotics track. The service robotics track consists of several tasks with the ultimate goal for the competing robot system to autonomously create a table setting for four. The manufacturing track consists of several manufacturing assembly tasks with the goal of supporting the advancement of robotic systems for variable small-batch production runs.

Online Competition

- IROS-SB Self-Balance Robot Competition for Young Students
- METRICS HEART-MET Assistive Robot Challenge
- Industrial Mobile Manipulator Challenge (IMMC)
- Safe Robot Learning Competition
- The Season Depth Prediction Challenge



VisionNav Robotics

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