Conference Digest

2025 IEEE/RSJ International Conference on Intelligent Robots and Systems
October 19–25, 2025 in Hangzhou, China

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SCAN ME!

Internet Access

Free WiFi is available during the conference at the entire Hangzhou International Expo Center.

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Welcome

Welcome to IROS 2025 in the enchanting city of Hangzhou, known as the "Heaven on Earth"!

The theme of IROS 2025 is "human-robotics frontier". Empowered by Al breakthroughs, the future of robotics envisions intelligent systems transforming industries, enhancing productivity, and tackling global challenges through seamless human collaboration. IROS 2025 commits to be a forum to facilitate multi-disciplinary and convergent research in human-robotics frontier. Twenty years after IROS 2006 in Beijing, we are proud to take up the torch by showcasing the cutting-edge robotics innovation to the world.

We are delighted to announce that IROS 2025 received 5,083 submissions from 66 countries and regions, including 4,306 conference papers and 777 journal transfers (from RA-L, RA-P, T-RO, T-FR, T-ASE, RA-M, T-IE, T-II, and T-MECH). Following a rigorous review process led by the IROS Conference Paper Review Board, 1,991 conference papers have been accepted (acceptance rate: 46%). The technical presentations include three plenary lectures, 48 keynote talks, 187 Late Breaking Results posters, and 2672 paper presentations organized into 359 sessions presented in 30 parallel tracks. Each technical session consists of two parts: a first half consisting of 5-minute oral presentations for each paper, and a second half devoted to poster presentations for these same papers. The keynote talks are organized into a single-track that will run in parallel with the technical sessions. This keynote track consists of 12 sessions, each of which features four 20-minute talks on a single topic. The organization of this year's technical program is inspired by ICRA2025 (Atlanta) and by the recently held ICRA@40 (Rotterdam).

In addition to the technical presentations, IROS 2025 also features 82 Workshops and 3 Tutorials, and several forums including the Government Forum, Special Forums, Women in Engineering Forum, and Industry Forum. A debate panel will be held on Wednesday to debate on the question: Humanoids Will Soon Replace Most Human Workers: True or False?

Serving as the primary venue for exhibition and interactive events, the approximately 17300 sq. m. Exhibition Hall in Hangzhou International Expo Center will accommodate a diverse range of activities. The expansive exhibition area will host over 157 exhibitors showcasing cutting-edge technologies, alongside 8 robotics competitions. The IROS Expo will also serve as a dynamic hub for live interaction, inspired by the successful model of IROS 2023, ICRA 2024, and ICRA 2025. It provides a unique platform for researchers to demonstrate their robotic systems in real-world scenarios and engage in direct discussion.

As the southern terminus of the ancient Grand Canal, Hangzhou has been a vibrant hub of exchange for over a millennium. The city is celebrated for its historic silk production, which represented one of the highest forms of technical skill of its time. This long tradition of excellence has nurtured a culture of precision and innovation. Today, that spirit lives on, as Hangzhou has grown into a major hub for the digital economy and advanced technology like robotics.

On behalf of the IROS 2025 Organizing Committee, we extend our warmest welcome to all participants. We are thrilled to host this premier gathering in the inspiring setting of Hangzhou, where ancient traditions of innovation meet cutting-edge technology. Over the coming days, we wish you inspiring discussions and fruitful exchanges, and we look forward to exploring the new frontiers of human-robot interaction together.

Hesheng Wang

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DEXMAL

Exhibitors (cont.)

Conference Venue

Hangzhou International Expo Center (HIEC)
353 Benjing Avenue, Xiaoshan District, Hangzhou City, Zhejiang Province, China.

How to get there?

Metro: As Google map can NOT be accessed without VPN, while other electronic maps do not have mature English version, we recommend IOS users to use the iPhone map and Android users to use Petal map for navigation.

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Bus: While there is no foreign language service on Hangzhou public buses and most drivers do not speak English, you can use maps and translation apps for navigation. It's also advisable to learn basic Chinese phrases for asking directions.

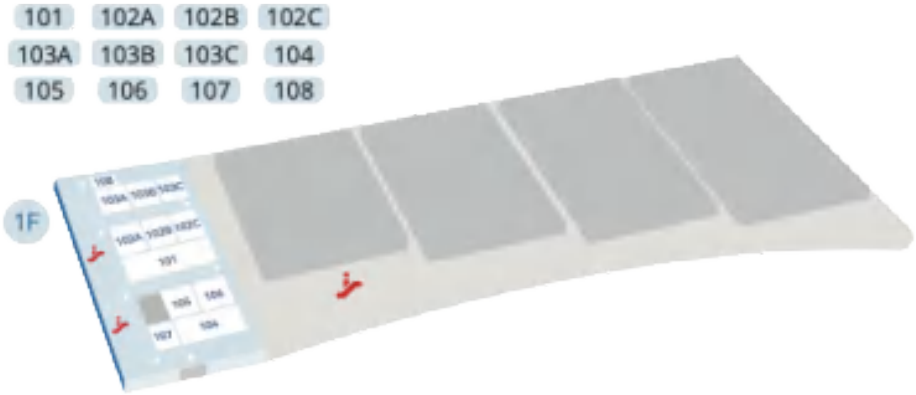
Taxi or Ride-hailing Service: Didi Chuxing (滴滴出行) is China's leading mobile transportation platform, often referred to as China's Uber.

For more information, you could refer to our transportation guide
https://www.iros25.org/templates/iros2025/doc/LocalTransportation.pdf

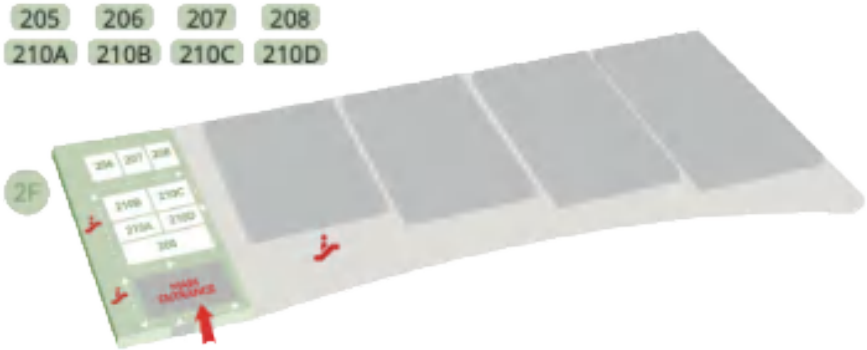
Floorplan

Hangzhou International Expo Center

First Floor:

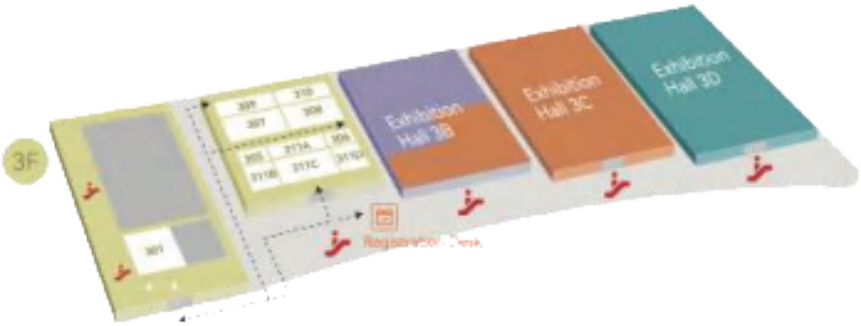


Second Floor:



Third Floor:

301 305 306 307 308 309 310
311A 311B 311C 311D
Exhibition Hall 3B Exhibition Hall 3C Exhibition Hall 3D



Fourth Floor:

401 402 403 404
405A 405B 407
Exhibition Hall 4C Exhibition Hall 4D

Program at a Glance

Technical Program – Tuesday, October 21, 2025

10:30-11:50

401	Award Finalists 1
402	Mobile Manipulation 1
403	In-Hand Manipulation
404	Robot Safety 1
407	Motion Control 1
301	Micro/Nano Robots 1
307	Motion and Path Planning 1
308	Medical Robots and Systems 1
309	Computer Vision Applications
310	Computer Vision for Medical Robotics
311A	Reinforcement Learning 1
311B	RGB-D Perception 1
311C	Deep Learning for Visual Perception 1
311D	Deep Learning Methods 1
206	Swarm Robotics 1
207	Human-Robot Interaction 1
210A	Autonomous Navigation
210B	Multi-Robot Systems 1
210C	Grasping 1
210D	Humanoid Robot Systems 1
101	Optimization and Optimal Control 1
102A	Robotics and Automation in Agriculture and Forestry 1
102B	Sensor Fusion 1
102C	Software Architecture and Tools
103A	Dexterous Manipulation 1
103B	Soft Robot Materials and Design 1
103C	Space Robotics and Automation
104	Marine Robotics 1
105	SLAM 1
106	Aerial Perception 1

13:20-14:40

401	Award Finalists 2
402	Mobile Manipulation 2
403	Agricultural Automation
404	Robot Safety 2
407	Motion Control 2
301	Micro/Nano Robots 2
307	Motion and Path Planning 2
308	Medical Robots and Systems 2
309	Semantic Scene Understanding: Sensor Fusion
310	Semantic Scene Understanding
311A	Reinforcement Learning 2
311B	RGB-D Perception 2
311C	Deep Learning for Visual Perception 2
311D	Deep Learning Methods 2
206	Swarm Robotics 2
207	Human-Robot Interaction 2
210A	Autonomous Vehicles 1
210B	Multi-Robot Systems 2
210C	Grasping 2
210D	Humanoid Robot Systems 2
101	Optimization and Optimal Control 2
102A	Robotics and Automation in Agriculture and Forestry 2
102B	Sensor Fusion 2
102C	Software Architecture and AI-Based Methods
103A	Dexterous Manipulation 2
103B	Soft Robot Materials and Design 2
103C	Service Robotics
104	Marine Robotics 2
105	SLAM 2
106	Aerial Perception 2

15:00-16:20

401	Award Finalists 3
402	Modeling, Control, and Learning for Soft Robots 1
403	Automation at Micro-Nano Scales
404	Robot Control
407	Dynamics
301	Micro/Nano Robots 3
307	Motion and Path Planning 3
308	Medical Robots and Systems 3
309	Semantic Scene Understanding: Visual Learning
310	Semantic Scene Understanding: Segmentation and Mapping
311A	Reinforcement Learning 3
311B	RGB-D Perception 3
311C	Deep Learning for Visual Perception 3
311D	Deep Learning Methods 3
206	Simulation
207	Human-Robot Collaboration
210A	Autonomous Vehicles 2
210B	Multi-Robot Systems 3
210C	Grasping 3
210D	Humanoid and Bipedal Locomotion 1
101	Optimization and Optimal Control 3
102A	Robotics in Automation in Construction
102B	Sensor Fusion 3
102C	Robust/Adaptive Control 1
103A	Dexterous Manipulation 3
103B	Soft Robot Materials and Design 3
103C	Parallel and Redundant Robots 1
104	Marine Robotics 3
105	SLAM 3
106	Aerial Systems

16:40-18:00

401	Gesture, Posture and Facial Expressions 2
402	Intelligent and Flexible Manufacturing
403	Autonomous Agents 2
404	AI-Enabled Robotics 4
407	Tendon/Wire Mechanism
301	Data Sets for Robotics 2
307	Human Detection and Tracking
308	Human-Centered Robotics 2
309	Visual Learning
310	Visual Servoing and Application
311A	Physically Assistive Devices
311B	Vision-Based Navigation 4
311D	Medical Robots and Systems 8
206	Perception for Grasping and Manipulation 5
207	Task Planning: AI-Based Methods
210A	Field Robots 4
210B	Mapping 4
210C	Aerial Systems: Applications 3
210D	Perception for Grasping and Manipulation 4
101	Machine Learning for Robot Control 4
102A	Collision Avoidance 2
102B	Networked System and Telerobotics
102C	Educational and Emotional Robotics
103A	Planning and AI-Based Methods
103B	Human and Humanoid Motion Analysis and Synthesis
103C	Flexible Robotics
104	Medical Vision
105	Manipulation Planning
106	Embedded Systems for Robotics and Automation

Technical Program – Wednesday, October 22, 2025

10:30–11:50

401	Award Finalists 5
402	Modeling, Control, and Learning for Soft Robots 3
403	Soft Sensors and Actuators 1
404	Surgical Robotics
407	Kinematics, Planning and Control 1
301	Deep Learning in Grasping and Manipulation 1
307	Motion and Path Planning 5
308	Medical Robots and Systems 5
309	Object Detection, Segmentation and Categorization 1
310	Range Sensing 1
311A	Reinforcement Learning 5
311B	Robotic Imitation Learning 1
311C	Deep Learning for Visual Perception 5
311D	Learning from Demonstration 1
206	Computer Vision 1
207	Prosthetics and Exoskeletons 1
210A	Intelligent Transportation Systems 1
210B	Multi-Robot Systems 5
210C	Biologically-Inspired Robots 1
210D	Grasping & Manipulation 1
101	Force and Tactile Sensing 1
102A	Mechanism and Control
102B	Path Planning for Multiple Mobile Robots or Agents 1
102C	Sensor Fusion 5
103A	Legged Robots 1 - Locomotion
103B	Localization 1
103C	Performance Evaluation and Benchmarking 1
104	Marine Robotics 5
105	SLAM 5
106	Aerial Systems: Mechanics and Control 1

13:20–14:40

401	Sensor Fusion & SLAM 1
402	Social HRI
403	Soft Sensors and Actuators 2
404	Surgical Robotics: Planning
407	Kinematics, Planning and Control 2
301	Deep Learning in Grasping and Manipulation 2
307	Motion and Path Planning 6
308	Micro/Nano Robots 5
309	Object Detection, Segmentation and Categorization 2
310	Recognition 1
311A	Reinforcement Learning 6
311B	Robotic Imitation Learning 2
311C	Deep Learning for Visual Perception 6
311D	Learning from Demonstration 2
206	Computer Vision 2
207	Prosthetics and Exoskeletons 2
210A	Intelligent Transportation Systems 2
210B	Multi-Modular Robot Systems 1
210C	Biologically-Inspired Robots 2
210D	Grasping & Manipulation 2
101	Force and Tactile Sensing 2
102A	Mechanism Design 1
102B	Path Planning for Multiple Mobile Robots or Agents 2
102C	Sensor Fusion 6
103A	Legged Robots 2 - Learning
103B	Localization 2
103C	Performance Evaluation and Benchmarking 2
104	Marine Robotics 6
105	SLAM: Localization 1
106	Aerial Systems: Mechanics and Control 2

15:00–16:20

401	Sensor Fusion & SLAM 2
402	Vehicle Intelligence
403	Soft Sensors and Actuators 3
404	Surgical Robotics: Laparoscopy
407	AI-Based Methods
301	Deep Learning in Grasping and Manipulation 3
307	Motion and Path Planning 7
308	Micro/Nano Robots 6
309	Object Detection, Segmentation and Categorization 3
310	Recognition 2
311A	Reinforcement Learning 7
311B	Robotic Imitation Learning 3
311C	Deep Learning for Visual Perception 7
311D	Learning from Demonstration 3
206	Autonomous Vehicle Navigation 1
207	Prosthetics and Exoskeletons 3
210A	Intelligent Transportation Systems 3
210B	Multi-Modular Robot Systems 2
210C	Biologically-Inspired Robots 3
210D	Grasping & Manipulation 3
101	Force and Tactile Sensing 3
102A	Mechanism Design 2
102B	Path Planning for Multiple Mobile Robots or Agents 3
102C	Computer Vision for Transportation 1
103A	Legged Robots 3 - Control
103B	Localization 3
103C	Planning, Scheduling and Coordination 1
104	Marine Robotics 7
105	SLAM: Localization 2
106	Aerial Systems: Perception and Autonomy 1

16:40–18:00

401	Sensor Fusion & SLAM 3
402	Actuation and Joint Mechanisms
403	Soft Sensors and Actuators 4
404	VR and Vision-Based Planning
407	Computer Architecture and Computational Geometry
301	Deep Learning in Grasping and Manipulation 4
307	Motion and Path Planning 8
308	Micro/Nano Robots 7
309	Object Detection, Segmentation and Categorization 4
310	Bioinspired Robot Learning
311A	Reinforcement Learning 8
311B	Robotic Imitation Learning 4
311C	Deep Learning for Visual Perception 8
311D	Deep Learning Methods 5
206	Autonomous Vehicle Navigation 2
207	Computer Vision for Automation and Manufacturing
210A	Intelligent Transportation Systems 4
210B	Probability and Statistical Methods
210C	Biologically-Inspired Robots 4
210D	Haptics and Haptic Interfaces
101	SLAM and Control
102A	Mechanism Design 3
102B	Path Planning for Multiple Mobile Robots or Agents 4
102C	Computer Vision for Transportation 2
103A	Legged Robots 4
103B	Localization 4
103C	Planning, Scheduling and Coordination 2
104	Cognitive Robotics
105	SLAM: Sensing and Mapping
106	Aerial Systems: Perception and Autonomy 2

Technical Program – Thursday, October 23, 2025

10:30-11:50

401	Intention Recognition 1
402	Industrial Robots and Actuators 1
403	Physical Human-Robot Interaction 1
404	AI-Enabled Robotics 1
407	Formal Method in Robotics and Automation 1
301	Deep Learning in Grasping and Manipulation 5
307	Human-Aware Motion Planning 1
308	Human-Robot Collaboration and Teaming 1
309	Object Detection, Segmentation and Categorization 5
310	Visual-Inertial SLAM
311A	Reinforcement Learning 9
311B	Vision-Based Navigation 1
311C	Deep Learning for Visual Perception 9
311D	Deep Learning Methods 6
206	Telerobotics and Teleoperation 1
207	Task and Motion Planning 1
210A	Field Robots 1
210B	Mapping 1
210C	Biologically-Inspired Robots 5
210D	Perception for Grasping and Manipulation 1
101	Machine Learning for Robot Control 1
102A	Dual Arm Manipulation 1
102B	Force and Tactile Sensing 4
102C	Calibration and Identification 1
103A	Legged Robots 5
103B	Localization 5
103C	Energy and Environment-Aware Automation 1
104	Rehabilitation Robotics 1
105	Wearable Robotics 1
106	Wheeled Robots 1

13:20-14:40

401	Intention Recognition 2
402	Industrial Robots and Actuators 2
403	Physical Human-Robot Interaction 2
404	AI-Enabled Robotics 2
407	Formal Method in Robotics and Automation 2
301	Deep Learning in Grasping and Manipulation 6
307	Human-Aware Motion Planning 2
308	Human-Robot Collaboration and Teaming 2
309	Transportation Vision
310	Visual Servoing and Tracking
311A	Reinforcement Learning 10
311B	Vision-Based Navigation 2
311C	Deep Learning for Visual Perception 10
311D	Medical Robots and Systems 6
206	Telerobotics and Teleoperation 2
207	Task and Motion Planning 2
210A	Field Robots 2
210B	Mapping 2
210C	Aerial Systems: Applications 1
210D	Perception for Grasping and Manipulation 2
101	Machine Learning for Robot Control 2
102A	Dual Arm Manipulation 2
102B	Force and Tactile Sensing 5
102C	Calibration and Identification 2
103A	Legged Robots 6
103B	Cooperating Robots
103C	Energy and Environment-Aware Automation 2
104	Rehabilitation Robotics 2
105	Wearable Robotics 2
106	Wheeled Robots 2

15:00-16:20

401	Gesture, Posture and Facial Expressions 1
402	Industrial Robotics and Control
403	Autonomous Agents 1
404	AI-Enabled Robotics 3
407	Force Control
301	Data Sets for Robotics 1
307	Human-Aware Motion Planning 3
308	Human-Centered Robotics 1
309	Vision for Automation
310	Visual Tracking
311A	Reinforcement Learning 11
311B	Vision-Based Navigation 3
311C	Deep Learning for Visual Perception 11
311D	Medical Robots and Systems 7
206	Telerobotics and Teleoperation 3
207	Task and Motion Planning 3
210A	Field Robots 3
210B	Mapping 3
210C	Aerial Systems: Applications 2
210D	Perception for Grasping and Manipulation 3
101	Machine Learning for Robot Control 3
102A	Collision Avoidance 1
102B	Force and Tactile Sensing 6
102C	Compliance and Control
103A	Soft Robot Applications
103B	Distributed Robot Systems
103C	Factory Automation and Failure Detection
104	Rehabilitation Robotics 3
105	Whole-Body Motion Planning and Control
106	Telerobotics and Navigation

16:40-18:00

401	Gesture, Posture and Facial Expressions 2
402	Intelligent and Flexible Manufacturing
403	Autonomous Agents 2
404	AI-Enabled Robotics 4
407	Tendon/Wire Mechanism
301	Data Sets for Robotics 2
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103C	Flexible Robotics
104	Medical Vision
105	Manipulation Planning
106	Embedded Systems for Robotics and Automation

Plenary Speakers

Plenary 1

Tuesday October 21, 9:00–10:00 Exhibition Hall 4D

TongBrain: Bridging Physical Robots and AGI Agents

Song-Chun Zhu

Chair Professor, Peking University & Tsinghua University

Founding Director, Beijing Institute for General Artificial Intelligence

In this talk, I will present recent research on Robotics and Artificial General Intelligence (AGI) conducted at Beijing Institute of General Artificial Intelligence (BIGAI). I will begin by discussing our work on visual scene understanding, cognitive reasoning, and task and motion planning, which together enable robots to engage in complex physical and social interactions. These developments build upon a progressively deepening cognitive architecture and value system that mark a paradigm shift in the robotics and computer vision communities—from modeling pixels (image-centric) to modeling scenes (object-centric), and to modeling cognitive aspects (agent-centric). Then, I will introduce 'TongTong,' a digital AGI agent that extends this paradigm into a unified agentic framework defined by three interconnected components: the cognitive architecture (C), potential functions (U) representing skills, and value functions (V). Various AGI systems can be characterized as points within this joint (C, U, V) space. A new benchmarking framework and testing platform, TongTest, is also presented for measuring the general intelligence of various AI agents on performing multi-modal embodied tasks in complex environments. It assesses the intelligence of TongTong to match a 5-6 years old child. Finally, I will showcase TongBrain which encapsulates a series of Real2Sim2Real efforts: digitizing tens of thousands of real scenes to train TongTong and transferring the learned skills to real-world robotic systems under various application scenarios. These advances provide a foundation for exploring higher-level topics such as AGI/robot morality, social norms, and safety, ultimately paving the way toward a symbiotic society of interconnected humans, physical robots and digital agents.

Plenary 2

Wednesday October 22, 9:00–10:00 Exhibition Hall 4D

The New Era of Mobility: Humanoids and Quadrupeds Enter the Real World

Marco Hutter

Professor, ETH Zurich
Director, Center for Robotics, ETH Zurich

Legged robotics has made remarkable strides in recent years, with quadrupeds and humanoids beginning to demonstrate real value in practical applications. Beyond the rapid advances in hardware, breakthroughs in perception, navigation, planning, and reinforcement learning for locomotion have unlocked unprecedented levels of mobility and autonomy on challenging terrain. In this talk, I will explore how reinforcement learning and autonomy are transforming the capabilities of legged robots and other mobile machines. I will share insights into the underlying methodologies, highlight real-world deployments "in the wild," and discuss where we stand today in the long-envisioned journey toward a ubiquitous robotic workforce.

Plenary 3

Thursday October 23, 9:00–10:00 Exhibition Hall 4D

Autonomous Aerial Manipulation: Toward Physically Intelligent Robots in Flight

Hyoun Jin Kim

Professor, Seoul National University
Director, Automation and Systems Research Institute, Seoul National University

Aerial robotics is rapidly evolving from platforms that merely fly to systems capable of physical interaction, manipulation, and collaboration. The emerging field of aerial manipulation marks a paradigm shift—enabling flying robots not only to navigate through space but to act upon and reshape it. This talk will explore the expanding frontier of physically intelligent aerial robotics, bridging dynamics, control, perception, and mechanical design to realize truly autonomous aerial interaction. At the heart of this transformation lies the ambition to achieve full autonomy in physical interaction—to manipulate and exert forces at arbitrary poses with precision and robustness. From innovative aerial platforms to fully dexterous multi-DOF manipulators, new control architectures are addressing the coupled dynamics of flight and contact. Advances in time-varying force control, hybrid control for improved transient performance, and robust trajectory tracking have begun to demonstrate stable, force-aware interactions. Beyond individual controllers, the field is exploring whole-body planning and control, where the aerial vehicle and manipulator act as a single, dynamically consistent system. This paradigm enables contact-rich behaviors—including inspection, maintenance, and cooperative transport—while preserving flight stability and efficiency. At a higher level, aerial robotics is becoming increasingly adaptive through learning-based skill generalization, allowing robots to acquire and transfer skills across diverse settings. Ultimately, aerial manipulation represents a new stage in the evolution of flying robots—merging flight and contact, autonomy and intelligence, and transforming them from passive observers into active, intelligent systems capable of shaping their environment.

Keynotes

Keynote Session Schedule

Tuesday October 21
Room: 405B

Keynote Session	Time	Speakers			
Rehab. & Physically Assistive Sys.	10:30-11:50	Patrick Wensing	Hao Su	Lorenzo Masia	Shingo Shimoda
Bio-inspired Robotics	13:20-14:40	Kevin Chen	Josie Hughes	Jee-Hwan Ryu	Lei Ren
Soft Robotics	15:00-16:20	Bram Vanderborght	Cecilia Laschi	Kyujin Cho	Li Wen
AI and Robot Learning	16:40-18:00	Fuchun Sun	Xifeng Yan	Cewu Lu	Karinne Ramirez-Amaro

Wednesday October 22
Room: 405B

Keynote Session	Time	Speakers			
Perception and Sensors	10:30-11:50	Davide Scaramuzza	Kris Dorsey	Perla Maiolino	Roberto Calandra
Human Robot Interaction	13:20-14:40	Javier Alonso-Mora	Jing Xiao	Dongheui Lee	Ya-Jun Pan
Embodied Intelligence	15:00-16:20	Fumiya Iida	Angela P. Schoellig	Fumin Zhang	Long Cheng
Medical Robots	16:40-18:00	Kenji Suzuki	Li Zhang	Kanako Harada	Loredana Zollo

Thursday October 23
Room: 405B

Keynote Session	Time	Speakers			
Field Robotics	10:30-11:50	Matteo Matteucci	Brendan Englot	Jiancheng Yu	Timothy H. Chung
Humanoid Robot Systems	13:20-14:40	Kei Okada	Xingxing Wang	Wei Zhang	Dennis Hong
Mechanisms and Controls	15:00-16:20	Kenjiro Tadakuma	Tiefeng Li	Eiichi Yoshida	Fei Miao
Learning and Embodied Ctrl.	16:40-18:00	Liang Ding	Abhinav Valada	Lu Liu	Nidhi Seethapathi

Keynote Session: Rehabilitation & Physically Assistive Systems

Tuesday October 21, 10:30–11:50 (405B)

Session Chair: Seth Hutchinson (Northeastern University)

Speakers:

Patrick Wensing (University of Notre Dame)

Title — From Controlled Tests to Open Worlds: Advancing Legged Robots and Lower-Limb Prostheses

Abstract — Recent years have seen remarkable progress in legged robotics, with quadrupeds and humanoids now demonstrating athletic behaviors that were out of reach only five years ago. In parallel, actively powered lower-limb prostheses have advanced rapidly, with open-source platforms such as the Open-Source Leg broadening access and accelerating innovation. Yet controlled tests in the lab only go so far. The variability of real-world environments and human users presents challenges that cannot be fully anticipated during development. To confront this gap, the first part of the talk will highlight recent work on controlling the MIT Mini Cheetah, focusing on computational methods that enable the robot to reason about its actions on the fly in novel environments. The second part will present ongoing research on improving user interfaces for lower-limb prostheses, aiming to make human–robot interaction more seamless and intuitive. Together, this work lays a foundation to expand the versatility of robotic systems in open worlds, paving the way for broader adoption in the "wild".

Hao Su (New York University)

Title — AI-Powered Wearable and Surgical Robots for Human Augmentation

Abstract — Wearable and surgical robots have the potential to transform human health and performance, but their development has been slowed by two persistent challenges: they are often bulky and confined to lab settings, and they lack autonomy to effectively collaborate with humans. Our work on high-torque density motors enables compact, lightweight exoskeletons and neurosurgical robots. On the control side, we introduce a physics-informed learning-in-simulation framework, combined with deep reinforcement learning, that creates adaptive controllers without costly human experiments. This approach, published in Nature, allows robots to understand human intention and act with greater autonomy. Together, these advances move robotics beyond lab prototypes toward real-world systems that make movement easier, surgery safer, and healthcare robotics more accessible.

Lorenzo Masia (Technical University of Munich)

Title — Wearable Robots and AI for Rehabilitation and Human Augmentation

Abstract — In the dynamic field of assistive technology, soft wearable exosuits represent a significant breakthrough, setting them apart from traditional rigid exoskeletons. However, the complexity of mastering soft structures is significant: it involves not just handling the non-linear dynamics of the device but also accurately interpreting the physiological signals that are crucial to the exploit a human control loop control. My talk will cover the latest advancements from my team over the past five years, detailing our development of compact, robust, reliable, and efficient exosuits. I will discuss the critical role of integrating biomechanical modelling into control strategies to customize how the machine interacts with the user's biomechanics, aiming to enhance human performance in tasks like collaborating with industrial manipulators or improving running endurance. I will also introduce a new method called 'Context Aware Control,' which combines traditional control techniques with machine learning, including artificial vision, to fine-tune the assistance provided. This approach endows our exosuits with the unique ability to adapt to varying external conditions or environmental changes, significantly improving the user's integration with these wearable robotic systems.

Shingo Shimoda (Nagoya University)

Title — Science of Awareness: Toward a New Paradigm for Brain-Generated Disorders

Abstract — It is increasingly recognized that less than 10% of human neural activity is consciously accessible, while the vast majority is processed unconsciously. Importantly, such unconscious processing is not merely reflexive but reflects a sophisticated form of "unconscious intelligence," which underlies adaptive motor control and contextual meaning attribution, closely related to the concept of affordances. Recent findings indicate that unconscious intelligence does not emerge from global optimization of brain activity but rather from the integration of localized processes. While adaptive in many cases, this mechanism can also result in maladaptive states, giving rise to brain-generated disorders. Notable examples include chronic nociplastic pain and functional movement disorders, where symptoms such as persistent pain or impaired voluntary movement occur in the absence of significant structural abnormalities. These conditions, which I describe as "software diseases," are notoriously difficult to treat within conventional paradigms focused on hardware-level pathology. Our research aims to visualize maladaptive processes of unconscious intelligence and to develop novel therapeutic strategies by bridging conscious and unconscious functions. Building on recent insights that unconscious processes can, at least partially, be accessed via associative mechanisms, we are developing Awareness AI—a framework that integrates conscious and unconscious intelligence to resolve maladaptive loops and to promote positive awareness, such as relief of pain and recovery of movement. To this end, we have established a high-density electromyography platform that enables functional estimation of limb muscle activity, including deep muscles reflecting unconscious

control. This system has successfully identified causative muscles in patients with writer's cramp and other functional movement disorders, facilitating effective recovery by targeted intervention below the threshold of conscious awareness. These advances demonstrate the feasibility of restoring adaptive function through precise measurement and intervention at the unconscious level. Through Awareness AI, we seek to establish a new medical paradigm in which software diseases are addressed by harmonizing conscious and unconscious intelligence, ultimately contributing to innovative strategies for the treatment of brain-generated disorders.

Keynote Session: Bio-inspired Robotics

Tuesday October 21, 13:20–14:40 (405B)

Session Chair: Yi Guo (Stevens Institute of Technology)

Speakers:

Kevin Chen (Massachusetts Institute of Technology)

Title — Agile and robust micro-aerial-robots driven by soft artificial muscles

Abstract — Flapping-wing flight at the insect-scale is incredibly challenging. Insect muscles not only power flight but also absorb in-flight collisional impact, making these tiny flyers simultaneously agile and robust. In contrast, existing aerial robots have not demonstrated these properties. Rigid robots are fragile against collisions, while soft-driven systems suffer limited speed, precision, and controllability. In this talk, I will describe our effort in developing a new class of bio-inspired micro-flyers, ones that are powered by high bandwidth soft actuators and equipped with rigid appendages. We constructed the first heavier-than-air aerial robot powered by soft artificial muscles, which can demonstrate a 1000-second hovering flight. In addition, our robot can recover from in-flight collisions and perform somersaults within 0.10 seconds. I will also discuss our recent progress in incorporating onboard sensors, electronics, and batteries.

Josie Hughes (École Polytechnique Fédérale de Lausanne)

Title — Bioinspired Robots: Building Embodied Intelligence

Abstract — This talk will explore a number of approaches to designing and fabricating robots that can robustly interact with the environment through embodied intelligence. This involves developing and exploiting materials, structure and sensory-motor control, to provide robots with advantageous capabilities. These approaches stem from bio-inspiration and biomimicry but also exploring computational approaches to design. The applications and new capabilities enabled

by these robots will be discussed, with a focus on sustainability and agricultural applications.

Jee-Hwan Ryu (Korea Advanced Institute of Science and Technology)

Title — Soft Growing Robots: From Disaster Response to Colonoscopy

Abstract — Soft growing robots, often referred to as vine robots, represent a new class of continuum robots that achieve locomotion by extending their body through tip eversion, much like the growth of a plant vine. This simple yet powerful principle enables robots to navigate confined and cluttered environments without causing significant disturbance to their surroundings. Despite their promise, early implementations have faced key challenges that limit their deployment in real-world scenarios, including restricted steering, difficulty in mounting sensors and tools at the tip, challenges in controlled retraction, and robustness under diverse operating conditions. In this keynote, I will introduce the fundamental working principle of vine robots and present recent advances in mechanisms that overcome these limitations, enabling practical deployment. I will describe new approaches for high-curvature steering, modular tip-mounting of sensors and end-effectors, and efficient retraction strategies, each designed to expand the capabilities of soft growing robots. These innovations open the door to a wide range of impactful applications, from disaster response and search-and-rescue operations in collapsed structures, to directional drilling and underwater exploration, to minimally invasive medical procedures such as colonoscopy. By bridging fundamental mechanisms with practical implementation, this talk highlights how soft growing robots are transforming from laboratory prototypes into versatile tools for some of society's most urgent and delicate challenges.

Lei Ren (Jilin University)

Title — Layagrity robotics: inspiration from the human musculoskeletal system

Abstract — Humanoid robot has potential applications in a variety of areas. However, poor locomotor energy efficiency, limited manipulation capability and poor physical human-robot interaction safety significantly hinder its advance and practical application, posing a great challenge in the robotics field. To address this problem, we propose a novel idea of bionic layagrity robotic system, inspired by the human musculoskeletal system. We reveal the fundamental principle of biological layagrity system and associated mechanical intelligences by analysing the effects of material property, morphology and topology of the musculoskeletal system on economical locomotion and versatile hand manipulation. By employing advanced functional materials and state-of-art manufacturing technologies, we finally achieve human-like locomotor system with low energy cost and bionic robotic arm-hand system with dexterous manipulation skills and excellent human-robot interaction safety. This will provide theoretical foundation and enabling design and manufacturing techniques for future advanced humanoid robotic systems.

Keynote Session: Soft Robotics

Tuesday October 21, 15:00–16:20 (405B)

Session Chair: Zhidong Wang (Chiba Institute of Technology)

Speakers:

Bram Vanderborght (Vrije Universiteit Brussel)

Title — Self healing materials for sustainable soft robots

Abstract — Soft robots, inspired by the biological systems, face the issue of being prone to damage. However, biological entities have self-repair capabilities—a feature we've introduced in soft robots to foster renewed confidence in their reliability. Our technological advancements enable these robots to self-heal, enhancing their durability and extending their operational lifespan. This innovation not only increases reuse but also allows for recycling and is based on bio-sources, contributing to sustainability. We've revolutionized the entire value chain by developing materials that surpass mere coatings; they form structural 3D components with wide range of mechanical, conductive, and magnetic properties. These materials are compatible with extrusion and molding techniques as well as multi-material printing—processes typically unsuitable for traditional network polymers and delamination risks at material interfaces. Our breakthroughs innovations include self-repairing robotic grippers with integrated sensors that not only detect but also respond to damage. Currently we are maturing the technology in order to realize a deeptech spinoff Valence Technologies, commercialising self-closing suction cups and self healing bike and car tires.

Cecilia Laschi (National University of Singapore)

Title — From AI Scaling to Embodied Control: Toward Energy-Frugal Soft Robotics

Abstract — Robotics is moving steadily toward greater reliance on AI, massive datasets, and ever-increasing computation, often with the implicit assumption that more power and more complexity will yield more intelligence. While these approaches have delivered impressive capabilities, they also come at the cost of energy, scalability, and accessibility. In contrast, biological intelligence is strikingly frugal, achieving robust sensory–motor coordination and adaptive behavior under severe energy and computational constraints. One key mechanism behind this frugality is embodied intelligence: musculoskeletal structures, compliant materials, and morphological design allow the body itself to offload part of the computation mechanically, reducing the burden on centralized control. This principle of morphological computation shows that perception and action emerge not only from neural processing, but from the tight coupling of body, environment, and control.

Looking ahead, we can envision the extreme case of electronics-free soft robots—robots whose behavior is programmed mechanically, not digitally.

Kyu-Jin Cho (Seoul National University)

Title — Soft Wearable Robots: Navigating the Challenges of Building Technology for the Human Body

Abstract — Soft wearable robots promise to support, assist, and augment human movement in ways that rigid machines cannot. Yet building technology that works with the complexity, variability, and softness of the human body remains a significant challenge—both technically and conceptually. In this talk, I will share our experiences at the Soft Robotics Research Center at Seoul National University, where we have pursued this challenge through long-term, interdisciplinary research. Our efforts span soft wearable robots for various parts of the body, human intention detection, soft sensors, and wearable system design. Key results include multimodal sensors for activity recognition, vision-based intention detection, and wearable robotic devices for the hand, back shoulder and ankle support. These outcomes came from the collaboration between engineering, medicine, biomechanics, and design in creating systems that are not only functional, but also comfortable, and usable in everyday life. Looking ahead, the Center will become a core unit of the new SNU Robotics Institute, a university-wide initiative to unify and advance robotics research across disciplines at SNU.

Li Wen (Beihang University)

Title — Multimodal Soft Robots: Elevating Interaction in Complex and Diverse Environments

Abstract — Animals in their natural habitats exhibit extraordinary multimodal locomotion, exemplifying their remarkable capacity to effortlessly switch between different movement modes. This unique ability enables them to rapidly adapt to various environmental challenges, evade predators, and optimize strategies for capturing prey. Inspired by these biological wonders, our research seeks to advance robotic systems capable of achieving multimodal motion, designed to navigate unstructured and dynamic environments while fulfilling complex tasks. During this talk, I will showcase three compelling examples of multimodal robots that leverage soft materials and highly adaptable structures: 1) a multimodal robot engineered to cross air-water boundaries and hitchhiking on complex surfaces, 2) an octopus-inspired soft robotic arm equipped with stretchable electronics that provide bending and suction capabilities for interaction with the environment, and 3) a miniature morphable robot designed for deep-sea environment, demonstrating multiple locomotion modes. Furthermore, I will discuss several critical challenges that needs to be tackled to elevate the operational potentials of multimodal robots, ultimately paving the way for enhanced operational capabilities in unstructured and dynamically changing environments in the future.

Keynote Session: AI and Robot Learning

Tuesday October 21, 16:40–18:00 (405B)

Session Chair: Jianwei Zhang (University of Hamburg)

Speakers:

Fuchun Sun (Tsinghua University)

Title — Knowledge-Guided Tactile VLA: Bridging the Sim-to-Real Gap with Physics and Geometry Awareness

Abstract — The Vision-Language-Action (VLA) paradigm has significantly advanced robotic control through Internet-scale pre-training. However, its application to real-world manipulation tasks, particularly those requiring high precision in contact-rich scenarios or dealing with complex dynamics, is often limited by a lack of fine-grained physical grounding. To address this, we propose a Knowledge-Guided Tactile VLA framework that enhances traditional vision-language-action models with robust physical reasoning capabilities through tactile sensing and world modeling. Our Unified Digital Physics System (UDPS) incorporates tactile perception with physical knowledge prior via a novel tokenization scheme that encodes geometry, physics, and tactile cues into a unified representation. The cross-domain alignment distilled from geometry invariances substantially improving sim-to-real transfer for contact-rich manipulation. Simultaneously, physical token enables the modelling of dynamic and complex physical process, including soft-body deformation and contact transitions. The framework is rigorously validated in two demanding tasks: precision 3C assembly and humanoid handkerchief dancing. In 3C assembly, UDPS taking tactile feedback as position offset in sim-to-real transfer and achieves sub-millimeter precision in connector mating in a zero-shot manner. For handkerchief manipulation, the physical tokens models complex fabric dynamics, enabling stable rhythmic motions through whole-body coordination. These results demonstrate the critical importance of integrating physical knowledge and tactile sensing for solving complex, contact-rich manipulation tasks in real-world environments without real-world fine-tuning.

Xifeng Yan (University of California, Santa Barbara)

Title — Adaptive Inference in Transformers

Abstract — Transformer-based large language models (LLMs) have achieved remarkable success across both language and vision tasks, with their impact now extending into robotics—for example, through VLA models in robotic manipulation. Despite these advances, many open questions remain. In this talk, I will focus on one fundamental question: Do all tokens require the same amount of computation within a Transformer? I will share insights into this question and present preliminary approaches to adaptive inference, in which different tokens are generated using

varying numbers of Transformer layers. Actually many layers can be automatically skipped without compromising output quality. The overarching goal is to demonstrate how such methods can enhance the efficiency of Transformer-based models and improve their applicability to domains beyond LLMs.

Cewu Lu (Shanghai Jiao Tong University)

Title — Digital Gene: An Analytical Universal Embodied Manipulation Ideology

Abstract — Reviewing the progress in artificial intelligence over the past decade, AI systems have achieved human-level understanding and reasoning at the semantic level and have been widely adopted in Internet scenarios. Nevertheless, when it comes to understanding and interacting with the physical world, AI systems still face significant challenges. This reveals an important issue: relying solely on the semantic-level concepts learned by large models is far from sufficient for embodied applications -- current AI systems lack an effective way to comprehend the physical world. This research considers the processes of object manufacturing and manipulating from a cognitive perspective and introduces the idea of "digital gene" representing the commonalities and differences of similar objects through programmed and parameterized methods, providing a computable, unambiguous, and highly generalizable structured abstraction at the level of physical concepts. In this manner, it offers machine intelligence a portal to perceive, reason about, and interact with the physical world.

Karinne Ramirez-Amaro (Chalmers University of Technology)

Title — Transparent Robot Decision-Making with Interpretable & Explainable Methods

Abstract — Transparent decision-making enables humans to understand, interpret, and predict what robots do. Interpretable and explainable methods enhance transparency: interpretable methods clarify how a learned model reaches decisions, while explainable methods articulate why specific decisions were made. In this talk, I will first introduce our interpretable AI methods that generate compact, general semantic models to infer human activities, enabling robots to gain a high-level understanding of human movement. Next, I will present our causal approach, which enables robots to rapidly predict and prevent both immediate and future failures, helping them understand why failures occur, learn from mistakes, and improve future performance. Finally, I will discuss how we combine these methods into a single framework that integrates symbolic planning with hierarchical reinforcement learning. This integration allows us to learn flexible, reusable robot policies for manipulation tasks, yielding coherent sequences of actions that can be executed independently. Interpretable and explainable AI are key to developing general-purpose robots. These approaches enable robots to make complex decisions in dynamic and unpredictable environments.

Keynote Session: Perception and Sensors

Wednesday October 22, 10:30–11:50 (405B)

Session Chair: Jianwei Zhang (University of Hamburg)

Speakers:

Davide Scaramuzza (University of Zurich)

Title — Low-latency Robotics with Event Cameras

Abstract — Event cameras are bio-inspired vision sensors with much lower latency, higher dynamic range, and much lower power consumption than standard cameras. This talk will present current trends and opportunities with event cameras, ranging from robotics to virtual reality and smartphones, as well as open challenges and the road ahead.

Kris Dorsey (Northeastern University)

Title — Sensor design for soft robotic proprioception

Abstract — Due to their continuum structures, an existing challenge in soft robotics is creating sensors for proprioception and exteroception to facilitate control and reconfigurability. I will discuss some sensing-related challenges in these soft applications and present recent work that applies these concepts to origami robots, grippers, and wearable devices. I will also present work in enhancing the stability and mechanical selectivity of stretchable sensors and discuss applications for such sensors in wearable healthcare applications, soft robotics, and beyond.

Perla Maiolino (University of Oxford)

Title — Shaping Intelligence: Soft Bodies, Sensors, and Experience

Abstract — Robot intelligence does not emerge from data alone. Much like humans, robots can be instructed through explicit teaching or learn by imitation. Yet the most profound form of learning arises through experience, through acting, sensing, and adapting in the world. To build robots that truly learn, we must give them the capacity to generate their own data through physical interaction. In this keynote, I will discuss how equipping robots with advanced sensors, compliant morphologies, and artificial skins can transform their bodies into perceptive surfaces. These designs enable robots to explore, adapt, and interact safely with humans. Unlike pre-collected datasets, this data is grounded in physical experience: robots bump, grasp, yield, and recover, constructing their own understanding of themselves and their environments. Such sensorized and adaptive bodies make it possible for robots to continuously gather the experiential data that supports learning while ensuring safety in human–robot interaction. In this emerging paradigm, the body is not just a container for sensors, it is the generator of data, the mediator of safe interaction, and the foundation of robotic intelligence.

Roberto Calandra (Technische Universität Dresden)

Title — Digitizing Touch and its Importance in Robotics

Abstract — Touch sensing is a crucial sensing modality in humans. However, compared to vision and audio, touch sensing is still in its infancy -- both in scientific knowledge and in applications. This talk will present an overview of recent developments in touch sensing: from new superhuman hardware, to the development of new AI algorithms for touch processing, and demonstrations of the importance of touch in robotics. Finally, I will discuss open-challenges and opportunities in this growing field.

Keynote Session: Human Robot Interaction

Wednesday October 22, 13:20–14:40 (405B)

Session Chair: Herman Castaneda (Tecnológico de Monterrey)

Speakers:

Javier Alonso-Mora (Delft University of Technology)

Title — Multi-Agent Autonomy: from Interaction-Aware Navigation to Coordinated Mobile Manipulation

Abstract — In the pursuit of scalable, socially aware, and safety-critical autonomous systems, our recent research has focused on integrating learning, planning, and control across aerial, ground, and maritime robotic platforms. Central to this effort is the fusion of model-based and data-driven approaches, enabling robust decision-making in dynamic and uncertain environments, seamless multi-robot coordination, and the ability to learn from human demonstrations. This talk will highlight recent advances in three key areas: 1) interaction-aware navigation among other robots and humans, using sampling-based model predictive control, socially compliant behavior learning, and semantic mapping; 2) real-time task and motion planning for teams of mobile manipulators through expert demonstrations, physically grounded plans, and whole-body control; and 3) decentralized 6-DoF manipulation of cable-suspended loads by a team of drones using multi-agent reinforcement learning. These contributions advance the frontier of scalable autonomy in dynamic, multi-agent environments across diverse robotic platforms.

Jing Xiao (Worcester Polytechnic Institute)

Title — Robotic Manipulation in Unknown and Uncertain Environments

Abstract — Human-robot complementary collaboration can leverage both human and robotic strengths in handling manipulation tasks in unstructured and uncertain

environments effectively, either in workspace involving both human workers and robots or in hazardous environments for humans. Important challenges include interaction and perception modalities and control methods to best utilize human guidance and autonomous robotic actions. I'll talk about the research work for side-by-side human-robot direct cooperation and human-robot collaboration in tele-manipulation at WPI and their applications. I'll also briefly introduce human-robot social interaction.

Dongheui Lee (Technische Universität Wien)

Title — From Passive Learner to Pro-Active and Inter-Active Learner with Reasoning Capabilities

Abstract — Autonomous motor skill learning and control are central challenges in the development of intelligent robotic systems. Imitation learning offers an efficient approach, enabling robots to acquire new skills from human guidance while reducing the time and cost of manual programming. Traditional approaches to robot learning from demonstration tend to render the robot a passive learner, confined largely to motion planning derived from the current observations. To progress beyond the traditional paradigm of imitation learning, it is essential to develop methods that allow robots to continuously learn new skills and to refine previously learned ones, if necessary, particularly in uncertain or dynamic environments. This may require the ability to reason about the robot's own actions, or to extend its knowledge through proactive and interactive engagement with humans.

Ya-Jun Pan (Dalhousie University)

Title — Intelligent Adaptive Robot Interacting with Unknown Environment and Human

Abstract — Intelligent robotic systems are widely applied in many areas such as inspection, search and rescue, co-manipulations in Industrial 5.0, healthcare services, and logistics etc. Robots with effective intelligent adaptive control are more efficient and with more operational capability in achieving the tasks. Effective adaptive interaction of robot-robot and human-robot interaction becomes more challenging when the robots vary in terms of hardware, size, and functionalities within dynamic environments. In this talk, I will outline the challenges of the navigation and control of intelligent robotics working in unknown and dynamic environments and will present on several recent innovative intelligent adaptive control approaches we have verified through experimental studies. Specifically, results on the vision-based motion planning, intelligent navigation avoiding dynamic obstacles, adaptive robust control for multiple aerial and ground vehicles, adaptive dexterous manipulations interacting with human, and adaptive cooperative manipulation systems will be presented. The robot system is to dynamically adapt to the environment through intelligent planning and adaptive control, avoid obstacles and prevent collisions during the mission. While interacting with human, sensor-based learn-from-demonstration and adaptive admittance control grant the system a level of compliance for safe human-robot physical interaction.

Keynote Session: Embodied Intelligence

Wednesday October 22, 15:00–16:20 (405B)

Session Chair: Houxiang Zhang (Norwegian University of Science and Technology)

Speakers:

Fumiya Iida (University of Tokyo)

Title — Informatizing Soft Robots for Super Embodied Intelligence

Abstract — Soft robotics has made remarkable advances in developing deformable functional materials for locomotion, manipulation, and other forms of morphological adaptation such as self-morphing, self-healing, and mechanical growth. While these technologies have opened up new applications for robotics, they also present novel challenges in sensing, modelling, planning, and control. Due to the inherent complexity of systems based on flexible and continuum mechanics - and the wide range of interactions with their environments - conventional methods often fall short, making novel approaches rooted in advanced machine learning essential. In this talk, I will introduce several projects in our laboratory that leverage sensorized soft robots and machine learning to tackle these challenges. I will also present the concept of "Super Embodied Intelligence" as a new research framework for realizing the next generation of intelligent robots and its technological underpinnings. As research in soft robotics and functional materials progresses, we are witnessing a fusion of the informational and physical entities. Within this context, where new forms of embodied intelligence are emerging, I will discuss how rapidly evolving fields such as machine learning can accelerate this development. Moving beyond traditional notions of bodily control and AI as purely computational, this approach explores the potential for new forms of intelligence in which the body itself becomes an active site for information processing and generation.

Angela P. Schoellig (Technical University of Munich)

Title — AI-Powered Robotics: From Semantic Understanding to Safe Autonomy

Abstract — Foundation models and large-scale learning are transforming robotics: robots can now be programmed through language, vision, and demonstrations rather than hand-crafted code. Yet this new paradigm raises a fundamental question: how do we guarantee safety in open, dynamic environments? In this talk, I will present recent work on combining semantic understanding and generative policies with safety-critical control frameworks. Examples include safe crowd navigation using diffusion models with human motion prediction, semantic safety filtering for manipulation, and swarm control through natural-language instructions with built-in safeguards. These results highlight both the new opportunities and

challenges of deploying internet-scale AI in robotics. I will conclude with a roadmap for trustworthy, scalable, and safe autonomy in human-centered environments.

Fumin Zhang (Hong Kong University of Science and Technology)

Title — Bayesian Learning and Bio-Inspired Autonomous Search

Abstract — The employment of robotic platforms and autonomy might significantly increase the efficiency and reduce the risk to humans in search and rescue missions. Motivated by insights from the autonomous collective foraging behaviors performed by animals in aquatic environments, this talk introduces models and provable strategies from control theory and robotics towards bio-inspired autonomous search operations. The bio-inspired methods generalize to a Bayesian learning framework where insights from biology are well justified by systems theory such as reachability, consistency, and optimality. Experimental effort with promising results demonstrates that bio-inspired autonomy might be preferred in aquatic environment that features severe limitation in communication, localization, and power consumption.

Long Cheng (Chinese Academy of Sciences)

Title — Learning from Demonstrations by the Dynamical System Approach

Abstract — A central goal in robotics is to build machines that can fluidly learn complex skills from human demonstration and interact safely and reliably in unstructured environments. While imitation learning has shown significant promise, conventional methods often struggle with a fundamental trade-off between accurately reproducing demonstrated motions and guaranteeing the stability and generalization required for real-world deployment. This talk will present a principled approach to robotic skill learning rooted in the theory of dynamical systems (DS), which models movements not as fixed trajectories, but as vector fields that guide the robot towards a goal with inherent robustness to perturbations. We will trace the evolution of DS-based imitation, from early concepts of movement primitives and Dynamic Movement Primitives (DMPs) to modern techniques that formally address the stability-accuracy dilemma. A key focus will be on the use of diffeomorphic transformations, powered by invertible neural networks, to learn complex, nonlinear skills while providing mathematical guarantees of global stability. This framework enables novel applications in high-precision tasks, such as robotic drawing and forgery detection in signatures, and extends to periodic motions for collaborative tasks like physical rehabilitation through the integration of Neural Liénard systems. Finally, the talk will explore the burgeoning synergy between classical dynamical systems and the new era of foundation models. We will discuss how DS principles can enhance modern AI, offering computationally efficient and physically grounded alternatives to Transformers, such as State Space Models, and improving the physical realism of world models through methods like Variational Information Bottleneck. Conversely, we will look to the future, investigating how large-scale models can help solve long-standing challenges in control theory, such as the automated discovery of global Lyapunov functions. This synthesis charts a path toward a new generation of

robotic intelligence that combines the rigor of control theory with the expressive power of deep learning.

Keynote Session: Medical Robots

Wednesday October 22, 16:40–18:00 (405B)

Session Chair: Fanny Ficuciello (Università di Napoli Federico II)

Speakers:

Kenji Suzuki (Institute of Science Tokyo)

Title — Small-data Deep Learning for AI Doctor and Smart Medical Imaging

Abstract — Deep learning-based artificial intelligence (AI) has shown to be a breakthrough technology in many fields including robotics, robot vision, industrial pattern recognition, and medical imaging. The performance of deep learning can exceed even human performance when it is trained with "big data". However, there are many areas where big data is not available. Thus, a chief limitation of deep learning is the requirement of "big data". My group has been actively studying on deep learning in medical imaging in the past 25 years, including ones of the earliest deep-learning models for image generation and lesion detection and classification in medicine. In this talk, "small-data" AI that can be trained with a small number of images is introduced. We applied our small-data AI to develop AI-aided diagnostic systems ("AI doctor") and image generation for diagnosis ("virtual AI imaging"), including 1) AI systems for detection, segmentation, and diagnosis of major and rare cancers in medical images, and 2) virtual AI imaging systems for separation of bones from soft tissue in x-ray imaging and for denoising and quality improvement in x-ray imaging and computed tomography. Some of them have been commercialized via FDA and other regulatory approvals in the U.S., EU, and Japan, including the world-first FDA-approved deep-learning product. Our small-data deep-learning technology would be useful for the development of AI in "small-data" areas where "big data" are not available.

Li Zhang (Chinese University of Hong Kong)

Title — Magnetic Microrobots for Translational Biomedicine: From Individual and Modular Designs to Microswarms

Abstract — Robotics at small scales has attracted considerable research attention both in its fundamental aspects and the potential for biomedical applications. As the characteristic dimensions of the robots or machines scaling down to the milli-/microscale or even smaller, they are ideally suited to navigating in tiny and tortuous lumens inside the human body which are hard-to-reach using regular medical tools

such as endoscopy. Although the materials, structural design, and functionalization of miniature robots have been studied extensively, several key challenges have not yet been adequately investigated for in vivo applications, such as controlled locomotion of the microrobots in dynamic physiological environment, in vivo tracking, the efficiency of therapeutic intervention, biosafety of the miniature agents, and autonomy levels of the microrobotic platform. In this talk, I will first present the recent research progress in development of magnetic microrobots, from the biohybrid designs, motion control, and the rise of intelligence to rapid endoluminal delivery using clinical intervention tools. Then the key challenges and perspective of using small-scale robots, from individual to microswarms, for clinical applications with a focus on endoluminal procedures will be discussed.

Kanako Harada (The University of Tokyo)

Title — Co-evolution of Human and AI-Robots to Expand Science Frontiers

Abstract — Self-driving laboratories are advancing rapidly, enabling high-throughput and reproducible experiments through the integration of AI and automation. While these systems accelerate existing workflows, the challenge remains to expand scientific exploration into domains that exceed human cognitive and physical capacities. Our vision is to go beyond mimicking human scientists by developing AI-robotic systems capable of conducting experiments that humans alone cannot perform. This requires the integration of cognitive AI for hypothesis generation, physical AI for delicate and adaptive manipulations, and mathematical frameworks for their seamless coordination, supported by innovations in robotic hardware. Through this approach, we have developed prototypes of AI-robot scientists and applied them to real scientific contexts, ranging from plant biology to animal and human-related studies, generating new discoveries and insights. This presentation introduces the concept and achievements of this transdisciplinary project, highlighting how the co-evolution of humans and AI-robots can open unprecedented avenues for scientific discovery.

Loredana Zollo (Università Campus Bio-Medico di Roma)

Title — Towards Synergistic Human-Machine Interaction in Assistive and Rehabilitation Robotics: Multimodal Interfaces, Sensory Feedback, and Future Perspectives

Abstract — Recent advancements in assistive and rehabilitation robotics have demonstrated the growing potential of current technologies to restore communication with the nervous system along both afferent and efferent pathways, primarily through the development of closed-loop human-robot interfaces. This talk will explore the synergistic interaction between users and robotic systems, highlighting how such integration enables motor recovery and functional substitution in individuals with motor impairments or limb loss. Starting from a critical overview of the state of the art, the presentation will delve into recent advances in multimodal interfaces and sensory feedback mechanisms, including haptic and proprioceptive feedback, integrated into rehabilitation and assistive

robots. Finally, the discussion will open toward future perspectives, highlighting key challenges and research directions in the field, including long-term adaptability, user-specific customization, and the convergence of bioengineering, AI, and robotics to shape the next generation of assistive and rehabilitative technologies.

Keynote Session: Field Robotics

Thursday October 23, 10:30–11:50 (405B)

Session Chair: Ya-Jun Pan (Dalhousie University)

Speakers:

Matteo Matteucci (Politecnico di Milano)

Title — Robotics Meets Agriculture: SLAM and Perception for Crop Monitoring and Precision Farming

Abstract — The growing demand for food, combined with labor shortages and the need for sustainable practices, is driving a profound transformation in agriculture. Under the banner of Agriculture 4.0, digital technologies, automation, and data-driven decision-making are reshaping the way we produce food. The integration of robotics into agriculture is foreseen as a key enabler of this shift, offering new ways to monitor, manage, and optimize farming systems. This talk explores recent advances in perception for agricultural robotics, with a focus on how SLAM and vision-based methods support crop monitoring and precision farming practices. I will discuss key challenges such as dealing with unstructured environments, seasonal variability, and plant occlusions, and highlight opportunities for combining multi-modal sensing.

Brendan Englot (Stevens Institute of Technology)

Title — Situational Awareness and Decision-Making Under Uncertainty for Marine Robots

Abstract — This talk will discuss recent work aimed at advancing the autonomy of marine robots operating in complex environments. First, to achieve the situational awareness needed for autonomous inspection and precise physical intervention, I will discuss research that aims to produce accurate, high-definition 3D maps of underwater structures using wide-aperture multi-beam imaging sonar. Second, I will discuss research intended to help marine robots make safe and efficient navigation decisions under both epistemic and aleatoric uncertainty. To address the former, sonar-equipped underwater robots use "virtual maps" as a tool to support accurate map-building under localization uncertainty. To address the latter, we employ distributional reinforcement learning to help lidar-equipped unmanned surface

vehicles navigate congested and disturbance-filled environments. Our results include several open-source algorithm implementations and benchmarking tools.

Jiancheng Yu (Shenyang Institute of Automation)

Title — Multidisciplinary Optimization Design and Key Technologies for Long-range Autonomous Underwater Vehicles

Abstract — The endurance of AUV is closely related to its sailing resistance, the amount of carrying batteries and equipment load, which involves interactions among multiple disciplines. In order to develop the conceptual design of a long-range AUV in the early stage, a multidisciplinary optimization design framework is presented for decision-makers to explore the given design space, which takes into account the coupling between the disciplines of hull form, structural design and energy use. A Self-adaptive Surrogate Ensemble (SASE) method is proposed to replace the expensive process of hydrodynamic analysis, a recommended approach by the China Classification Society (CCS) specification is applied to carry out the design of metallic pressure hulls, and the classical lamination theory and Tsai–Wu criteria are adopted in the design of composite pressure hulls. The evaluation model of AUV endurance is created from the perspective of energy capacity and consumption. The conceptual design of a 200 kg-class AUV is executed to maximize the endurance based on the proposed multidisciplinary optimization design framework. Then, a brief introduction is given to the key technical issues involved in the development of long-range autonomous underwater vehicles. Finally, The Sea-Whale 2000 AUV was developed based on the optimal result and the excellent endurance performance in the sea trial validated the effectiveness of the proposed design method.

Timothy Chung (Microsoft)

Title — Catalyzing the Future of Human, Robot, and AI Agent Teams in the Physical World

Abstract — The convergence of technologies—from foundation AI models to diverse sensors and actuators to ubiquitous connectivity—is transforming the nature of interactions in the physical and digital world. People have accelerated their collaborative connections and productivity through digital and immersive technologies, no longer limited by geography or language or access. Humans have also leveraged and interacted with AI in many different forms, with the advent of hyperscale AI models (i.e., large language models) forever changing (and at an ever-astonishing pace) the nature of human-AI teams, realized in this era of the AI "copilot." Similarly, robotics and automation technologies now afford greater opportunities to work with and/or near humans, allowing for increasingly collaborative physical robots to dramatically impact real-world activities. It is the compounding effect of enabling all three capabilities, each complementary to one another in valuable ways, and we envision the triad formed by human-robot-AI teams as revolutionizing the future of society, the economy, and of technology.

Keynote Session: Humanoid Robot Systems

Thursday October 23, 13:20–14:40 (405B)

Session Chair: Tamim Asfour (Karlsruhe Institute of Technology)

Speakers:

Kei Okada (The University of Tokyo)

Title — Transforming Humanoid Robot Intelligence: From Reconfigurable Hardware to Human-Centric Applications

Abstract — With the spread of foundation models and affordable humanoid platforms, the possibilities of humanoid research are becoming increasingly tangible. As the next stage of development, this talk will address two perspectives: hardware innovation and the deepening of human-centric applications. On the hardware side, I will present a trajectory that extends from our previous work on tool-use intelligence—where robots adaptively employ tools for tasks—towards reconfigurable humanoids that can construct their own bodies according to the task at hand. In a separate line of research, I will introduce bio-inspired humanoids evolving towards tissue-level imitation, aiming to contribute to scientific understanding by mimicking biological organization at the structural level. On the application side, I will highlight the vision of human-centric humanoids that truly serve people, showcasing an example of a humanoid capable of assisting a person to stand up or be lifted. Through these discussions, I would like to explore with the audience how humanoid research can be further developed beyond the current state.

Xingxing Wang (Unitree)

Title — A New Era of Global Collaboration in Intelligent Robotics

Abstract — This presentation will briefly cover recent technological developments and achievements of Unitree and our global customers. Furthermore, it will outline a vision for international collaboration to accelerate the growth of the intelligent robotics industry in the next few years.

Wei Zhang (Southern University of Science and Technology)

Title — Towards Physical Intelligence in Humanoid Robotics

Abstract — Humanoid robots are poised to become a transformative technology, with their societal and industrial roles expanding rapidly. This surge creates exceptional opportunities for both fundamental research and industry innovation in humanoid robotics. At the core of their future capabilities lies physical intelligence—the ability to sense, plan, decide, and execute motion with human-like versatility. We present two complementary foundation models as the backbone of this intelligence: a prefrontal/sensory–cortex-like model for perception, planning, and decision, and a

motor-cortex–like model for precise, whole-body control. Both rely on large-scale, multimodal data, but each requires a specialized data pipeline designed to meet its unique functional and temporal requirements. The talk will highlight key industrial achievements shaping today's humanoid landscape and present cutting-edge academic advances toward the two foundation models of humanoid physical intelligence. I will present a holistic perspective that unites model- and rule-based methods with data-driven approaches, emphasizing key research findings and supporting experimental evidence. I will conclude by highlighting the key research challenges for humanoid robots to reach their full potential in society.

Dennis Hong (University of California, Los Angeles)

Title — Staging the Machine: Not Built for Work, Built for Wonder

Abstract — Robots are usually designed for utility — to execute tasks efficiently, reliably, and with precision. Yet when freed from function, robots can take on entirely new roles: as cultural artifacts, performers, and even works of art. What happens when a machine is no longer judged only by how well it works, but by how deeply it can move us, provoke questions, and spark imagination? In this keynote, Dennis Hong shares a journey of reimagining robotics through unexpected contexts — from COSMO, a robot featured in a Hollywood blockbuster film, to experimental installations where play, presence, and emotion take center stage. These experiences reveal how the artistic lens can drive new forms of engineering creativity and expand our understanding of what robots can be. Looking ahead, Hong offers a first glimpse of Aequor Triformis, a new robotic artwork inspired by natural fluidity and designed to blur the line between mechanism and organism. Together, these explorations invite us to view robots not only as tools of science and industry, but as mirrors of human imagination — expanding the future of robotics from work, to wonder.

Keynote Session: Mechanisms and Controls

Thursday October 23, 15:00–16:20 (405B)

Session Chair: Xiang Li (Tsinghua University)

Speakers:

Kenjiro Tadakuma (The University of Osaka)

Title — Topological Robotic Mechanisms

Abstract — Conventional omnidirectional wheel mechanisms are limited in their ability to climb steps and cross gaps. The Omni-Ball, consisting of two connected hemispherical wheels, overcomes these limitations by enabling the crossing of

higher obstacles and larger gaps than previously. By elongating the Omni-Ball longitudinally into a cylinder shape, we obtained the Omni-Crawler, which enables omnidirectional mobility on rough terrain. In addition, transforming the cylinder shape into a torus with inner-outer membrane motion not only enables robotic mobility in murky water, but makes it possible to further transition from Omni-Crawler to Omni-Gripper. Conventional soft grippers are not suitable for objects with sharp sections such as broken valves and glass shards, but the torus shape solves this problem by using a three-layered variable stiffness skin-bag made of cut-resistant cloth. A similar function could also be achieved using a string of beads made of titanium which can grip objects of almost any shape, even when they are on fire. To build on these gripper mechanisms from the viewpoint of bioinspired robotics, we also developed a structure inspired from the proboscis (mouthpart) of Nemertea, also known as the ribbon worm, and combined it with self-healing materials to realize a robotic blood vessel with active self-healing properties. Through the addition of repair mechanisms, we expect it to be possible to achieve the active transformation of one's own body, thereby creating the ultimate robotic mechanism. Thus, the perspective of topology can be harnessed in the design of robotic mechanisms, culminating in the establishment of a new academic discipline—Topological Mechanism Science—as a counterpart to topological geometry.

Tiefeng Li (Zhejiang University)

Title — Mechanics Guided Soft Material-Structure-Robot for Extreme Conditions

Abstract — Robots for extreme environments and complex task are challenged in both the mechanical and electronic systems. Natural creatures may inspire the soft material and system design for excellent adaptability and multi-functions. This talk focuses on the interdisciplinary research between mechanics and soft robotic system. We discuss the mechanics guided strategy for extreme conditions, with the following 3 examples, soft robot in deep sea, soft hydrogel in extreme temperature and mechano-intelligent knots for surgery robot suture: 1) The design theory of deep sea soft robot intelligent system is developed, as well as its manufacturing and application methods. Put forward the principle and control method of soft robot system adapting the deep sea pressure. For the first time, the soft robotic fish operate in the Mariana Trench at the depth of 10900 m and free swim in the South China Sea at the depth of 3224 m. (Nature 2021,591, 66-71); 2) For the soft hydrogel in extreme temperature, we introduce a strategy called "hydro-locking," which involves immobilizing the water molecules within the polymer networkof the hydrogel. Under the hydro-locking mode, the hydrogel remains highly watery and stretchable under the temperature from –115° to 143°C. The strategy may inspire future soft robot and device design. (Science 2025, l387, 967-973); 3) Through topological design, slipknot tying and releasing can encode and deliver "mechano-intelligent" force transmission in operations and robotic suturing, which previously need force control sensors. Furthermore, the force encoding and releasing

mechanism of slipknots is validated in micro structure and heavy-duty robotic operations, spanning wide geometric and force scales.

Eiichi Yoshida (Tokyo University of Science)

Title — More Contacts in Interactions: Learning Humanoid Motions from Humans

Abstract — Recent advent of artificial intelligence and rapid progress on motion capacity of humanoid robots are bringing a strong attention expecting industrial and social applications. Despite their highly dynamic motion ability, humanoid robots need further improvements in motions involving contacts with all over their body. We humans generate such contact-rich motions with ease while solving the complex problem of combined discrete contact sequence and continuous dynamic motions is extremely hard. In this talk, I will present ongoing research to address the following challenges: collecting whole-body contact motion data from humans, learning behaviors from those data and synthesizing multi-contact humanoid motions.

Fei Miao (University of Connecticut)

Title — From Uncertainty to Action: Robust and Safe Multi-Agent Reinforcement Learning for Embodied AI

Abstract — Deploying Embodied AI and multi-agent systems is critically hampered by challenges in perception uncertainty and robust decision-making in various scenarios. This talk presents novel uncertainty quantification and robust multi-agent reinforcement learning (MARL) frameworks that directly confront this challenge. First, we introduce an uncertainty quantification method for deep learning-based perception and prediction models. Building upon this, we provide a theoretical analysis of MARL under state uncertainties, leading to a provably robust algorithm that can withstand worst-case uncertainties. Furthermore, we leverage control theory with robust MARL framework to achieve a critical balance between provable safety and high operational efficiency. We demonstrate the power of this research in the context of connected autonomous vehicles, validating our framework in both high-fidelity simulators and on real-world hardware testbeds. The talk will conclude by outlining a forward-looking research agenda for creating the next generation of trustworthy, cooperative AI systems.

Keynote Session: Learning and Embodied Control

Thursday October 23, 16:40–18:00 (405B)

Session Chair: Jing Xiao (Worcester Polytechnic Institute)

Speakers:

Liang Ding (Harbin Institute of Technology)

Title — From Terramechanics to Physical Intelligence: A Planetary Robotics Perspective

Abstract — Planetary mobile exploration robots are the core highlight of lunar and Martian landing missions and represent a key technological frontier among leading spacefaring nations. Planetary surface exploration faces numerous challenges: difficult terrain traversal, harsh space environments, and long communication distances between Earth and the target planet. These require breakthroughs in key bottlenecks such as low-accuracy mechanical models, limited reliability of robotic mechanisms, and insufficient autonomy and intelligence. This talk focuses on the fundamental theories and key technologies of planetary mobile exploration robots, highlighting research achievements in robot–terrain interaction mechanics through the integration of theoretical and data-driven models, as well as intelligent perception, planning, and control. It also introduces the application of these advances in the Yutu lunar rovers, the Zhurong Mars rover, and legged robots. This talk also envisions the future development of planetary exploration robotics through the deep integration of intelligent ground vehicles, planetary robots, and AI4Science. It proposes a new research framework for intelligent, high-speed, heavy-duty mobile exploration systems, providing a novel platform to support future manned planetary exploration and base construction.

Abhinav Valada (University of Freiburg)

Title — Open World Embodied Intelligence: Learning from Perception to Action in the Wild

Abstract — A longstanding goal in robotics is to build agents that learn from the world and assist people in everyday tasks across homes, factories, and streets. This talk outlines a path to open world autonomy that learns continuously, reasons with language and vision, and closes the loop from perception to action. I will present representations that capture objects, relations, and articulation, online learning that adapts during deployment without forgetting, and uncertainty-aware decision making that knows when to ask for clarification, seek information, or recover. I will also discuss data and model efficiency in policy learning for long-horizon tasks, including from demonstrations, teleoperation, and world models for rapid offline adaptation. I will conclude with a discussion of safety, fairness, and responsible

deployment, so that learning-enabled autonomy earns trust and delivers value to society.

Lu Liu (Chinese University of Hong Kong)

Title — Safety-Aware Multi-Agent Self-Deployment: Integrating Cybersecurity and Constrained Coordination

Abstract — Advances in multi-agent systems (MAS) for applications such as surveillance and environmental monitoring demands a paradigm shift from performance optimization to holistic safety assurance. This talk presents a safety framework that addresses critical threats across both cyber and physical domains to enable reliable autonomous self-deployment. We first outline foundational cybersecurity strategies focused on privacy preservation and network resilience against data theft and service disruptions. We then turn to constrained coordination, emphasizing collision avoidance, handling communication delays, and maintaining connectivity to ensure physical and operational safety. By integrating cybersecurity with constrained coordination, the talk offers a unified approach to safety-aware MAS design. We conclude with future directions for extending these principles to heterogeneous and energy-constrained systems.

Nidhi Seethapathi (Massachusetts Institute of Technology)

Title — Predictive Principles of Locomotion

Abstract — The best current robots still fall short of the efficiency and safety guarantees exhibited by humans. One way to understand this superior performance is to develop computational models that predict how humans select, execute, and learn everyday movements like legged locomotion. Despite this need, most of our current computational and theoretical understanding of human movement is limited to simple tasks or explanatory models with limited predictive breadth. My talk will highlight the predictive principles of safe and efficient locomotion we've uncovered recently: the cost functions, controller structures, and learning rules. These principles will provide a blueprint for engineering human-like performance in wearable and autonomous robots.

Social Events

WELCOME RECEPTION

Date & Time: October 20 (Mon.), 18:30 - 20:00
Location: 2nd Floor Main Entrance

CONFERENCE BANQUET

Date & Time: October 22 (Wed.), 18:30 - 20:00
Location: Exhibition Hall 4C-4D

FAREWELL PARTY (schedule as per option)

Date: October 23 (Thu.)

Song Dynasty Town "The Romance of the Song Dynasty" performance
Time: 20:20 - 21:20
Location: No. 148 Zhijiang Road, Xihu District

"Impressions West Lake" Performance
Time: 19:40 - 20:30
Location: No. 82 Beishan Road, Xihu District

Sky Garden Reception
Time: 19:30 - 21:00
Location: Hangzhou International Expo Center, top floor (accessible on foot)

To help us arrange accordingly, please confirm your participation preference at **https://iros2025.scimeeting.cn/cn/survey-user/index/28140?s=4015**

Exhibition

IROS2025 Exhibits are located at **Exhibition Hall 3B and 3C**. Exhibit hours are as follows:

October 21 (Tue.)	8:30 - 18:00
October 22 (Wed.)	8:30 - 18:00
October 23 (Thu.)	8:30 - 18:00

IROS Expo

IROS2025 Expo is located at **Exhibition Hall 3B**. The Expo hours are as follows:

October 21 (Tue.)	13:00 - 17:00

Technical Tours

Unitree Robotics

Date & Time: October 19 14:30 - 16:30
October 23 14:30 - 16:30
Fee: $50 USD
Maximum Capacity: 100 participants per tour (all tours sold out)

Unitree Robotics specializes in the research, development, production, and sales of high-performance general-purpose robots for both consumer and industrial applications, including quadruped robots, humanoid robots, six-axis manipulators, dexterous hands, and related technologies.

Deep Robotics

Date & Time: October 20 9:00 - 12:00
October 20 13:30 - 16:30
October 24 9:00 - 12:00
October 24 13:30 - 16:30
Fee: $50 USD
Maximum Capacity: 50 participants per tour (all tours sold out)

The tour will include live demonstrations at DEEP Robotics, exploring the technical boundaries of quadruped robotics and showcasing real-world applications in education, security, industrial inspection, rescue, logistics, and more.

Zhejiang Institute of Quality Sciences, CHINGMU (Hangzhou) Robot Technology, and Zhejiang Qiangnao Technology

Date & Time: October 21
Tour Time: 13:15 - 18:10
Fee: $80 USD
Maximum Capacity: 50 (sold out)

The Zhejiang Institute of Quality Sciences is the highest legal metrology institution in Zhejiang Province, relying on innovative platforms such as the Provincial Key Laboratory of Digital Precision Measurement Research and the National Key Laboratory of Acoustic Vibration for Market Regulation. Currently, it has formed capabilities in metrology testing, standard

formulation, certification and accreditation, covering intelligent robots, core components, intelligent perception, environmental adaptability and reliability evaluation.

CHINGMU is an internationally leading manufacturer of optical motion capture systems. Leveraging its independently developed sub-millimeter-level ultra-high-precision motion capture system, it enables precise motion capture of target objects—including six-degree-of-freedom (6DoF) pose tracking and finger-joint-level fine movements—along with multi-modal training data acquisition.

The Zhejiang Qiangnao Technology tour will feature a presentation of BrainCo's product portfolio, with a special focus on advanced robotic hands.

Xiaoshan Robot Exhibition Center

Date & Time: October 21
Tour Time: 14:00 - 16:00
Fee: $50 USD
Maximum Capacity: 50 (sold out)

The Xiaoshan Robot Expo Center is Zhejiang Province's first exhibition and experience center dedicated to robotics. It also serves as the showcase and central hub of Xiaoshan Robot Town. The 1st Floor: Over 20 robot-related products are featured in the industrial achievements area. The 2nd Floor: Entertainment Interactive Experience Area & Korean Exhibition Area: Interact with robots here!

Rocktiger-Hill Robot Innovation Base

Date & Time: October 22
Tour Time: 9:00 - 12:00
Fee: $50 USD
Maximum Capacity: 50 (sold out)

An innovation base dedicated to smart robotics and future technologies, focusing on technology transfer, startup incubation, and talent development.

Humanoid Robot Industry Innovation Center, CHINGMU (Hangzhou) Robot Technology, Zhejiang Qiangnao Technology, and Zhicheng (Yingda) Hangzhou Technology

Date & Time: October 22 13:15 - 18:20
October 23 13:15 - 18:20
Fee: $80 USD
Maximum Capacity: 50 participants per tour (all tours sold out)

The Humanoid Robot Industry Innovation Center is a major sci-tech innovation platform jointly established by Zhejiang University and the Hangzhou Municipal Government. It focuses on two core technological pillars—"Advanced Intelligence" and "Enhanced Physical Capabilities"—and is committed to building a national hub for robotics technology innovation and a gathering place for the industrial ecosystem through institutional innovation. The center has successfully developed representative outcomes, such as a "robot band" and a "home companion robot," overcoming key challenges in areas like voice interaction and dexterous manipulation.

CHINGMU is an internationally leading manufacturer of optical motion capture systems. Leveraging its independently developed sub-millimeter-level ultra-high-precision motion capture system, it enables precise motion capture of target objects—including six-degree-of-freedom (6DoF) pose tracking and finger-joint-level fine movements—along with multi-modal training data acquisition.\

The Zhejiang Qiangnao Technology tour will feature a presentation of BrainCo's product portfolio, with a special focus on advanced robotic hands.

Touring at Zhicheng AI (Hangzhou) will showcase pioneering advances in physical intelligence and AGI, highlighting the company's embodied intelligence foundation model and next-generation humanoid robots. Demonstrations will illustrate how fully end-to-end models enable advanced perception, decision-making, and adaptive action in complex real-world scenarios, driving intelligent transformation across industries and daily life. The tour also presents Zhicheng's vision of "empowering the physical world with general artificial intelligence," supported by an elite global team of researchers and engineers.

Shanghai Jiao Tong University Global College (SJTUGC)

Date & Time: October 25
Tour Time: 8:30 - 19:30
Fee: $100 USD
Maximum Capacity: 50

The Shanghai Jiao Tong University Global College, formerly known as the University of Michigan-Shanghai Jiao Tong University Joint Institute (UM-SJTU JI) established in 2006,

underwent a strategic upgrade in 2025 as a flagship platform for advancing SJTU's internationalization strategy. Rooted in China and committed to delivering world-class education, GC pioneers a new model of high-quality partnerships with leading institutions worldwide. Upholding the educational philosophy of "Internationalization, Interdisciplinarity, Innovation, and Quality", the college integrates the essence of both Chinese and Western educational systems, and has developed a distinctive talent cultivation model. This model has received widespread recognition both domestically and internationally, earning numerous prestigious awards.

Time	Agenda	Location	Participants
08:30-11:30	Departing from Hangzhou	IROS Partner Hotels	
11:30-13:30	Academic Lunch	Buffet at the SJTU Academic Center	Haojin Zhu(Chairman of the GC Council), GC leadership team, GC faculty, IROS applicants, FIT speakers
13:30-14:30	Building Tour & Group Photo	GC Longbin Building	David Hung(Associate Dean for Academic Affairs, GC), IROS applicants
14:30-15:30	Laboratory Tour	GC Longbin Building	Yanfeng Shen(Associate Dean for Research, GC), IROS applicants
15:30-16:30	SJTU Campus Tour	SJTU Museum	GC faculty, IROS applicants
16:30-19:30	Return to Hangzhou	GC Longbin Building	

Events by Sponsoring Societies

IEEE Robotics and Automation Society (RAS) Town Hall

Date & Time: Oct 21 (Tue), 12:15 – 13:15
Location: 405A

Calling all Robotics and Automation Society (RAS) members, and those interested in learning more about RAS! The RAS leaders want to connect with you at the upcoming RAS Town Hall. They will be present to discuss current initiatives and future programs, and to hear your voice on the priorities of RAS and our community.

Student Activities Committee and Young Reviewers Program Social Hour

Date & Time: Oct 21 (Tue), 18:30 – 20:30
Location: Yunying Hall A-D (at The Hangzhou International Expo Center North Star Hotel)

The Student Activities Committee (SAC) of IEEE RAS represents students worldwide, creating opportunities to network, exchange ideas, and engage with leaders across academia and industry. At conferences, SAC organizes signature events like Lunch with Leaders, social hours, and networking sessions to ensure that students' voices are heard and their professional growth supported.

For this special SAC + Young Reviewers Program (YRP) Social Hour, the focus will be on demystifying the peer-review process while strengthening community connections.

We'll address questions such as:
- Can I use AI tools to review papers? What are the limitations?
- What does "double-anonymous review" really mean, and how does it work in practice?
- What do I need to know about the review process of the conference or journal where I want to submit my work?

Through the YRP, participants will also learn best practices in reviewing and gain insight into how RAS handles the evaluation of scientific papers. Both new and experienced reviewers are encouraged to attend.

Beyond professional development, this is also a space to connect with peers, build your network, and share ideas about the future of robotics and automation in a relaxed setting.

There is NO CHARGE for this event, however space is limited. Please REGISTER in advance using the form here.

Women's Forum & WiE Panel Lunch

Women in Engineering Committee (WIE)

Date & Time: Oct 22 (Wed), 12:15 – 13:15
Location: Chengshan Hall A-D (at The Hangzhou International Expo Center North Star Hotel)

Join us for the Women's Forum - WiE Luncheon @ IROS 2025. This event will feature the WiRA finalist presentations, a special keynote faculty speaker, a mingling speed-networking session, lunch, and the announcement of WiRA winners. All are welcome to join us!

There is NO CHARGE for this event, however space is limited. Please REGISTER in advance using the following form here.

Science Communication Crash Course

Women in Engineering Committee (WIE)

Date & Time: Oct 23 (Thu), 11:00 – 12:00
Location: Chengshan Hall C+D (at The Hangzhou International Expo Center North Star Hotel)

Interested in sharing your robotics research with a broader audience?

Effective science communication is crucial. It bridges the gap between complex robotics concepts and diverse groups, including policymakers, business leaders, and the general public. As a researcher, honing this skill can not only improve your communication but also broaden your network and amplify the impact of your work.

In this concise tutorial, top science communicators in robotics and AI will guide you on how to present your research clearly and succinctly to non-specialists. You'll discover how to steer clear of hype, select appropriate images and videos to showcase your work, and get started with social media. We'll conclude with tips from mainstream media on how to reach a wider audience with your story.

SAC Lunch with Leaders

Date & Time: Oct 23 (Thu), 12:00 – 13:30
Location: Qianjiang Hall A-C (at The Hangzhou International Expo Center North Star Hotel)

The Student Activities Committee (SAC) invites students and young professionals to its flagship Lunch with Leaders (LwL) event.

As part of SAC's mission to represent and empower students in robotics worldwide, LwL provides a unique opportunity to sit down with leaders from RAS and industry in an informal, small-group setting. Over lunch, participants can seek career advice, gain insight into emerging opportunities, and engage in candid conversations with pioneers shaping the future of robotics and automation.

This free SAC event is designed to help you build meaningful connections, expand your professional network, and strengthen your place in the RAS community.

There is NO CHARGE for this luncheon, however space is limited. Please REGISTER in advance using the form here.

For more information on the SAC and current activities, check out their social media handles:

Instagram: @ieee_ras_sac
Bluesky: IEEE RAS SAC at ieee-ras-sac.bsky.social
X: @ieee_ras_sac
LinkedIn: linkedin.com/company/ieee-ras-sac

SICE Luncheon Seminar

The "Robotics without Borders" luncheon seminar series, which is supported by SICE, is open to ALL IROS attendees. Enjoy lunch with a technical and social presentation.

Date & Time: Oct 21 (Tue), 12:00 – 13:10
Location: 301

Title: Artificial Intelligence without Restriction Surpassing Human Intelligence with Probability One - Theoretical Foundation on Singularity Turning Point and Social Impact in Intelligent Economy with AI Twins of the Brain

Speaker: Guang-Bin Huang, Chair Professor, Southeast University, China, Founder of Mind PointEye, Singapore

Abstract: Driven by Watt's steam engine, the Industrial Revolution transformed production methods from manual labors to machine operations, resulting in a significant increase in productivity. Similarly, Artificial Intelligence (AI) heralds the arrival of what may be the greatest new era in human history: the Intelligence Revolution. This revolution is accelerating the transition from a digital economy to an Intelligent Economy, which could potentially surpass the scale of the traditional economy by several times.
It is difficult to understand meanings of Intelligence. Intelligence is composed of an infinite number of systems and functions. From the traditional perspectives of mathematics and biology, analyzing whether artificial intelligence can surpass human intelligence seems to be

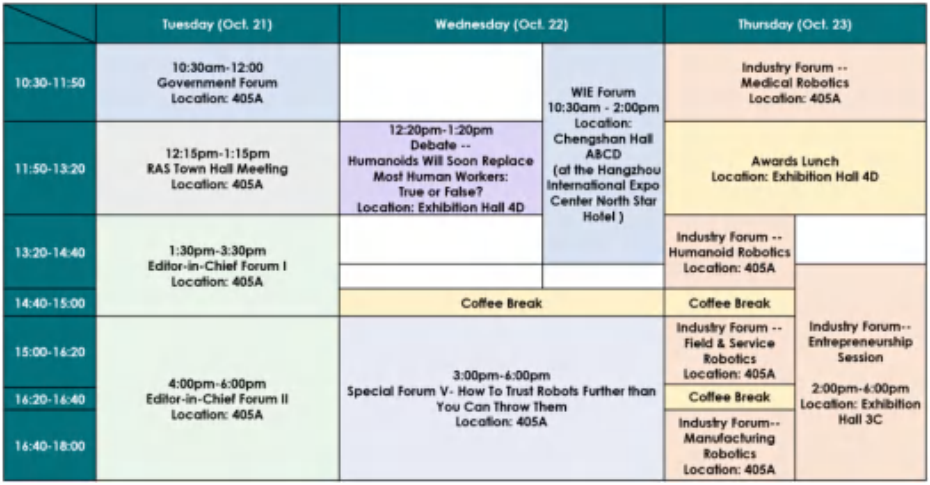
an unsolvable question. However, the AI twin of the brain offers a third way to analyze and understand the intelligent functions of the brain.

This talk will brief a latest theoretical proof and AI twins insight on unconstrained artificial intelligence surpassing human intelligence with probability one, which further shows the singularity turning point and demonstrates that artificial intelligence can develop the theoretical foundations for reasoning, innovation, and the discovery of natural principles and rules.

This talk will further focus on the AI's social potential in intelligent economy, especially in two aspects: 1) As AI systems become more integrated with robotics, we are witnessing the emergence of autonomous agents that not only think but act—machines that can perceive, decide, and interact with the physical world. As AI empowers machines with cognitive and physical abilities, robots become the tangible embodiment of artificial intelligence. 2) As AI reshapes every domain of society, AI education may evolve in parallel. Preparing the next generation of scientists, engineers, and informed citizens requires a rethinking of educational systems at all levels. Cultivating interdisciplinary talent in AI, neuroscience, robotics, and ethics will be essential to ensure the responsible and creative development of future technologies. This talk will share some observations and thoughts on the trend of embodied robots and AI education in China and Singapore.

Speaker Bio: Guang-Bin Huang is Chair Professor, Southeast University, China and Founder of Mind PointEye, Singapore. He was a Full Professor in the School of Electrical and Electronic Engineering, Nanyang Technological University, Singapore. He was a Nominee of Singapore President Science Award (2016, 2017, 2018 and 2019), was awarded by Thomson Reuters "Highly Cited Researcher" (in two fields: Engineering and Computer Science) and listed in Thomson Reuters's "The World's Most Influential Scientific Minds" since 2014. He received the best paper award from IEEE Transactions on Neural Networks and Learning Systems (2013). His two works on Extreme Learning Machines (ELM) have been listed by Google Scholar in 2017 as Top 2 and Top 7, respectively in its "Classic Papers: Articles That Have Stood The Test of Time" - Top 10 in Artificial Intelligence. He was Principal Investigator of BMW-NTU Joint Future Mobility Lab on Human Machine Interface and Assisted Driving, Principal Investigator (data and video analytics) of Delta – NTU Joint Lab, Principal Investigator (Scene Understanding) of ST Engineering – NTU Corporate Lab, and Principal Investigator (Marine Data Analysis and Prediction for Autonomous Vessels) of Rolls Royce – NTU Corporate Lab. He has led/implemented several key industrial projects (e.g., Chief architect/designer and technical leader of Singapore Changi Airport Cargo Terminal 5 Inventory Control System (T5 ICS) Upgrading Project, etc).

Forums & Debates



Government Forum - Robotics for Grand Challenges: National Strategies for Societal Impact

Time: 10:30 - 12:00, Oct. 21st, 2025
Location: 405A

The transformative potential of robotics extends far beyond the laboratory and the factory floor. As the world grapples with complex, large-scale societal challenges—from demographic shifts and healthcare accessibility to climate resilience and sustainable exploration—robotics is emerging as a critical enabling technology. This high-level government forum moves beyond technical discussions to focus on the national strategies and visionary funding models designed to harness robotics for tangible global impact. This forum brings together the leadership of the world's most influential public research and funding agencies (e.g., National Natural Science Foundation of China, National Robotics Programme of Singapore, Japan Science and Technology Agency, and Italian National Research Council). They will share their unique perspectives on how targeted, mission-oriented investment is catalyzing breakthroughs that address their nations'—and the world's—most pressing needs.

Industry Forum - Robotics and AI for Industry and Society

Part I
Time: 10:30 - 18:00, Oct. 23rd, 2025
Location: 405A

Session 1 (Medical Robotics): 10:30 – 11:50
Session 2 (Humanoid Robotics): 13:20 - 14:40
Session 3 (Field & Service Robotics): 15:00 - 16:20
Session 4 (Manufacturing Robotics): 16:40 - 18:00

Part II
Time: 14:00 - 18:00, Oct. 23rd, 2025
Location: Exhibition Hall 3C

Session 5 (Entrepreneurship Session (Andra Keay))

Robotics and AI are increasingly recognized as general-purpose technologies with far-reaching implications for both industry and society. From an economic perspective, they are engines of productivity and competitiveness; from a societal perspective, they are tools to enhance health, safety, and quality of life. International policy frameworks often highlight Robotics and AI as cornerstones of the digital transformation, linking them to innovation, sustainability, and future workforce development. At the same time, researchers describe them as embodiments of physical and cognitive intelligence, capable of bridging perception, reasoning, and action in the real world. These complementary perspectives underline the systemic importance of Robotics and AI: they are not confined to single applications, but rather define how future industries and communities will operate.

The Forum will first set the stage with insights from leading experts on the industrial and societal impact of Robotics and AI. It will then highlight four major application frontiers: Medical Robotics, Humanoid Robotics, Field & Service Robotics, and Manufacturing Robotics, each showcasing how Robotics and AI are transforming practices, capabilities, and markets. In parallel, an Entrepreneurship Session will bring perspectives from innovators and investors on how research breakthroughs can be translated into scalable products and business opportunities. Participants will be actively engaged in discussions across these themes, with opportunities to exchange ideas, raise questions to experts, and explore future directions for Robotics and AI in industry and society.

Editor-in-Chief Forum I - Publications of Advanced Research on Robotics, Mechatronics, and Industrial Electronics in the Era of AI

Time: 13:30 - 15:30, Oct. 21st, 2025
Location: 405A

In this forum, speakers from Editor-in-Chiefs of different IEEE Transactions will present their perspectives on the publication roadmap, visions, and opportunities on advanced research on robotics, mechatronics, and industrial electronics in the era of AI. The forum will consist of a series of brief lightning talks by the Editor-in-Chiefs of several flagship journals followed by a moderated Q&A session.

Editor-in-Chief Forum II - Publishing High-Impact Research: Tools, Ethics & Best Practices

Time: 16:00 - 18:00, Oct. 21st, 2025
Location: 405A

This special forum is designed to guide participants through the essential requirements for successfully publishing in a journal, in particular the Advanced Portfolio. Attendees will gain a comprehensive understanding of the current guidelines and best practices, including the current permitted use of artificial intelligence in the publishing process. The special forum will cover the key responsibilities of authors and reviewers, ensuring that ethical standards and integrity are upheld throughout the publication journey.

Participants will receive valuable advice on how to write clearly and effectively, enhancing the readability and impact of their manuscripts. The importance of high-quality graphics and videos will also be highlighted, as these elements play a crucial role in conveying research findings and engaging readers.

By the end of this special forum, participants will be equipped with the knowledge and skills necessary to navigate the complex landscape of academic publishing, produce compelling and well-structured articles, and contribute to the advancement of their respective fields. Whether you are an experienced researcher or new to the world of academic writing, this tutorial offers practical insights and expert guidance to help you achieve your publishing goals.

How To Trust Robots Further than You Can Throw Them

Time: 15:00 - 18:00, Oct. 22nd, 2025
Location: 405A

What should we trust robots to do reliably? For 25 years corporations and universities have argued that AI will usher in a new era of more reliable, effective robotics but from self-driving cars to fully autonomous robots, the reliability and robustness of behavior has been limited. How do we measure reliability today and how might this need to change in the future as robotics scales? The question of reliability is especially true for mobile ground systems such as self-driving cars which encounter a good deal of chaos in many real-world settings like construction, roadways, and logistics environments.

What are the main research challenges that remain when it comes to reliability and trust? Positioning is supposedly a solved problem but SLAM often fails in dynamic environments and GPS is easy to spoof and jam. Path planning is a solved problem in the academic world, but robots often fail to get to their destination. Why is this? An argument could be made that 25 years of research focused on better mapping and planning has limited trustworthy behavior rather than promoting it. On the other hand, AI is a long-term success story when it comes to the history of IROS. AI has been successfully controlling robot behavior for 25 years, but how has the reliability of robots changed over this period? What can we do to improve trust? Perhaps the best way to enable appropriate trust is to also enable appropriate distrust.

Women in Engineering (WIE) Forum

Time: 10:30 - 14:00, Oct. 22nd, 2025
Location: Chengshan Hall ABCD (at the Hangzhou International Expo Center North Star Hotel)

Debate – Humanoids Will Soon Replace Most Human Workers: True or False?

Time: 12:20 - 13:20, Oct. 22nd, 2025
Location: Exhibition Hall 4D

Participants:

- XingXing Wang (Unitree Robotics)
- Shigeki Sugano (Waseda University)
- Hong Qiao (Chinese Academy of Sciences)

- Andra Keay, (Silicon Valley Robotics)
- Yu Sun (EiC, IEEE Trans on Automation Science and Engineering)
- Tamim Asfour (Prof. of Humanoid Robotics, Karlsruhe Institute of Technology)
- Ken Goldberg (UC Berkeley, Moderator)

Format: A spirited Oxford-style debate on the future of humanoid robotics in the workforce.

Note: Lunch will be served in adjacent Hall 4C, and attendees may bring meals into the auditorium.

Workshops

Monday, Oct 20th

The SOFT frontier 2: Practical Applications In Soft Robotics

(AM - Venue 102B)

Enhancing Human Engagement in Social Assistive Robotics: Exploring Interaction, Cognitive Load, and Adaptive Support

(AM - Venue 103C)

ROMADO: 5th workshop on RObotic MAnipulation of Deformable Objects: holistic approaches and challenges forward

(AM - Venue 401)

The Art of Robustness: Surviving Failures in Robotics

(AM - Venue Multi-functional Hall B)

Bioinspired and Biohybrid (Cyborg) Systems

(AM - Venue Multi-functional Hall C)

Nature-Inspired Intelligent Flight (NIIF)

(AM - Venue 207)

Foundation Models for Robotic Design

(AM - Venue 404)

Benchmarking in Soft Robotics Towards Community-driven Standards for Simulations, Sensing, and Control

(AM - Venue 310)

Workshop on Textile Robotics: A Material (R)Evolution

(AM - Venue 311B)

Perception and Planning for Mobile Manipulation in Changing Environments

(AM - Venue 309)

Frontiers in Dynamic, Intelligent, and Adaptive Multi-Arm Manipulation

(AM - Venue 103B)

Bridging Human Expertise and Robotics: How Can AI and Soft Robotics Revolutionize Agriculture

(AM - Venue 210A)

Benchmarking via Competitions in Robotic Grasping and Manipulation – 2nd edition
(AM - Venue 311A)

Advancing Active Perception: Bridging Sensing, Planning, and Interaction
(AM - Venue 301)

2nd Human Modeling Workshop: AI-Powered Human Modeling for Healthcare Robotics
(AM - Venue 103A)

Advanced Haptic Sensors and Devices for Healthcare Robots
(AM - Venue 101)

3rd Advanced Marine Robotics TC Workshop: From the Lab to the Field
(AM - Venue 402)

Tactile Sensing Toward Robot Dexterity and Intelligence
(AM - Venue 102C)

Workshop on Multimodal Robot Learning in Physical Worlds (MRLPW)
(AM - Venue 210D)

Biomimetic Perception in Robotics: From Biological Insights to Advanced Sensor Systems
(AM - Venue 311D)

4th Workshop on Are You Happy with Autonomous Vehicles (AV) & User Experience (UX) in AV-Human Interaction
(Full Day - Venue 403)

LeaPRiDE: Learning, Planning, and Reasoning in Dynamic Environments
(Full Day - Venue 102A)

OCEANTECH: Marine Science and Marine Robotics
(Full Day - Venue 210C)

Building Safe Robots: A Holistic Integrated View on Safety from Modelling, Control & Implementation
(Full Day - Venue 210B)

Agricultural Robotics: Advances in Design, Perception and Control to Deal With the Complex Agricultural Environment
(Full Day - Venue 206)

Robotic Fine Manipulation: Integrating Tactile, Visual, and Intelligent Control
(PM - Venue 311B)

Perception and Navigation for Autonomous Heavy Machines in Shared Environments
(PM - Venue 105)

Intelligent Robotics: Harnessing Embodied Intelligence and Learning for Next-Generation Manipulation
(PM - Venue 103B)

15th Workshop on Planning, Perception and Navigation for Intelligent Vehicles
(PM - Venue 402)

Continuum Robots for Surgery
(PM - Venue 309)

Human-in-the-Loop Robot Learning in the Era of Foundation Models: Challenges and Opportunities
(PM - Venue 310)

Event-Based Vision for Advanced State Estimation and Image Processing
(PM - Venue 301)

2nd RoboTwin: Reciprocal Studies Between Biology and Robotics
(PM - Venue 101)

Robot Learning From Human Teleoperation: Prospects and Challenges
(PM - Venue 210D)

How can Computational and Numerical Modelling Enable the Next Generation of Soft Robots?
(PM - Venue 102B)

Open World Navigation in Human-centric Environments
(PM - Venue 311A)

Touching Tomorrow: How Soft Robotics, Flexible Electronics, and the Metaverse are Shaping Future Haptics
(PM - Venue 103A)

4th Sensorimotor-Augmented Teleoperation: Human-interaction-oriented Paradigm and Real-world Concerns
(PM - Venue 207)

Symbiotic Society with Avatars (SSA): Dynamic Remote Social Interactions Beyond Space and Time
(PM - Venue 404)

Safety of Intelligent and Autonomous Vehicles: Formal Methods vs. Machine Learning approaches for reliable navigation (SIAV-FM2L)
(PM - Venue 103C)

S'MORE: Shape-Morphing Robotics via Embodied Sensing and Mechanisms
(PM - Venue 210A)

4th Workshop on Mobile Manipulation and Embodied Intelligence: Towards Next-Gen Mobile Manipulation with Modularity, Reconfiguration, and Generalization (MOMA.v4)
(PM - Venue 401)

Towards Sustainability and Resiliency of Field Robotics
(PM - Venue 106)

Multi-Agent Cooperative Systems and Swarm Robotics in the Era of Generative AI
(PM - Venue 311D)

Robotics for Better Life: IROS 2025 Meituan Academy of Robotics Shenzhen (MARS) Annual Academic Conference
(PM - Venue Multi-functional Hall A 1F)

Friday, Oct 24th

Soft Tissue Manipulation in Robotic Surgery
(AM - Venue 102B)

Bimanual Manipulation: Advancing Human-Humanoid Interaction and Collaboration
(AM - Venue 311B)

IEEE/RSJ IROS 2025 Workshop on Neuromorphic Perception for Real World Robotics (NeuRobots)
(AM - Venue 102A)

Beyond R,r,reply- Articles Towards evidence based measurable robotics research
(AM - Venue 402)

Data-Enabled Learning and Control for Robotics

(AM - Venue 210B)

Multi-Robot Systems Empowered by Large Language Models

(AM - Venue 103A)

Guiding Vector Fields for Safe Robot Navigation and Coordination

(AM - Venue 403)

REliable Sensing for REsilient and Sustainable Automation (ReS)2A Workshop

(AM - Venue 401)

The 3rd C4SR+ Workshop: Continuum, Compliant, Cooperative, Cognitive Surgical Robotic Systems in the Embodied AI Era

(AM - Venue 210C)

SPACE- Semantic Planning of robotic Agents in Collaborative Environments

(AM - Venue 206)

Advancements in Aerial Physical Interaction

(AM - Venue 106)

Towards Resilient Navigation in the Wild

(AM - Venue 404)

1st Workshop on Embodied AI and Robotics for Future Scientific Discovery

(AM - Venue 210A)

From Thought to Touch and Back: AI, Neural Interfaces, and Sensory Feedback in Prosthetics

(AM - Venue 101)

Robot Embodied Computational Neuroscience

(AM - Venue 309)

Workshop on Climbing Robotics

(AM - Venue 102C)

Contact and Impact-aware Manipulation

(AM - Venue 207)

Agricultural Robotics and Automation: Driving Innovation in Agri-Food Systems

(AM - Venue 210D)

Exploring the Role of Energy in Robot Learning and Control
(Full Day - Venue 105)

RoboGen: 3D World Generation for Robot Learning and Autonomous Systems
(Full Day - Venue 311A)

Challenges and Applications Prospects for Reconfigurable Modular Robots
(Full Day - Venue 310)

Workshop on Generative AI for Robotics and Smart Manufacturing [Full Day]
(Full Day - Venue 103B)

The Future of Hybrid Mobility: Innovations in Wheeled-Legged Robots
(Full Day - Venue 311D)

The 2nd Workshop and Competition on Multi-Robot Perception and Navigation Challenges in Logistics and Inspection Tasks
(Full Day - Venue 103C)

FAST: Fully Autonomy Emerges from Situational CogniTion
(PM - Venue 102B)

Embodied AI and Edge Computing for Intelligent Robots (EAI-EC)
(PM - Venue 210D)

Edge AI for Robotics: Emerging Technology and Application
(PM - Venue 210A)

Bio-Inspired Robotic Perception and Control: Bridging Centralized and Decentralized Intelligence
(PM - Venue 401)

Human-aware Embodied AI
(PM - Venue 402)

AI-Driven Surgical Autonomy: From Realistic Simulation to Real World
(PM - Venue 403)

2nd Workshop on AI Meets Autonomy: Vision, Language, and Autonomous Systems
(PM - Venue 210C)

Shared Autonomy and Sense of Agency: Balancing Control, Effort, and Experience in Human-Robot Interaction
(PM - Venue 404)

Action and Interaction: Humans and Robots in Collaboration
(PM - Venue 207)

Embodied Intelligence for Medical Robotics: Learning, Adaption, and Interaction
(PM - Venue 210B)

RoDGE: Robotic Data Generation and Evaluation: Bridging Simulation and Real-World Deployment
(PM - Venue 311B)

Augmentative Human-Robot Interaction: From Human Augmentation to Human-Inspired Collaboration
(PM - Venue 206)

Advancements for Intelligent Robotics in 4D Scenes: Localization, Reconstruction, Rendering, and Generation
(PM - Venue 106)

Tutorials

Monday, Oct 20th

Enhancing Digital Accessibility in Higher Education
(PM – Venue 102C)

Friday, Oct 24th

Design and Development of Rehabilitation Robotic Devices: Healthcare Challenges
(PM – Venue 103A)

Retico: A Framework for Robot-ready Spoken Dialogue with Robots
(PM – Venue 102C)

Competitions

AgiBot World Challenge

URL: https://agibot-world.com/challenge

Most existing robot learning benchmarks fall short when it comes to addressing real-world challenges, particularly those arising from low-quality data and limited sensing capabilities. These benchmarks often focus on short-horizon tasks within controlled environments. In contrast, the AgiBot World is the first large-scale multi-agents robotic dataset designed to advance multi-purpose humanoid robots. Building on the AgiBot World benchmark, this challenge offers a brand-new perspective to discuss broad areas of humanoid robots. Our goal is to provide a platform for these discussions at the IROS 2025 competition, fostering real-world impact and driving the development of more intelligent, embodied systems.

In this challenge, participants are required to work with data from the real-world domain or collected interactively in a simulator. In both scenarios, participants must demonstrate an accurate understanding of their surroundings and make informed decisions based on the given context. Looking ahead, we are dedicated to continuously refining and evolving the benchmark, while also organizing more related events to foster progress and shape the future of the robotics community.

Organizers:

- Maoqing Yao (AgiBot)
- Hongyang Li (The University of Hong Kong)
- Huijie Wang (OpenDriveLab)
- Chengyue Zhao (AgiBot)
- Shukai Yang (AgiBot)
- Jianlan Luo (AgiBot)
- Shijia Peng (OpenDriveLab)
- Liliang Chen (AgiBot)
- Jin Chen (OpenDriveLab)

RoboSense: The Robust Robot Sensing Challenge

URL: https://robosense2025.github.io/

The RoboSense Challenge @ IROS 2025 is an international competition designed to evaluate and advance the robustness of robot sensing systems under real-world conditions. As robots increasingly operate in open and dynamic environments, ensuring resilience to data corruptions, sensor failures, and domain shifts has become a critical requirement. Spanning five diverse tracks, the challenge covers a wide range of robotic perception and planning tasks, including: (1) Driving with Language, (2) Social Navigation in Human-Crowd Environments, (3) Sensor Placement for Scene Understanding, (4) Cross-View Localization and Retrieval, and (5) Cross-Platform 3D Object Detection. Each track introduces unique challenges such as natural corruptions, occlusions, and platform shifts (e.g., from vehicles to drones and quadrupeds),

encouraging the development of generalizable and robust methods. Participants will be evaluated using strong baselines, high-quality multi-modal datasets, and carefully designed robustness protocols. The competition aims to foster collaboration between academia and industry, promote open benchmarks, and catalyze innovation in resilient robot autonomy.

Organizers:

- Lingdong Kong (National University of Singapore)
- Ao Liang (National University of Singapore)
- Dongyue Lu (National University of Singapore)
- Yuhao Dong (Nanyang Technological University, Singapore)
- Shaoyuan Xie (University of California, Irvine)
- Tianshuai Hu (Hong Kong University of Science and Technology)

Future of Robo

URL: https://ucis.ubtrobot.com:34088/robot-competition/

The "Future of Robo" competition simulates a smart factory environment where Humanoid Robots (HR) act as intelligent controllers and Engineering Vehicle Robots (EVR) serve as mobile executors. Contestant teams program and control these robots to collaboratively complete three core tasks: (1) Cargo Transportation: Efficiently moving objects within the factory. (1) Obstacle Crossing: Navigating robots through complex terrain. (3) Cargo Sorting: Accurately identifying and categorizing items. Teams will leverage key technologies including voice interaction, visual positioning, visual recognition, posture calibration, motion control, and multi-robot collaboration to achieve these objectives on a designated competition map.

Organizers:

- Jichao Jiao (UBTECH ROBOTICS CORP LTD)
- Xiaoming Li (UBTECH ROBOTICS CORP LTD)
- Jialin Le (UBTECH ROBOTICS CORP LTD)
- Jinlian Li (UBTECH ROBOTICS CORP LTD)
- Jiamao Zhao (UBTECH ROBOTICS CORP LTD)
- Xiaobin Yang (UBTECH ROBOTICS CORP LTD)

Aerial Autonomy Challenge

URL: https://www.nspacerobot.com/iroschallenge/

The Aerial Autonomy Challenge is a competition designed to promote breakthroughs in aerial robots autonomy technology, especially in autonomous navigation.

As part of the 2025 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), the competition of this year including the variety of complex scenarios, which simulates real-world environments, such as featuring structural and moving obstacles, narrow gaps, undulating surfaces, wind disturbances and a unique "grove" setup. The Aerial Autonomy Challenge is also committed to advancing the development of aerial intelligent systems for

industrial applications, all these competition scenarios are carefully designed to test key aspects of aerial autonomy, including environmental adaptability, motion agility and disturbance resilience.

We cordially invite research institutions, industrial teams, and developers worldwide to join us in pioneering the frontiers of autonomous flight technology and exploring its future possibilities.

Organizers:

- Fei Gao (Zhejiang University)
- Boyu Zhou (Southern University of Science and Technology)
- Guodong Lu (Zhejiang University)
- Xinmin Lyu (Sun Yat-sen University)
- Huan Yu (Zhejiang University)
- Muqing Cao (Carnegie Mellon University)

Quadruped Robot Challenge (QRC)

URL: http://rise.skku.edu/iros2025qrc

Autonomy in disaster response situations requires a good mobile platform, perception technologies, navigation technologies, etc. Quadruped robots are inherently dynamic; thus, their competition is interesting to the audience and public and may draw the attention of potential sponsors. Quadruped Robot Challenges (QRC) was inaugurated in ICRA 2023 to test teams for autonomous traversability on various kinds of terrains. At Stage 1, each robot runs the test field alone, solo start. In Stage 1+ which is about the mobility with inspection test at ICRA 2024 and IROS 2024, ICRA 2025, we witnessed more teams use autonomy and an exploration mission is still difficult for autonomous robots. As a next step, IROS 2025 QRC will move to Stage 2 where the multiple robot collaboration concept will be introduced. Teams may need to deal with collaborative tasks, dynamic obstacles, real-time perception, and planning in this stage. The QRC has great potential to lead the robotics community in technology advancement, inform researchers about the rigors required to reliably deploy into unstructured environments, and foster interactions with commercial manufacturers to create practical robotic systems. Examples of commercially available quadrupeds are shown in Fig. 1 (listed by weight). In addition to demonstrating the state-of-the science in legged robotics for unstructured environments, the QRC is helping to develop the standard test methods emergency responders and others around the world can use to objectively evaluate commercial robots, train with measures of remote operator proficiency, and compare results no matter where or when the evaluations are conducted. During scheduled down times in the IROS-2025 QRC, the test lanes can also provide a commercial robot demonstration area to highlight best-in-class performance throughout the industry. Consider this when selecting the location for the competition so the commercial booths are nearby and note that these same standard test methods are used by emergency responders to inform their purchasing decisions. Emergency responders like to ask the robot manufacturers in the booths to come to the arena so they can try the interface or watch the manufacturer's "expert" operator do

what they say the robot can do. This is a chance for them to see which systems are actually ready for purchase and deployment.

Organizers:

- Adam Jacoff (National Institute of Standards and Technology)
- Hyungpil Moon (Sungkyunkwan University)
- Soeren Schwertfeger (ShanghaiTech University)
- Yangsung Lim (TeamGrit)

Volting Cup

URL: https://duchanglin.top/volting

The Volting Cup is a pioneering competition that blends robotics, art, and human performance to explore the frontiers of Embodied Intelligence. This concept emphasizes learning and decision-making through interaction with the physical world, pushing the boundaries of how humans and robots coexist and collaborate. The competition focuses on promoting exclusivity by encouraging participation from the disabled and elderly, while also serving as a creative platform for scientists, artists, and athletes. Participants are invited to design and perform artistic presentations that integrate robot systems, including human-robot dance, wheelchair dance, music and light interaction, physical drama, and musical theater. These performances aim to demonstrate the potential of robotics in adaptive sports and rehabilitation, as well as the emotional and expressive power of human-machine collaboration. The Volting Cup not only showcases technological innovation but also advocates for a society that is both intelligent and inclusive.

Organizers:

- Eric Monacelli (University of Versailles, Paris-Saclay University)
- Hirata Yasuhisa (Tohoku University)
- Jianmin Wang (Tongji University)
- Alex Caldas (ESME Sudria)
- Hongyu Guan (Paris-Saclay University)
- Baolin Peng (Beijing Souhuo Technology Co., Ltd.)

The Embodied Intelligence Challenge

URL: https://embodied-intelligence-challenge.live/

The Soft Robotics Embodied Intelligence Challenge invites teams to draw inspiration from advancements in the soft robotics field to explore how nature-inspired designs leverage body environment interactions to achieve efficient locomotion, whether by crawling, undulating, inching, rolling, or employing novel forms of movement. The principal aim of the competition is to design a low cost, bio-inspired, robotic system that exemplifies embodied intelligence through locomotion, challenging the state of the art in soft robotics. The challenge invites participants to study how organisms exploit compliance, distributed actuation, and material properties and translate these into an operational robot. The design should not only be

functional but should also highlight the potential of soft robotics to navigate and adapt to complex environments. Furthermore, accessibility and inclusivity are key aspects of this competition, so solutions that utilize low-cost, easily fabricable materials and techniques will receive extra recognition by emphasizing affordability and reproducibility. Additional points will be awarded for innovative approaches that showcase “spectacular” behaviours arising from the interplay of materials, structure, and control.

Organizers:

- Kyle L. Walker (EPFL)
- Nana Obayashi (EPFL)
- Alixander Partridge (The National Robotarium)
- Maks Gepner (University of Edinburgh)
- Mannus Schomaker (AMOLF)
- Josie Hughes (EPFL)
- Ankur Mehta (UCLA)

Mecha Challenge

URL: https://duchanglin.top/robocom/

In the "Iron Blood Mecha-Resource Competition Challenge" competition, participants have to design and operate their own robots and perform a series of tasks, including resource collection, transportation, processing and storage. This competition will provide participants with an opportunity to think about how technology can cope with the challenge of resource shortage in the future. The competition aims to stimulate the creativity of participants and find innovative ways to solve the problem of resource acquisition. This competition emphasizes robotics and demonstrates creativity, strategy and teamwork. The participating robots must be designed within the limited size, operated by the players remotely or automatically, competing for different resource props and sending them safely to the partition, while avoiding the interference of opponents and possible robot failures.

Organizers:

- Baolin Peng (Beijing Souhuo Technology Co., Ltd.)
- Wenbin Peng (Wuhan Huarui Zhide Technology Co., Ltd.)
- Man Xu (Hangzhou Xuewuji Robot Co., Ltd.)
- Bin Gong (Hangzhou Souhuohui Technology Co., Ltd.)
- Jie Hong (Beijing Souhuo Technology Co., Ltd.)