ICR 2025

10th International Conference on
Interactive Collaborative Robotics

ICR 2025

Conference Programme and Abstracts

November 10-13, 2025
Hanoi, Viet Nam

LE QUY DON TECHNICAL UNIVERSITY

Springer

SPC RAS

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Conference at a glance

Monday, November 10, 2025		
16:00-18:00	**Registration (for on-site participants)**	
Tuesday, November 11, 2025		
08:00-08:30	**Registration (for on-site participants)**	
08:30-08:50	**Opening Ceremony (room H9-401)** https://us06web.zoom.us/j/83782678933?pwd=SE9EUlhxdnpsbWVENEJ2aEhrWXJDdz09 Chair: Tran Xuan Nam	
08:50-10:10	**Plenary Session 1: (room H9-401)** https://us06web.zoom.us/j/83782678933?pwd=SE9EUlhxdnpsbWVENEJ2aEhrWXJDdz09 Chairs: Chu Anh My, Roman Meshcheryakov	
10:10-10:40	**Coffee Break and Exibition** **On-line Joint Photography of Conference Participants**	
10:40-12:00	**Oral Session 1: Human-Robot Interaction (room H9-401)** https://us06web.zoom.us/j/83782678933?pwd=SE9EUlhxdnpsbWVENEJ2aEhrWXJDdz09 Chairs: Tran Duc Tan, Susanna Gordleeva	**Oral Session 2: Unmanned Aerial Vehicles (room H9-403)** https://us06web.zoom.us/j/83782678933?pwd=SE9EUlhxdnpsbWVENEJ2aEhrWXJDdz09 Chairs: Hoang Van Xiem, Aleksandr Protsenko
12:00-13:30	**Lunch**	
13:30-15:30	**Online Session 1: Water Robotics (room H9-401)** https://us06web.zoom.us/j/83782678933?pwd=SE9EUlhxdnpsbWVENEJ2aEhrWXJDdz09 Chairs: Dao Quy Thinh, Aleksandr Panov	**Online Session 2: Ground Robotics (room H9-403)** https://us06web.zoom.us/j/83782678933?pwd=SE9EUlhxdnpsbWVENEJ2aEhrWXJDdz09 Chairs: Nguyen Xuan Chiem, Vyacheslav Pshikhopov
15:30-15:50	**Coffee Break and Exibition**	
15:50-17:50	**Online Session 3: Collaborative Robotics (room H9-401)** https://us06web.zoom.us/j/83782678933?pwd=SE9EUlhxdnpsbWVENEJ2aEhrWXJDdz09 Chairs: Nguyen Anh Tuan, Rinat Galin	**Online Session 4: Multi-Robot Control (room H9-403)** https://us06web.zoom.us/j/83782678933?pwd=SE9EUlhxdnpsbWVENEJ2aEhrWXJDdz09 Chairs: Nguyen Dinh Quan, Mikhail Medvedev
Wednesday, November 12, 2025		
08:00-08:30	**Registration (for on-site participants)**	
08:30-09:30	**Plenary Session 2: (room H9-401)** https://us06web.zoom.us/j/83782678933?pwd=SE9EUlhxdnpsbWVENEJ2aEhrWXJDdz09 Chairs: Chu Anh My, Andrey Ronzhin	
09:30-10:00	**Coffee Break and Exibition**	
10:00-12:00	**Oral Session 3: Water Robotics (room H9-401)** https://us06web.zoom.us/j/83782678933?pwd=S	**Oral Session 4: Robot Navigation (room H9-403)** https://us06web.zoom.us/j/83782678933?pwd=

	E9EUlhxdnpsbWVENEJ2aEhrWXJDdz09 Chairs: Thai Mai Thanh, Iuliia Litvinenko	SE9EUlhxdnpsbWVENEJ2aEhrWXJDdz09 Chairs: Trinh Luong Mien, Andrei Konstantinov
12:00-13:30	**Lunch**	
13:30-15:30	**Oral Session 5: Group Robotics (room H9-401)** https://us06web.zoom.us/j/83782678933?pwd=SE9EUlhxdnpsbWVENEJ2aEhrWXJDdz09 Chairs: Pham Duy Hung, Petr Trefilov	**Oral Session 6: Robot Control (room H9-403)** https://us06web.zoom.us/j/83782678933?pwd=SE9EUlhxdnpsbWVENEJ2aEhrWXJDdz09 Chairs: Pham Xuan Thuy, Lev Utkin
15:30-16:00	**Coffee Break and Exibition**	
18:00-21:00	**Gala Dinner and Closing Ceremony** *(Buffet Sen Tây Hồ, 614 Lac Long Quan Street, Tay Ho, Hanoi, Vietnam)*	
Thursday, November 13, 2025		
06:00-18:00	**Sightseeing Tour**	

The time of the video conference is specified in the time zone of Hanoi, Viet Nam (UTC + 7): https://24timezones.com/Vietnam/time.

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08:50-10:10	**Plenary Session 1: (room H9-401)** https://us06web.zoom.us/j/83782678933?pwd=SE9EUlhxdnpsbWVENEJ2aEhrWXJDdz09 Chairs: Chu Anh My, Roman Meshcheryakov
	Andrey Ronzhin and Roman Meshcheryakov. Fundamental Problems of Autonomous Functioning and Physical Interaction of Robot Groups
	Trung Dung Ngo. A Kangaroo-inspired Large-scale Swarm of Mobile Robots as the First Responder in Emergency - Hierarchical Distributed Control Approach
10:10-10:40	**Coffee Break and Exibition** **On-line Joint Photography of Conference Participants**
10:40-12:00	**Oral Session 1: Human-Robot Interaction (room H9-401)** https://us06web.zoom.us/j/83782678933?pwd=SE9EUlhxdnpsbWVENEJ2aEhrWXJDdz09 Chairs: Tran Duc Tan, Susanna Gordleeva
	Alexey Yakushev and Alexey Kashevnik. EffiAtt-Emotion: A Lightweight Emotion Recognition Model for Adaptive Human-Robot Interaction in Collaborative Robotics
	Susanna Gordleeva and Victor Kazantsev. Improving of Brain-Machine Interaction Performance by Sensory and Transcranial Magnetic Stimulation
	Thanh Nguyen Canh, Thang Tran Viet, Son Tran Duc, Huong Nguyen The, Trang Huyen Dao, Viet-Ha Nguyen, and Xiem HoangVan. Efficient Human-Robot Interaction via Deep Perception and Flexible Motion Planning
	Dung Tien Nguyen and Lac Van Duong. A Fuzzy Logic Control for Tactile Antenna-Based Wall-Following in Autonomous Robots
10:40-12:00	**Oral Session 2: Unmanned Aerial Vehicles (room H9-403)** https://us06web.zoom.us/j/83782678933?pwd=SE9EUlhxdnpsbWVENEJ2aEhrWXJDdz09 Chairs: Hoang Van Xiem, Aleksandr Protsenko
	Anton Gubankov, Alexander Zuev, Dmitriy Yukhimets, Alexander Protsenko, and Anastasia Serdyukova. Development of a Method for Synthesizing Disturbance Identification Systems for Unmanned Aerial Vehicles
	Petr Trefilov. Robust UAV Control Using Confidence-Weighted Multi-Sensor Integration
	Dmitry Yukhimets and Anton Gubankov. Synthesis Method for UAV Automatic Landing System on a Marine Moving Platform Using UWB Technology
	Thanh Dao Minh, Quynh T. Thanh Nguyen, and Thiem V. Pham. Actuator Faults Detection and Isolation Based on Nonlinear Observer for Quadcopter
12:00-13:30	**Lunch**
13:30-15:30	**Online Session 1: Water Robotics (room H9-401)** https://us06web.zoom.us/j/83782678933?pwd=SE9EUlhxdnpsbWVENEJ2aEhrWXJDdz09

	Chairs: Dao Quy Thinh, Aleksandr Panov
	Anatoly Gaiduk, Viacheslav Pshikhopov, and Vladimir Kostyukov. Synthesis of Nonlinear Systems of Underwater Vehicles Based on Quasi-Linear Models
	Andrey Maevskiy, Vladimir Ryzhov, Tatiana Fedorova, and Igor Kozhemyakin. Comparison of the Effectiveness of the Application of the Genetic Algorithm and the Modified Louvain Algorithm in the Clustering Model of an Underwater Wireless Sensor Network
	Elena Rubleva, Konstantin Mironov, and Aleksandr Panov. Optimizing the Trajectory of Robotic Manipulator: Reinforcement Learning for the Generation of Initial Guess
	Le Van Nghia, Tran Van Tuyen, Aleksandra Figurek, and Andrey Ronzhin. Fish Disease Detection Using Enhanced YOLOv11 for Application in Aquatic Robots
	Zhao Min, Elchin Khalilov, Xiangyong Zheng, Farid Khalilov, and Min Wang. Application of an Aqua-Aero Robotic System for Hyperspectral and Biochemical Monitoring of Environmental Pollution in Water Areas
	Thanh Nguyen Canh, Quang Minh Trinh, Thai-Viet Dang, Phan Xuan Tan, and Xiem HoangVan. Refined 3D Object Localization with Monocular Camera using Depth Estimation and Geometric Refinement
13:30-15:30	**Online Session 2: Ground Robotics (room H9-403)** https://us06web.zoom.us/j/83782678933?pwd=SE9EUlhxdnpsbWVENEJ2aEhrWXJDdz09 Chairs: Nguyen Xuan Chiem, Vyacheslav Pshikhopov
	Mikhail Medvedev, Vyacheslav Pshikhopov, and Azhar Kadhim Farhood. Intelligent Task Allocation between Moving Objects Based on Reinforcement Learning Algorithm
	Airat Migranov. Task Allocation in Groups of Mobile Robots under Uncertainty using an Adaptive Ant Colony Algorithm
	Nuraddin Kerimov, Aleksandr Onegin, and Konstantin Yakovlev. SI-RRT and ST-RRT* For Prioritized Multi-Manipulator Planning: Empirical Evaluation
	Ramil Faizullin, Niyaz Imamov, Tatyana Tsoy, Edgar A. Martinez-Garcia, and Evgeni Magid. Multi-Criteria Approach to Path Planning for Unmanned Tractors Considering Energy Constraints and Soil Compaction
	Vitaly Bondarenko, Tatyana Yermolenko, Andrey Grabarchuk, and Egor Moroz. Generation of Synthetic Images to Expand Datasets for Computer Vision Systems Used on Robotic Conveyors
	Thanh Luan Bui, Vo Dang Huy Tran, Truong Anh Khoa Le, An Khang Do, and Giang Hoang. Hybrid Extended State Observer with Enhanced Sliding Mode Control for Tracking and Disturbance Rejection for Mecanum Wheeled Mobile Robots Apply in an Automotive Manufacturing
15:30-15:50	**Coffee Break and Exibition**
15:50-17:50	**Online Session 3: Collaborative Robotics (room H9-401)** https://us06web.zoom.us/j/83782678933?pwd=SE9EUlhxdnpsbWVENEJ2aEhrWXJDdz09 Chairs: Nguyen Anh Tuan, Rinat Galin
	Daniyar Wolf, Rinat Galin, Yaroslav Turovskiy, Roman Meshcheryakov, and Saniya Galina. Methodology for Personalized Human–Robot Collaboration That Accounts for Individual Characteristics of Human Biological Signals
	Dobrynin Dmitry and Yulia Zhiteneva. Near Field Scanning System of Home Walking Robot
	Dmitry Dobrynin. Foot Trajectory Generation for a Quadruped Home Robot

	Andrei Malchikov and Sergey Jatsun. Automated Control System for Magnetically Active Microrobots for Medical Applications
	Shifa Sulaiman, Maksim Mustafin, Hongbing Li, and Evgeni Magid. Closed-Loop Chain Linkage-Based Hand Exoskeleton: A Lightweight and Modular Solution for Hand Rehabilitation
	Sergey Yatsun, Oksana Emelyanova, and Egor Tistsov. Determination of Forces Acting in the Joints of the Lower Extremities during Rehabilitation
15:50-17:50	**Online Session 4: Multi-Robot Control (room H9-403)** https://us06web.zoom.us/j/83782678933?pwd=SE9EUlhxdnpsbWVENEJ2aEhrWXJDdz09 Chairs: Nguyen Dinh Quan, Mikhail Medvedev
	Vladimir Kostyukov, Mikhail Medvedev, and Petr Tregubov. Planning the Movements of a Mobile Robot in a Three-Dimensional Environment with Constraints on Pitch and Yaw Angles
	Konstantin Krestovnikov. UAV Control System Architecture with Integrated Visual Navigation for Agricultural Monitoring
	Alexander Gruzlikov and Vladislav Karaulov. Estimation of Coordinates and Motion Parameters of an Accompanied Vessel Based on Factor-Graph Optimization
	Vladimir Filaretov, Alexander Zuev, Alexander Protsenko, Igor Gornostaev, and Libin Du. Development of a Synthesis Method for Self-Adjusting Correction Devices for DC Brushless Motors
	Azad Bayramov, Samir Suleymanov, and Fatali Abdullaev. The Unmanned Complex of Assess Marksmanship Performance
	Anna Klimenko and Mikhail Elmekeev. Lamarckian Evolution Based Algorithm for Multi-robot Path Planning Problem
Wednesday, November 12, 2025	
08:00-08:30	**Registration (for on-site participants)**
08:30-09:30	**Plenary Session 2: (room H9-401)** https://us06web.zoom.us/j/83782678933?pwd=SE9EUlhxdnpsbWVENEJ2aEhrWXJDdz09 Chairs: Chu Anh My, Andrey Ronzhin
	Quang Ha. Robotics in Construction: advances, examples and what's next?
	Vladimir Filaretov, Aleksandr Zuev, Aleksandr Timoshenko, Igor Gornostaev, and Yunli Nie. A Method of Positional-Force Control of an Underwater Manipulator
09:30-10:00	**Coffee Break and Exibition**
10:00-12:00	**Oral Session 3: Water Robotics (room H9-401)** https://us06web.zoom.us/j/83782678933?pwd=SE9EUlhxdnpsbWVENEJ2aEhrWXJDdz09 Chairs: Thai Mai Thanh, Iuliia Litvinenko
	Oleg Stepanov and Alexey Isaev. Recursive Batch Smoother with Multiple Linearization for Single-Beacon Navigation Problem
	Nguyen Phu Dang, Dang Tran Huy, and Nguyen Trong Tuyen. Numerical Solution to Estimate the Transfer Function Describing the Towed Underwater Vehicle
	Yunli Nie, Di Tian, Libin Du, Vladimir Filaretov, Zhaojie Wang, Yizhe Huang, and Jiahao Du. Trajectory Tracking Control of Surface Mobile Buoys Based on A-Star – NMPC Algorithm
	LiBin Du, Zhen Zhu, Aleksander Zuev, LiXun Hou, YunLi Nie, ChengGang Wang, and ZiHao Zhang. Investigation into the Impact of Propellers on the Rudder Efficiency of Ships during Steering Operations

	Dmitry Yukhimets and Ivan Grigorev. A Method for Industrial Manipulators for Approximating Paths with an Excessive Number of Fly-by Points
	Nguyen Ngoc Tuan, Tran Van Tuyen, Tran Xuan Tinh, Tran Cong Tan, and To Xuan Dinh. Robust Sliding Mode Control for the Electro-Optical Observatory Drive System of a Patrol Ship
10:00-12:00	**Oral Session 4: Robot Navigation (room H9-403)** https://us06web.zoom.us/j/83782678933?pwd=SE9EUlhxdnpsbWVENEJ2aEhrWXJDdz09 Chairs: Trinh Luong Mien, Andrei Konstantinov
	Van Hung Nguyen, Pham Tran Quyen Anh, and Xuan-Tung Truong. Fast Path Planning with Hierarchical Approach Based on 3D Scene Graphs
	Truong Giang Dao, Truong Do, and Phi Long Nguyen. Variational Autoencoder for Efficient Image Representation in Deep Reinforcement Learning for Mobile Robot Navigation
	Viet-Tiep Nguyen, Hung Van Nguyen, Tran Cong Tan, Xuan-Tung Truong, and Cao Huu Tinh. An Efficient Navigation Algorithm for Unmanned Surface Vehicles in Dynamic Environments
	Nguyen An Hai, Le Tran Thang, Pham Chi Thanh, and Nguyen Pham Thuc Anh. EKF-FOGS Enhanced Observer for Autonomous Tracked Vehicle Control in Slippery Terrain
	Minh-Tuan Nguyen-Thai, Hoang Nam Nguyen, and Phuong Thao Thai. Path Planning for Smooth Operations of Nonholonomic Mobile Robots Using Piece-wise-Uniform Turning Maneuvers
	Ildar Nasibullayev, Nikita Kruglov, and Oleg Darintsev. Methodology for Calculating the Configuration Parameters of a Modular Wheeled Mobile Robot
15:00-16:00	**Lunch**
13:30-15:30	**Oral Session 5: Group Robotics (room H9-401)** https://us06web.zoom.us/j/83782678933?pwd=SE9EUlhxdnpsbWVENEJ2aEhrWXJDdz09 Chairs: Pham Duy Hung, Petr Trefilov
	Duc-Chi Nguyen, Duc-Huy Nguyen, Quy-Thinh Dao, and Thi-Van Anh Nguyen. Trajectory Tracking and Orientation Stability of Planar Cable Robots Using PSO-Tuned Sliding Mode Control
	Hong Nguyen Thi and Le Thi Thuy Nga. Distributed Swarm Robot Control Using Fuzzy Logic, Chaos Theory, and the Drag-onfly Algorithm
	Pham Quang Hung, Pham Duy Hung, and Trung Dung Ngo. Optimizing Contact Positioning Configuration of Multi-Robot System for Object Manipulation and Transportation
	Hoang Duc Long. Design of Synergetic Controller based on Nonlinear State Observer for Twin Rotor MIMO System
	Andrei Konstantinov and Lev Utkin. Set-Input Trees: An Interpretable Multiple Instance Learning Architecture for Robotics
	Hung Viet Bui, Sy Van Do, and Hiep Xuan Trinh. Toward Collaborative Robots: Hybrid Slider–Crank with Variable-Stiffness Soft Rod
13:30-15:30	**Oral Session 6: Robot Control (room H9-403)** https://us06web.zoom.us/j/83782678933?pwd=SE9EUlhxdnpsbWVENEJ2aEhrWXJDdz09 Chairs: Pham Xuan Thuy, Lev Utkin
	Kamil Aida-zade and Vugar Hashimov. Synthesis of Process Dynamics Control Using Current and Previously Conducted Measurements of Its State
	Kamil Aida-zade and Samir Guliyev. Feedback Control Approach Based on

	Classes of Zonal Control Actions
	Oleg Stepanov and Yulia Litvinenko. Research of Nonrecursive Federated Filtering Algorithms under Non-White Noise Measurement Errors
	Nguyen Xuan Chiem, Nguyen Cong Dinh, Nguyen Van Xuan, Le Minh Kien, and Nguyen Cong Binh Nguyen. Robust Control for Line-Following Robots with Model Uncertainties and Dynamic Disturbances
	Dmitrii Cherginets, Aleksei Vedyakov, and Andrei Motorin. Comparison of Methods for Covariance Estimation for Factor Graph Optimization of the Bayesian Estimation Problem
	Van Tien Bui, Pham Van Duy, Tran Van Nam, Do Van Minh, Tran The Hung, and Tran Dinh Thanh. Aerodynamic Characteristics and Dynamic Modeling of Long Endurance Unmanned Aerial Vehicle
15:30-16:00	**Coffee Break and Exibition**
18:00-21:00	**Gala Dinner and Closing Ceremony** (Buffet Sen Tây Hồ, 614 Lac Long Quan Street, Tay Ho, Hanoi, Vietnam)
Thursday, November 13, 2025	
06:00-18:00	**Sightseeing Tour**

Abstracts

Plenary Session 1

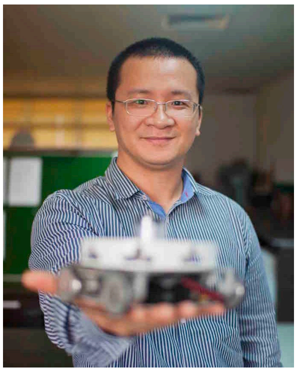
Plenary Speech: Fundamental Problems of Autonomous Functioning and Physical Interaction of Robot Groups.

Invited Speakers

Andrey Ronzhin, St. Petersburg Federal Research Center of the Russian Academy of Sciences (SPC RAS), St. Petersburg, Russia.

Roman Meshcheryakov, V.A. Trapeznikov Institute of Control Sciences of Russian Academy of Science, Moscow, Russia.

Abstract: This article reviews key challenges and approaches in enhancing the autonomy of robotic systems across diverse environments. We focus on three fundamental problems: autonomous navigation in GPS-denied conditions, dexterous physical manipulation of objects, and collaborative control of heterogeneous robotic groups. For each area, we analyze current methods, including semantic scene analysis, optimized gripper design, and hybrid swarm-hierarchical control algorithms. The review covers robotic platforms for ground, aerial, surface, and underwater operations, concluding with an overview of systems developed at SPC RAS and ICS RAS for the intertwined challenges of navigation, manipulation, and collaboration is crucial for advancing the operational autonomy of robotic systems in unstructured environments.



Plenary Speech: A Kangaroo-inspired Large-scale Swarm of Mobile Robots as the First Responder in Emergency - Hierarchical Distributed Control Approach.

Invited Speakers

Trung Dung Ngo, University of Prince Edward Island, Charlottetown, Canada.

Abstract: It is very risky for firefighters to search and rescue victims in fire-damaged buildings. The risks can be minimized if they know what is happening inside the building prior to carrying out their mission with the old-fashioned technology that they have used for the last 50 years.

A Kangaroo-inspired large-scale multi-robot system consisting of a mothership and child robots will serve as a team of first responders in emergency. The heterogeneous swarm can be rapidly deployed and dispersed for exploration, coverage, and victim identification and a “life-path” generated by an ad-hoc network of mobile robots is maintained during rescue operation. I will present the hierarchical distributed control strategy consisting of distributed node control for connectivity maintenance and distributed connectivity control for connectivity minimization and global network integrity. Finally, I will demonstrate the viability of the concept of homogeneous and heterogenous swarm of mobile robots through simulation and real-world experiments.

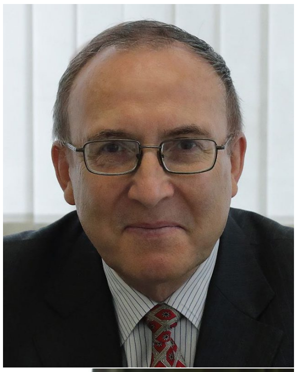
Plenary Session 2

Plenary Speech: Robotics in Construction: advances, examples and what's next?

Invited Speakers

Quang Ha, University of Technology Sydney, Australia.

Abstract: The emergence of robotics and AI has been advancing fast and is considered as the future of the construction industry. Technologies including visualization and digital twin, additive manufacturing, robotic cooperation and deep learning will be manifesting to transform the civil and infrastructure sector, making tomorrow's construction safer, more efficient and more environmentally sustainable. Embracing robotic autonomous systems and AI-powered technologies will significantly enhance construction performance and safety, in such tasks like 3D-printing, demolition waste management, progress monitoring, inspection and maintenance. This talk will provide a brief overview of advances in construction robotics, introduce some typical examples and outline what's next for automation and robotics in construction.



Plenary Speech: A Method of Positional-Force Control of an Underwater Manipulator.

Invited Speakers

Vladimir Filaretov, Institute of Automation and Control Processes FEB RAS, Vladivostok, Russia.

Aleksandr Zuev, Institute of Automation and Control Processes FEB RAS; M.D. Ageev Institute of Marine Technology Problems FEB RAS, Vladivostok, Russia.

Aleksandr Timoshenko, Institute of Automation and Control Processes FEB RAS; M.D. Ageev Institute of Marine Technology Problems FEB RAS, Vladivostok, Russia.

Igor Gornostaev, Institute of Automation and Control Processes FEB RAS; M.D. Ageev Institute of Marine Technology Problems FEB RAS; Admiral Nevelskoy Maritime State University, Vladivostok, Russia.

Yunli Nie, College of Ocean Science and Engineering; Shandong University of Science and Technology, Qingdao, China.

Abstract: The article is devoted to solving the problem of developing a method for constructing positional-force control systems for electric drives (ED) of multi-link underwater manipulators (UM) mounted on autonomous underwater vehicles operating in the mode of landing on the ground or on work sites. To solve this problem, a comprehensive method is proposed. First, for an ED of each degree of freedom of the UM, a self-adjusting correction device is constructed, which makes it possible to stabilize the variable dynamic parameters of this ED at a given nominal level. This stabilization compensates for the influence of Coulomb and viscous frictions, the interactions between the UM links and influence of a viscous medium, on the quality of control. Then, for each ED sliding observers are constructed, which make it possible to obtain information about the current values of the external torques, speeds and accelerations of rotation of the output shafts of all ED. Using this information and measurements of only position sensors of the

	specified ED, it is possible to construct position-force regulators for them that minimize the selected quadratic cost function. This minimization makes it possible to ensure not only the precise movement of the UM tool along specified spatial trajectories in the presence of significant impacts from the viscous medium, but also to create the required force effects on underwater work objects when performing various technological operations. The operability and effectiveness of the constructed positional-force control systems is confirmed by the results of computer modeling.

Oral Session 1

Alexey Yakushev, ITMO University, St. Petersburg, Russia.

Alexey Kashevnik, St. Petersburg Federal Research Center of the Russian Academy of Sciences (SPC RAS), St. Petersburg, Russia.

Lecture Title: EffiAtt-Emotion: A Lightweight Emotion Recognition Model for Adaptive Human-Robot Interaction in Collaborative Robotics.

Abstract: Effective and safe interaction in collaborative robotics hinges on the robot's ability to adapt its behavior to the human's cognitive and emotional state. This paper introduces EffiAtt-Emotion, a lightweight deep learning model for facial emotion recognition designed specifically for resource-constrained onboard robotic systems. With only 13.3 million parameters, the model demonstrates a high and balanced performance, achieving an accuracy of 80.6% and a macro F1-score of 0.806 for eight distinct emotion classes. We present a framework for integrating EffiAtt-Emotion into a collaborative robot's (cobot's) control loop, enabling real-time adaptive behavior. A use case on a collaborative assembly line is detailed, where the cobot adjusts its speed, provides assistance, or enters a safe stop mode in response to the human operator's recognized emotions, such as confusion, frustration, or fear. This approach directly addresses documented challenges in HRI, where human factors like stress and fatigue contribute to decreased performance and safety risks. By making the robot aware of the operator's state, our system aims to enhance task efficiency, ergonomics, and critically, to improve safety in line with the human-centric principles of Industry 5.0.

Susanna Gordleeva and Victor Kazantsev, Lobachevsky State University; Neimark University, Nizhny Novgorod, Russia.

Lecture Title: Improving of Brain-Machine Interaction Performance by Sensory and Transcranial Magnetic Stimulation.

Abstract: In this study, we address the issue of whether applying transcranial magnetic and vibrotactile stimulation can improve the motor imagery BMI performance. Our findings provide evidence that applying transcranial magnetic stimulation with specified parameters (frequency 5 Hz, duration 6 minutes, 90% of the muscle activation threshold at rest) leads to preactivation of the occipital brain region and facilitates sensorimotor integration during motor imagery. We found that this process results in TMS-induced decrease of the motor imagery BMI latency. Integration of vibrotactile feedback in motor imagery BMI leads to enhancement of the BMI performance by an increase of the ERD level of EEG patterns over the contralateral motor cortex area corresponding to the MI of the non-dominant hand and an increase in motor cortical excitability.

Thanh Nguyen Canh, School of Information Science, Japan Advanced Institute of Science and Technology, Japan.

Thang Tran Viet, Son Tran Duc, Huong Nguyen The, Trang Huyen Dao, Viet-Ha Nguyen, and Xiem HoangVan, University of Engineering and Technology, Vietnam National University, Vietnam.

Lecture Title: Efficient Human-Robot Interaction via Deep Perception and Flexible Motion Planning.

Abstract: Human-Robot Interaction (HRI) is an emergent field propelled by advancements in artificial intelligence, yet achieving seamless human understanding and responsive robot control remains a significant

<table>
<tr><td></td><td>challenge. This paper introduces an efficient, integrated HRI system for a custom-built dual-arm robot, presenting two primary contributions. First, we propose a sophisticated perception system that leverages deep learning to interpret human states. This system employs a Multi-task Cascaded Convolutional Neural Network (MTCNN) for robust face detection, a Deep Convolutional Neural Network (DCNN) for recognizing emotions, and a Long Short-Term Memory (LSTM) network to identify dynamic gestures from image sequences. Second, we detail a flexible dual-arm robot control system built on the Robot Operating System (ROS). This control system utilizes the Rapidly-exploring Random Tree (RRT) algorithm for efficient path planning, enabling the robot to translate recognized human cues into corresponding actions. Comprehensive evaluations on benchmarks, including the WIDER FACE and FER2013 datasets, validate the perception models. The proposed system was validated through both simulation and physical experiments, demonstrating high accuracy in perception and control. The results highlight the framework’s effectiveness in creating fluid and responsive interactions for complex HRI scenarios.</td></tr>
<tr><td></td><td>Dung Tien Nguyen and Lac Van Duong, Department of Mechatronics, School of Mechanical Engineering, Hanoi University of Science and Technology (HUST), Hanoi, Vietnam.
Lecture Title: A Fuzzy Logic Control for Tactile Antenna-Based Wall-Following in Autonomous Robots.
Abstract: While autonomous robots commonly rely on vision-based systems for navigation, their ability to physically interact with their environment through tactile perception remains a significant challenge. Inspired by the sensory whiskers of animals, this study introduces a novel, bio-inspired tactile antenna designed to provide continuous force feedback. This enables the robot to perceive and physically interact with its surroundings. A specialized fuzzy logic control (FLC) strategy was designed to utilize this force feedback as a primary input. The developed FLC processes the tactile information through a set of expertly defined rules to generate commanded angular velocities for the robot's wheels. This mechanism allows the robot to maintain a stable and smooth wall-following trajectory along various wall geometries, including straight, cornered, and curved paths. The effectiveness and robustness of the proposed system are validated through both simulations and real-world experiments. The findings suggest that this bio-inspired tactile sensing modality offers a promising solution for autonomous navigation in complex and confined spaces, laying the foundation for robots capable of exploring dark or obscured environments, such as surveying caves, underwater spaces, or performing search-and-rescue missions in collapsed structures.</td></tr>
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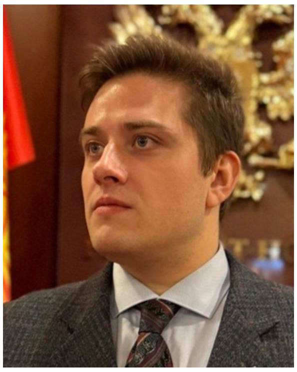
Oral Session 2

	**Anton Gubankov and Dmitriy Yukhimets**, Institute of Automation and Control Processes, FEB RAS; Admiral G.I. Nevelskoy Maritime State University, Vladivostok, Russia. **Alexander Zuev, Alexander Protsenko, and Anastasia Serdyukova**, Institute of Automation and Control Processes; Institute of Marine Technology Problems named after Academician M.D. Ageyev, FEB RAS, Vladivostok, Russia. **Lecture Title:** Development of a Method for Synthesizing Disturbance Identification Systems for Unmanned Aerial Vehicles. **Abstract:** This paper proposes a method for synthesizing a disturbance identification system for quadcopter-type unmanned aerial vehicles (UAVs) that allows determining the magnitudes of force and moment disturbances acting on all degrees of freedom of the UAV and caused by the uncertainty of the parameters and the presence of unknown external influences. We present a complete mathematical description of the UAV dynamics and kinematics taking into account the aerodynamic drag, as well as the uncertainties of the parameters and the influence of the environment, which are represented in the dynamic equations by additive unknown functions which are subject to estimation. To determine the values of these unknown functions in real time, sliding mode observers are proposed. The disturbance data can then be used by adaptive control systems to compensate for their negative effects and improve the accuracy of motion. Numerical simulation is performed, the results of which confirm the operability and effectiveness of the proposed solutions. The efficiency and accuracy of observer estimates are illustrated for several scenarios, including the movement of the UAV to a given point and along a predetermined trajectory.
	**Petr Trefilov**, ICS RAS, Moscow, Russia. **Lecture Title:** Robust UAV Control Using Confidence-Weighted Multi-Sensor Integration. **Abstract:** This paper presents an adaptive control framework that enables a unmanned robot to follow its planned trajectory including cases when the reliability of its sensor suite changes unpredictably. The main contribution is the adaptive mode of operation: the system dynamically adjusts the threshold value of each sensor stream, recalculates their weights in real time, and recombines control system. While high precision measurements are available, the controller runs in a nominal linear quadratic mode. When observability drops – because a sensor drifts, saturates, or fails – the algorithm transitions smoothly to a prediction only mode that relies on the process model, and, if necessary, to a robust H infinity mode that preserves stability under worst case disturbances. The underlying estimation layer is based on an innovation driven weighting rule embedded in an Extended Kalman Filter, making the approach independent of any particular sensor type. Hardware simulation and outdoor testing confirm that adaptive mode significantly improves tracking accuracy, shortens recovery time after faults, and eliminates the need for manual retuning when the sensor configuration changes.

Dmitry Yukhimets and Anton Gubankov, Institute of Automation and Control Processes, FEB RAS; Admiral G.I. Nevelskoy Maritime State University, Vladivostok, Russia.

Lecture Title: Synthesis Method for UAV Automatic Landing System on a Marine Moving Platform Using UWB Technology.

Abstract: The paper deals with an approach to synthesis a local navigation system for unmanned aerial vehicles (UAV) using ultra bandwidth (UWB) technology. Proposed navigation can be implemented to an automatic landing system on the deck of a marine moving platform, which use autonomous on-board UAV in difficult weather conditions (fog, drizzle). This system ensures sufficiently large range, accuracy, accessibility and low price for local navigation. A Kalman filter is used to estimate the position and speed of the UAV relative to the moving platform, and a nonlinear controller has been synthesized to control the movement of the UAV, which allows for a smooth and accurate approach of the UAV to the moving platform. At the same time, the specified controller generates the desired orientation angles of the UAV as control actions, which allows it to be used as an add-on above typical flight controllers. The results of simulation have confirmed the feasibility and effectiveness of the proposed local navigation system.

Thanh Dao Minh, Quynh T. Thanh Nguyen, and Thiem V. Pham, Faculty of Electrical and Electronic Engineering, Phenikaa University; ICALab, Phenikaa University, Hanoi, Vietnam.

Lecture Title: Actuator Faults Detection and Isolation Based on Nonlinear Observer for Quadcopter.

Abstract: This work presents a simplified FDI strategy tailored to the quadcopter's nonlinear dynamics. The approach employs a nonlinear observer to reconstruct system states and generate residuals by comparing observer-based estimates with measured angular rates. Fault-sensitive decision statistics are computed over finite sample windows and evaluated against adaptive thresholds to detect and isolate loss-of-effectiveness (LOE) actuator faults. Simulation studies demonstrate that the proposed method achieves accurate and timely fault detection and correct isolation over a range of fault severities, while maintaining low computational overhead. These results indicate that the observer-based FDI scheme offers a practical solution for onboard implementation in resource-constrained quadcopter platforms.

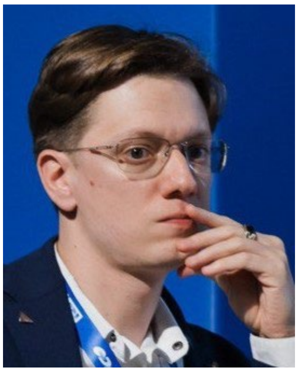
Online Session 1

Anatoly Gaiduk, Viacheslav Pshikhopov, and Vladimir Kostyukov, Southern Federal University, Rostov-on-Don, Russia.

Lecture Title: Synthesis of Nonlinear Systems of Underwater Vehicles Based on Quasi-Linear Models.

Abstract: This study is devoted to the application of one of the modern approaches to the synthesis of nonlinear automatic control systems for autonomous unmanned underwater vehicles. The high requirements for such underwater vehicles necessitate the use of methods that take into account the features of their nonlinear characteristics. At the same time, the task of synthesizing nonlinear control systems is quite complex. This has led to the development of a significant number of different methods for solving this problem. Most of these methods require a preliminary transformation of the equations of a nonlinear object to some special types, but finding the appropriate transformation is very often also a

difficult task. A new quasi-linear approach is considered below, in which the desired transformation is reduced to differentiation, and in some cases to integration of partial derivatives of the nonlinearities of the object. This approach leads to simple engineering methods for synthesizing control systems for autonomous underwater vehicles. Based on it, it is possible to create modern control systems for nonlinear objects in the field of shipbuilding, energy, agriculture, instrument engineering and other industries.



Andrey Maevskiy, Vladimir Ryzhov, Tatiana Fedorova, and Igor Kozhemyakin, Saint-Petersburg State Marine Technical University, St. Petersburg 190121, Russia.

Lecture Title: Comparison of the Effectiveness of the Application of the Genetic Algorithm and the Modified Louvain Algorithm in the Clustering Model of an Underwater Wireless Sensor Network.

Abstract: This paper presents a simulation model for managing the resources of an underwater wireless sensor network, based on the use of modularity as a metric in the clustering process. The model employs a modified Louvain algorithm, a genetic algorithm, and Dijkstra's algorithm for constructing optimal message transmission routes. The main focus is on the comparative analysis of the efficiency of the developed algorithms. Simulation results confirm that the proposed model effectively addresses the challenges of energy-efficient clustering and reliable routing. Algorithms that aim to maximize modularity form stable and balanced cluster structures by accounting for the residual energy of sensors and are capable of supporting dynamic reclustering under changing topological or energy conditions. This leads to reduced data loss, balanced load distribution, and extended autonomous operation time of the network. The genetic algorithm, which uses modularity as a target function, demonstrates high adaptability to various network configurations and significantly reduces the number of message retransmissions during data collection. The comparative analysis shows that the genetic approach provides higher transmission reliability and energy efficiency compared to the Louvain algorithm, particularly under dynamically changing underwater conditions. The developed model can be applied to practical marine monitoring tasks where physical constraints, equipment characteristics, and the variability of network topology must be taken into account simultaneously.

Elena Rubleva, Moscow Institute of Physics and Technology, Dolgoprudny, Moscow, Russia.

Konstantin Mironov, Ufa University of Science and Technology, Ufa, Russia.

Aleksandr Panov, Moscow Institute of Physics and Technology, Dolgoprudny; AIRI Artificial Intelligence Research Institute; Federal Research Center "Computer Science and Control" of the Russian Academy of Sciences, Moscow, Russia.

Lecture Title: Optimizing the Trajectory of Robotic Manipulator: Reinforcement Learning for the Generation of Initial Guess.

Abstract: This paper describes the challenge of trajectory planning for robotic manipulators operating in obstacle-rich environments. The goal is to propose a novel approach that integrates the TrajOpt algorithm with reinforcement learning (RL) to improve the efficiency and accuracy of motion planning. TrajOpt, a numerical optimization-based method, generates successful trajectories, while RL produces high-quality initial

trajectory estimates, serving as strong starting points for optimization. This integration enables TrajOpt to find feasible paths more efficiently and reduces collision risks. RL further refines initial trajectories, enhancing navigation in complex environments. Experimental results highlight the benefits of merging machine learning with traditional optimization methods. The RL-based approach achieved an 82% success rate in navigating obstacle-dense environments, outperforming the classical RRTConnect method, which achieved 68%. The proposed system improves planning efficiency and reliability in complex scenarios with obstacles by using reinforcement learning (RL) alongside TrajOpt. This research offers valuable insights into improving robotic manipulator performance and lays a foundation for future advancements in motion planning. It demonstrates that integrating reinforcement learning with existing algorithms can drive significant progress in addressing the complexities of navigating obstacle-laden environments, opening new directions for research and development.

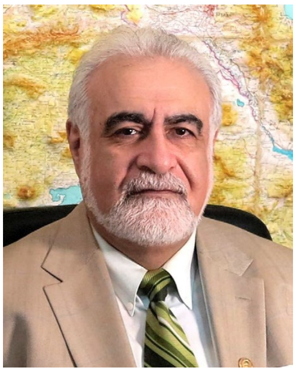
Le Van Nghia and Andrey Ronzhin, St. Petersburg Federal Research Center of the Russian Academy of Sciences (SPC RAS), St. Petersburg, Russia.

Tran Van Tuyen, Military Technical Academy of Vietnam, Ha Noi, Viet Nam.

Aleksandra Figurek, University of Nicosia, School of Business, GNOSIS Mediterranean Institute for Management Science, Nicosia, Cyprus.

Lecture Title: Fish Disease Detection Using Enhanced YOLOv11 for Application in Aquatic Robots.

Abstract: The rapidly growing global population creates urgent demand for protein and fish-based food sources. Consequently, the fisheries sector faces the dual challenge of meeting seafood supply needs while protecting marine ecosystems. AI and robotics-enabled smart aquaculture emerges as a critical solution to this dilemma. In high-density aquaculture systems, where disease transmission can escalate uncontrollably and cause catastrophic losses, computer vision integration has demonstrated exceptional efficacy through timely detection and enumeration of diseased fish. This paper analyzes a disease detection and counting system based on an enhanced YOLOv11 architecture. The model exhibits remarkable capability in identifying and localizing diseased specimens within complex underwater environments. On our manually annotated two-class dataset (diseased/healthy fish), it achieves 98.2% mAP@0.5, 76.9% mAP@0.5:0.95, 96.4% precision, and 95.2% recall. Critically, the system delivers not only real-time processing but also high accuracy, enabling prompt identification of piscine dermal pathologies for immediate intervention. This prevents widespread outbreaks and substantial economic damage. These findings pave the way for novel research trajectories and advanced intelligent solutions in future aquaculture development.



Zhao Min, Elchin Khalilov, Xiangyong Zheng, Farid Khalilov, and Min Wang, Wenzhou University, Lucheng District, Wenzhou, China.

Lecture Title: Application of an Aqua-Aero Robotic System for Hyperspectral and Biochemical Monitoring of Environmental Pollution in Water Areas.

Abstract: This paper presents the initial testing results of the AARS (Aqua-Aero Robotic System), a robotic complex designed for hyperspectral and biochemical monitoring of waterbody pollution. The AARS comprises an unmanned boat equipped with a landing platform for UAVs carrying a hyperspectral camera operating in the 400–1000 nm range. Upon detecting pollution zones via hyperspectral imaging, the system transmits the coordinates to the unmanned boat. The boat then navigates autonomously within the contaminated area, performing real-time biochemical express analysis while in motion. For this purpose, the boat is fitted with an autonomous water sampler capable of collecting eight water samples. Additionally, during operation, the system detects the presence of plankton and cyanobacteria by measuring photosynthetic activity, optical density, and chlorophyll concentration. Simultaneously, the following parameters are analyzed: pH, dissolved oxygen concentration, temperature, water hardness, transparency, and REDOX potential.

Thanh Nguyen Canh and Xiem Hoang Van, School of Information Science, Japan Advanced Institute of Science and Technology, Japan.

Quang Minh Trinh, University of Engineering and Technology, Vietnam National University, Vietnam.

Thai-Viet Dang, University of Engineering and Technology, Vietnam National University, Vietnam.

Phan Xuan Tan, Shibaura Institute of Technology, Japan.

Lecture Title: Refined 3D Object Localization with Monocular Camera using Depth Estimation and Geometric Refinement.

Abstract: Accurate 3D object localization is a fundamental requirement for applications in industrial robotics, augmented reality, and autonomous navigation. While traditional multi-view systems are precise, their hardware complexity and cost limit widespread adoption. Monocular vision offers a cost-effective alternative but struggles with the inherent challenge of inferring depth from a 2D image, often leading to significant localization errors. This paper presents a novel methodology that overcomes these limitations, achieving high-precision 3D localization using only a single camera. Our proposed framework integrates three synergistic stages. First, a camera calibration process using a checkerboard pattern corrects lens distortion and establishes a real-world metric coordinate system. Second, we employ the YOLOv8 model for real-time 2D object detection and the ZoeDepth network to generate a dense depth map from the monocular input. To mitigate spatial inaccuracies that arise when objects are positioned off-center, we introduce a geometric object position refinement technique. This method adjusts the object’s center based on its projected image coordinates and depth information. Experimental results demonstrate the superiority of our approach, which achieves an average position error of just 4.6mm. This represents a significant 59.29% improvement in localization accuracy compared to using the standalone YOLOv8 detector, showcasing our method's effectiveness for robust 3D localization.

Online Session 2	
	**Mikhail Medvedev, Vyacheslav Pshikhopov, and Azhar Kadhim Farhood**, Southern Federal University, Rostov-on-Don, Russia. **Lecture Title:** Intelligent Task Allocation between Moving Objects Based on Reinforcement Learning Algorithm. **Abstract:** This paper provides a review of task allocation in robot groups using reinforcement learning algorithms. Based on this review, it is concluded that there is a need to develop task allocation methods based on reinforcement learning. The variable number of robots and target points must be taken into account. The paper formulates a task allocation problem for a group of robots functioning in a discrete environment with obstacles. Two variants of Q-algorithm with deep neural network for task allocation are proposed. The first algorithm is a centralized one. It uses a single neural network that approximates the value of the actions of all robots in the group. The second algorithm is a distributed one. This algorithm on board each robot computes the selection values of each target point in the current state. The proposed algorithms are investigated by numerical modeling methods for an environment with a variable number of robots and target points.
	**Airat Migranov**, Mavlyutov Institute of Mechanics URFS RAS, Ufa, Russia. **Lecture Title:** Task Allocation in Groups of Mobile Robots under Uncertainty using an Adaptive Ant Colony Algorithm. **Abstract:** This paper addresses the task allocation problem in groups of mobile robots operating under parametric and stochastic uncertainty caused by sensor noise, environmental dynamics, and incomplete information about tasks. A task distribution method is proposed based on a modified ant colony optimization (ACO) algorithm incorporating an adaptive mechanism responsive to environ-mental changes. A mathematical model of multi-objective optimization is de-veloped, accounting for task completion time, energy consumption, and solution robustness. An enhanced algorithm is presented, capable of adjusting its parameters in response to the emergence of new tasks and robot failures. The objective function integrates total execution time, cumulative energy cost, and robustness to external disturbances. A key feature of the proposed modification is the linear adaptation of the weighting coefficients associated with the pheromone and heuristic components in the probabilistic decision rule, implemented through progressive adjustment of the α and β parameters. Numerical experiments confirm the superiority of the adaptive algorithm over the baseline version. It is shown that dynamic parameter tuning significantly accelerates solution reconfiguration in response to environmental changes. The results demonstrate the viability of the proposed approach and its effectiveness in constructing intelligent control systems for mobile robot groups operating in complex and dynamic environments.

Nuraddin Kerimov, FRC CSC RAS, Moscow, Russia.

Aleksandr Onegin, MIPT, Dolgoprudny, Moscow, Russia.

Konstantin Yakovlev, AIRI, Moscow, Russia.

Lecture Title: SI-RRT and ST-RRT* For Prioritized Multi-Manipulator Planning: Empirical Evaluation.

Abstract: Multi-manipulator systems are essential in warehouse automation, assembly, manufacturing, and logistics, requiring robots to coordinate within shared workspaces while avoiding collisions. This coordination is often formulated as multi-manipulator motion planning, which is notoriously hard to solve due to the high dimensionality of the configuration space. To this end, decoupled approaches are often used, such as prioritized planning. In the latter approach, robots are assigned priorities and plan trajectories sequentially, treating higher-priority agents as dynamic obstacles. Thus, the performance of a prioritized planner critically depends on the underlying single-agent planner. Recent advanced algorithms in this area, tailored specifically for manipulation planning in the presence of moving obstacles (high-priority robots), include Space-Time RRT* (ST-RRT*), which enhances RRTConnect for the time dimension, and Safe-Interval RRT (SI-RRT), which enriches RRTConnect with safe interval planning. While prior research demonstrated that SI-RRT outperforms ST-RRT* in the single-agent scenarios, their effectiveness in the multi-robot settings remains unexplored. This paper presents the first comprehensive evaluation of ST-RRT* and SI-RRT within prioritized planning for multi-manipulator systems. We compare both planners using the TAPAS dataset (containing diverse pick-and-place tasks) and synthetic random tests, scaling from 2 to 8 robots. On synthetic tests, SI-RRT achieves lower path lengths and makespan despite increased planning time for 6–8 robots due to constrained time corridors, caused by raised scene complexity resulting from reduced makespan. On the TAPAS benchmark, SI-RRT consistently demonstrates the same faster computation, shorter trajectories, better success rate and reduced makespan across all tested scenarios. Code for empirical evaluation is publicly available at github.com/PathPlanning/ManipulationPlanning-SI-RRT/tree/Multiagent-comp.

Ramil Faizullin, Niyaz Imamov and Tatyana Tsoy, Kazan Federal University, Kazan, Russia.

Edgar A. Martinez-Garcia, Autonomous University of Ciudad Juarez, Cd Juárez, Mexico.

Evgeni Magid, Kazan Federal University, Kazan; HSE University, Moscow, Russia.

Lecture Title: Multi-Criteria Approach to Path Planning for Unmanned Tractors Considering Energy Constraints and Soil Compaction.

Abstract: Autonomous agricultural vehicles operating under the Controlled Traffic Farming (CTF) paradigm face complex routing challenges when minimizing soil compaction, total mission time, and station placement under battery constraints. This paper introduces Multi-Objective Coordinated Autonomous Routing and Placement with Fixed Lanes (MO-CARP-FL), a novel multi-objective evolutionary algorithm designed to optimize the coordinated routing of homogeneous autonomous tractors over a predefined field traffic lane. The algorithm simultaneously addresses five conflicting objectives: minimizing soil compaction using a logarithmic saturation model, minimizing total route

	time, reducing the number of charging stations, preserving spatial coherence in assigned routes, and balancing workload among tractors. Chromosomes encode both routing and station placement decisions, and custom crossover and mutation operators preserve structural feasibility. A soil compaction model and energy-aware constraints are integrated into the evaluation function. Experimental simulations demonstrate that MO-CARP-FL produces environmentally sensitive routing plans while reducing field degradation. The proposed method is validated through CTF field scenarios, and its results are visualized to provide interpretable insights into route distribution, station usage, and soil impact. This work contributes to multi-objective optimization in agricultural logistics by addressing both environmental impact and operational efficiency in autonomous field operations.
	**Vitaly Bondarenko, Tatyana Yermolenko, Andrey Grabarchuk, Egor Moroz**, Institute of Artificial Intelligence Problems, Donetsk, Russia. **Lecture Title:** Generation of Synthetic Images to Expand Datasets for Computer Vision Systems Used on Robotic Conveyors. **Abstract:** The paper presents a comprehensive approach to expanding datasets using synthetic image generation for advanced computer vision systems applied to robotic sorting in automated glass product quality control systems. The proposed method integrates synthetic data generation with deep learning models for defect detection in glass container production. The system combines composite rendering using the Pillow library and automatic annotation generation in COCO format to create photorealistic variations of original objects with controlled variability in lighting and background conditions. The defect generation module integrated into the computer vision system realistically simulates production defects in glass containers, including chips, cracks, microbubbles, scratches, label wear, and shape deformations, significantly enhancing data variability and realism. Experimental validation demonstrated the method's effectiveness for generating balanced datasets for training robust computer vision models. A cascaded approach using YOLO for rapid region of interest extraction, EfficientDet and RetinaNet for precise defect identification, and Vision Transformer for verification achieves high accuracy in real-time industrial conditions. The system successfully generated 1000 synthetic images in approximately 15 seconds, maintaining 100% annotation accuracy and area deviation of less than 1%. This approach demonstrates high performance and is designed for integration into a comprehensive computer vision system architecture using cascaded models (YOLO, EfficientDet, Vision Transformer) for real-time quality control on production lines, effectively addressing class imbalance and data scarcity problems characteristic of industrial applications.

Thanh Luan Bui, Ho Chi Minh City University of Technology (HCMUT), Ho Chi Minh City, Vietnam.

Vo Dang Huy Tran and Truong Anh Khoa Le, HUTECH Institute of Engineering, HUTECH University Ho Chi Minh City, Viet Nam.

An Khang Do, Faculty of Engineering Kien Giang University, An Giang Province, Viet Nam.

Giang Hoang, National Key Laboratory of Digital Control and System Engineering, HCMUT, Ho Chi Minh City, Vietnam.

Lecture Title: Hybrid Extended State Observer with Enhanced Sliding Mode Control for Tracking and Disturbance Rejection for Mecanum Wheeled Mobile Robots Apply in an Automotive Manufacturing.

Abstract: This paper introduces an Adaptive Sliding Mode Control (ADSMC) framework integrated with an Extended State Observer (ESO) to enhance the robustness of a Mecanum Four Wheel Autonomous Vehicle (MFWAV) for automotive intralogistics. Mobile robots are subjected to external disturbances and model uncertainties that degrade tracking accuracy. The proposed control law is systematically derived from the robot's nonlinear dynamic model through the construction of an appropriate Lyapunov candidate function, ensuring closed loop stability under varying operating conditions. The ADSMC–ESO scheme is designed to provide robust disturbance rejection and adaptive compensation for parametric variations while maintaining high tracking precision, offering improved adaptability and robustness for modern automotive manufacturing.

Online Session 3

Daniyar Wolf, Rinat Galin, Yaroslav Turovskiy, Roman Meshcheryakov, and Saniya Galina, V.A. Trapeznikov Institute of Control Sciences of Russian Academy of Sciences, Moscow, Russia.

Lecture Title: Methodology for Personalized Human–Robot Collaboration That Accounts for Individual Characteristics of Human Biological Signals.

Abstract: This paper explores a methodology for integrating deep learning techniques into personalized human-robot collaboration (HRC) systems by decoding individual EEG-based neurophysiological patterns. Rather than focusing on biometric identity recognition, the proposed approach centers on detecting individual typological features of EEG dynamics – unique cognitive-motor response patterns that emerge during interaction with robotic systems. EEG data were collected from 30 participants under standardized conditions, with frontal channels (F3, F4, F7, F8) used for signal acquisition. The study introduces a targeted adaptation of classical CNN architectures – AlexNet and MobileNetV2 – to the structural and dynamic characteristics of EEG spectrograms, including low spatial resolution, single-channel input, and domain-specific noise. Two adapted models – SimpleAlexNet and LiteMobileNet2D – were evaluated for their ability to classify EEG-based pattern types under constrained computational conditions. Experimental results show that LiteMobileNet2D achieves a superior balance between accuracy and generalization, maintaining low overfitting despite aggressive model simplification. SimpleAlexNet, while prone to overfitting, demonstrated acceptable performance in medium-complexity tasks. These findings confirm that individualized EEG pattern recognition is feasible with lightweight neural models, enabling real-time adaptation of HRC behavior

	to the operator’s current physiological state and laying a foundation for scalable, context-aware HRC systems.
	**Dobrynin Dmitry**, Federal Research Center "Computer Science and Control" of the Russian Academy of Sciences, Moscow, Russia. **Yulia Zhiteneva**, State University of Humanities and Technology, Orekhovo-Zuyevo, Russia. **Lecture Title:** Near Field Scanning System of Home Walking Robot. **Abstract:** The paper considers the principles of constructing a machine vision system for a domestic four-legged robot. The machine vision system constructs a grid of distances to the support surface in places where the robot’s legs can be placed. Scanning along the robot’s line of motion is performed using a laser lidar. The proposed system is based on the use of an inexpensive 2D lidar. A model of surface scanning for determining support areas is presented. The influence of scanning parameters and distance measurement accuracy on the accuracy of constructing a height map is analyzed. It is shown that the accuracy of measuring the parameters of horizontal and vertical surfaces depends on their location relative to the robot’s body. Conclusions are made and recommendations are given for improving the accuracy of measurements. The conclusions made allow choosing a laser lidar that is most suitable for the scanning system. Testing on a simulator confirmed the high-quality scanning of the robot’s near zone. The proposed scanning method allows reducing the cost of the control system, reducing the requirements for computing power and increasing the battery life of the domestic robot.
	**Dmitry Dobrynin**, Federal Research Center "Computer Science and Control" of the Russian Academy of Sciences, Moscow, Russia. **Lecture Title:** Foot Trajectory Generation for a Quadruped Home Robot. **Abstract:** This article discusses the construction of a foot trajectory for a quadruped walking robot with 12 degrees of freedom. A mathematical model of the robot leg for calculating inverse kinematics is given. The trajectory of the robot’s foot motion is synthesized for uniform rectilinear motion of the robot. The foot trajectory is a basic element for constructing a smooth and stable gait of a walking robot. The trajectory of the robot’s foot consists of a support phase and a transfer phase. In the transfer phase, elliptical and rectilinear trajectories of the foot are used. Dependences of the robot leg drive parameters on time are constructed. The article analyzes these dependencies. It is shown that the maximum speeds and accelerations of the robot leg drives are achieved in the transfer phase. The possibility of optimizing the trajectory parameters for the specified drive parameters to obtain the maximum speed of the walking robot is shown. The trajectory of the robot leg prototype is tested on an experimental stand. It is shown that the executed trajectory has parameters that are in good agreement with the calculated values. In conclusion, practical conclusions are given on optimizing trajectory parameters in order to obtain maximum speed.

Andrei Malchikov and Sergey Jatsun, South-West State University, Kursk, Russia.

Lecture Title: Automated Control System for Magnetically Active Microrobots for Medical Applications.

Abstract: This paper presents an automatic control system for achieving controlled motion of magnetoactive micro-objects. A mathematical model is developed to describe the dynamics of a spherical body made of magnetically filled polymer under the influence of a moving permanent magnet's magnetic field. The proposed control system architecture enables two distinct motion regimes: rolling with minimal interaction forces against the channel wall, or sliding of the deformed magnetoactive object with significant contact forces. This effect is achieved through optimal positioning and orientation of the magnet, which provides precise control over the normal reaction force between the microrobot and the contact surface. The system has potential applications in various medical procedures, including thrombectomy and vascular biopsy. A key feature of the proposed system is the integration of a computational module that performs real-time calculations of force and kinematic parameters for magnetoactive control. The paper includes numerical simulations demonstrating different motion parameters of the magnetoactive object under identical surface and object con-ditions, validating the effectiveness of the proposed control architecture and methodology. The results confirm the system's capability to achieve diverse motion patterns through optimized magnetic field control.

Shifa Sulaiman and Maksim Mustafin, Kazan Federal University, Kazan, Russia.

Hongbing Li, Shanghai Jiao Tong University, Shanghai, Minhang, China

Evgeni Magid, Kazan Federal University, Kazan; HSE University, 34, Tallinskaya St., Moscow, Russia.

Lecture Title: Closed-Loop Chain Linkage-Based Hand Exoskeleton: A Lightweight and Modular Solution for Hand Rehabilitation.

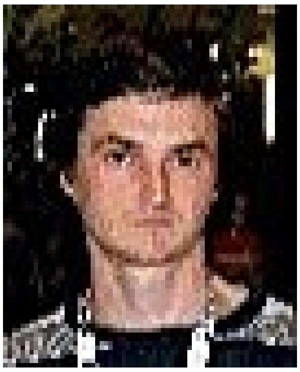
Abstract: Prosthetic hands are vital assistive devices that significantly enhance quality of life for individuals with upper limb amputations, enabling them to regain autonomy and perform essential daily activities. However, many existing prosthetic solutions are hindered by high costs, excessive weight, and complex actuation systems that limit accessibility and usability. This paper introduces a novel prosthetic hand design that addresses these limitations through a mechanically efficient and cost-effective approach. The proposed system employs five motors, one per finger, combined with a closed-loop chain linkage mechanism that transmits motion across joints of each finger. This eliminates a need for multiple actuators per finger, thereby reducing an overall weight, power consumption, and cost of the device. We present a complete design methodology, a mechanical architecture, and functional analysis of the prototype. The mechanical structure achieves finger flexion up to 125 degrees, distal interphalangeal (DIP) joint articulation up to 90 degrees, and wrist deviation of ±20 degrees, closely mimicking natural hand movement. The results demonstrate feasibility and advantages of the approach, offering a promising direction for developing affordable, efficient, and user-friendly prosthetic hands.

Sergey Yatsun, Oksana Emelyanova, and Egor Tistsov, Southwest State University, Kursk, Russia.

Lecture Title: Determination of Forces Acting in the Joints of the Lower Extremities during Rehabilitation.

Abstract: Currently, robotic stands are becoming widespread, and are used for the rehabilitation of the lower extremities based on the continuous passive development of one or more joints. In this case, additional excessive forces arise, which have a significant impact on the joints and the rehabilitation process. Direct measurement of these forces is not possible, as they are internal. The article considers the joint movement of the patient's leg and the rehabilitation exoskeleton as a human-machine system (HMS), with the help of which movement is provided in the joints of the lower extremities at a given law of change in the angle of rotation of the thigh. The method of estimating internal forces is based on the Dalembert principle, which allows us to consider and describe HMS under dynamic equilibrium conditions. The system of equations recorded for individual parts of the system allows real-time calculation of the forces acting in the joints based on data, including that obtained using a system of sensors installed on the exoskeleton. Thus, by calculation, it is possible to obtain the values of the forces acting in the thigh, knee and ankle joints. The results of numerical modeling, taking into account experimental studies, showed a significant effect of the coefficient of friction on horizontal forces arising in the femoral, knee and ankle joints, and a change in the angle of rotation of the thigh leads to an increase in the moments of resistance on the femoral and knee joints. This will help the rehabilitation doctor control the movement of the exoskeleton links and generate loads in passive and active modes of operation.

Online Session 4



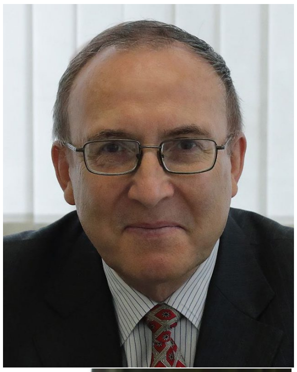
Vladimir Kostyukov, Mikhail Medvedev, and Petr Tregubov, Southern Federal University, Rostov-on-Don, Russia.

Lecture Title: Planning the Movements of a Mobile Robot in a Three-Dimensional Environment with Constraints on Pitch and Yaw Angles.

Abstract: In this paper, the problem of motion planning in a three-dimensional environment taking into account constraints on pitch and yaw angles is considered. A hierarchical algorithm for solving the problem for an environment in which obstacles are approximated by spheres is proposed. At the upper level, the feasibility of planar motions is analyzed taking into account the specified constraints and the location of the start and target points. If the analysis confirms that the constraints are met, a decision is made to move to the specified point. Otherwise, a maneuver is performed in order to ensure the required constraints on pitch and yaw angles. Options for performing additional maneuvers are proposed that ensure a significant reduction in the path length during its ex-ecution. The motions at the lower level are implemented using an algorithm based on the characteristic visibility graph. This algorithm has advantages over cellular decomposition methods in the case of sufficiently complex scenes. Docking of individual sections of the motion is performed using a smoothing procedure according to the modified Dubins method. The proposed algorithm allows obtaining relatively simple and feasible target trajectories. In addition, the algorithm allows you to build optimal movement trajectories.

	**Konstantin Krestovnikov**, St. Petersburg Federal Research Center of the Russian Academy of Sciences (SPC RAS), St. Petersburg, Russia. **Lecture Title:** UAV Control System Architecture with Integrated Visual Navigation for Agricultural Monitoring. **Abstract:** The development of unmanned aerial vehicles (UAVs) equipped with first-person view (FPV) cameras is advancing rapidly, posing novel engineering and scientific challenges. Research areas related to the implementation of operator assistance systems and partial flight automation are becoming increasingly relevant. This work is devoted to the development of the hardware component of an FPV UAV control system for partial flight automation based on visual navigation principles. The developed FPV UAV control system architecture features an original integration of a flight mode controller into the existing con-ventional flight controller-based control system. The paper presents an algorithm and describes the operational principles of the flight mode controller, which serves as the core element integrating the visual navigation system into the UAV's control system. Testing of the proposed control system architecture was conducted using a custom-built UAV designed for monitoring tasks. The UAV's maximum takeoff weight is 5.5 kg, and its propeller diameter is 22 inches. The average command latency of the flight mode controller is 0.42 ms, which increases the total control delay by 5.3% at a refresh rate of 250 Hz. The proposed solutions for visual navigation system integration allow the operator to control the UAV and switch flight modes without significant delays.
	**Alexander Gruzlikov and Vladislav Karaulov**, ITMO University, St. Petersburg, Russia. **Lecture Title:** Estimation of Coordinates and Motion Parameters of an Accompanied Vessel Based on Factor-Graph Optimization. **Abstract:** The signal from a noise-emitting source propagates due to the phenomenon of sound refraction in the marine environment along various trajectories (rays) and is received by the antenna array of an autonomous underwater vehicle from a certain direction (bearing) at different elevation angles. To reduce the uncertainty region of the target coordinates, the paper uses the values of signal correlation across elevation angles, which are compared with reference data computed on a grid of distances and formed based on a ray representation model of the marine environment field. Information on hydroacoustic conditions in the observation area, including measurements of the vertical sound speed distribution, is used as input data for the field model. The proposed solution is based on a combined approach, the essence of which is that the problem of estimating the coordinates and motion parameters of an accompanied vessel from bearing measurements and correlation values of received signals is formulated within a Bayesian framework, and factor-graph optimization methods are used to construct suboptimal algorithms. To evaluate the effectiveness of the proposed algorithm, a simulation program was developed and used to conduct predictive simulation modeling of the considered problem on various episodes and under different hydroacoustic conditions. The results obtained were compared with a non-recursive algorithm constructed within the Bayesian approach. An analysis of the algorithms' consistency was conducted. It is shown that the algorithm based on factor-graph optimization has a significant advantage in computational cost. The

results obtained were compared with a non-recursive algorithm. An analysis of the algorithms' consistency was performed. It is shown that the algorithm based on factor-graph optimization has a significant advantage in computational costs.



Vladimir Filaretov, Institute of Automation and Control Processes FEB RAS, Vladivostok, Russia.

Alexander Protsenko, Institute of Automation and Control Processes; Institute of Marine Technology Problems named after Academician M.D. Ageyev FEB RAS, Vladivostok, Russia.

Igor Gornostaev, Institute of Automation and Control Processes FEB RAS; Maritime State University named after. adm. G.I. Nevelskoy, Vladivostok, Russia.

Libin Du, College of Ocean Science and Engineering, Shandong University of Science and Technology, Qingdao, China.

Lecture Title: Development of a Synthesis Method for Self-Adjusting Correction Devices for DC Brushless Motors.

Abstract: The article is devoted to the solution of the problem of synthesizing self-adjusting correction devices (SCD) for brushless DC motors (BLDC) used as actuators of various mechatronic systems, including multi-stage manipulators and mobile robots. The specified correction devices allow to significantly increase the dynamic control accuracy of these loaded motors by generating an additional control signal fed to the input of the electronic speed controller of the motors. These ensures stabilization during operation at a given nominal level of their dynamic parameters taking into account the current values of external load moments reduced to their output shafts. To solve this problem, an equivalent model of a BLDC described by a system of three first-order differential equations and a method for synthesizing typical SCDs for collector motors are used. The use of an equivalent BLDC motor model made it possible to significantly simplify the control law obtained and reduce the power requirements for on-board computers of robotic systems. To confirm the efficiency of the synthesized SCDs, modeling and a full-scale experiment using an electromechanical stand were carried out. The experimental results confirmed the ability of the developed system to impart specified dynamic properties to the motor.

Azad Bayramov, Samir Suleymanov, and Fatali Abdullaev, Republican Seismic Survey Center, Baku, Azerbaijan.

Lecture Title: The Unmanned Complex of Assess Marksmanship Performance.

Abstract: Recently, in the training of military soldiers and officers, much attention has been paid to improving the efficiency and accuracy of shooting from small arms. Considering that hundreds and thousands of soldiers and officers participate in military exercises, there is a need to create robotic systems that would quickly assess the accuracy of shooting without the participation of a human operator. This paper presents the developed unmanned robotic complex of assess marksmanship performance for small arms fire. The complex is designed for effective training of soldiers and officers in shooting at close and long distances (20 □ 1500 m.). The operating principle of the system is briefly described and technical characteristics are given. It is shown that the proposed unmanned robotic system has significant advantages over foreign analogues. The shooting evaluation system uses automated LOMAH software, hardware, and a PTZ camera to conduct and

	automatically evaluate shots at various types of targets according to the shooting task. An electric Power Supply Unit, a Motor Control Unit and a software algorithm for controlling the complex have been developed. It has been shown that the developed robotic complex has a number of advantages over existing analogues.
	**Anna Klimenko and Mikhail Elmekeev**, Russian State University for Humanities, Russia. **Lecture Title:** Lamarckian Evolution Based Algorithm for Multi-robot Path Planning Problem. **Abstract:** This study addresses the issue of minimizing computational resources spent on solving the multi-robot path planning (MRPP) problem. We propose a novel algorithm inspired by Lamarckian evolution principles integrated into the traditional Darwin evolutionary algorithm. The proposed Lamarckian Evolution-Based (LEB) algorithm aims to enhance both the convergence rate and the accuracy of the MRPP problem solution, thereby reducing overall computational effort. Through extensive simulations, the LEB algorithm demonstrated superior performance compared to standard approaches such as Genetic Algorithm (GA) and Particle Swarm Optimization (PSO). Despite requiring additional computational resources per iteration due to added local optimization stages, the LEB algorithm achieves significant reductions in total resource expenditure and improves solution quality within a specified computational budget. Our findings highlight the potential of Lamarckian-inspired strategies for efficient multirobot navigation tasks. Moreover, the research emphasizes the importance of balancing convergence speed with accuracy under strict resource constraints, especially in scenarios with limited onboard energy. The proposed framework can be further generalized to other classes of combinatorial optimization problems where the trade-off between local refinement and global exploration is critical. Overall, the LEB algorithm contributes a promising direction for resource-aware multi-robot coordination in dynamic and uncertain environments.
Oral Session 3	
	**Oleg Stepanov and Alexey Isaev**, ITMO University, 49, Kronverksky Ave., St. Petersburg 197101, Russia. **Lecture Title:** Recursive Batch Smoother with Multiple Linearization for Single-Beacon Navigation Problem. **Abstract:** A problem of single-beacon navigation of an autonomous underwater vehicle (AUV) is considered. It is solved in terms of the Bayesian approach and belongs to the class of problems with essential nonlinearity, the posterior probability density function (PDF) of which changes from multi-extremal to single-extremal during its evolution. As a rule, traditional recursive Kalman-type algorithms do not work in this case. To solve the single-beacon navigation problem, an algorithm based on the combined use of recursive and nonrecursive data processing schemes, called a recursive batch smoother with multiple linearization, has been designed. Its main essence lies in the simultaneous use of a bank of batch algorithms – recursive iterative smoothing linearized filters, which allows identifying the point of time at which the PDF becomes single-extremal. After this moment is identified, it becomes possible to switch from the problem solution using a bank of batch algorithms to the solution with a single recursive iterative Kalman filter, thus decreasing the computational complexity. The possibilities of

reducing computational complexity by applying methods used in factor graph optimization algorithms are discussed. The advantages of the proposed algorithm are shown by the simulation.

Nguyen Phu Dang, Dang Tran Huy, and Nguyen Trong Tuyen, Institute of Control Engineering, Le Quy Don Technical University, Vietnam.

Lecture Title: Numerical Solution to Estimate the Transfer Function Describing the Towed Underwater Vehicle.

Abstract: Synthesizing the control system for objects with distributed parameters is carried out in two steps: first, a model with centralized parameters is established instead of the original object, then the synthesis of the controller is performed using well-known methods for linear systems. Therefore, this article will propose and investigate a solution estimating the transfer function (TF) describing the towed underwater vehicle (TUV) by an approximate model with the required error based on the real interpolation method (RIM). This solution allows manipulation of real numbers, which overcomes the limitations of previous estimation methods. It reduces the amount of calculation and allows to obtain an approximate model of arbitrary order without any difficulty. In addition, the proposed algorithm can be easily realized on computers. This study includes main contents: establishing the model of the Towed cable (TC)- Underwater vehicle (UV) system, proposing an estimation algorithm and building a program to automatically estimate the TF, which associates between displacement at the end of cable attached to the UV with displacement at the point attached to the winches, evaluating the impact of sea waves on the towed underwater vehicle.

Yunli Nie, Di Tian, Libin Du, Yizhe Huang, and Jiahao Du, College of Ocean Science and Engineering, Shandong University of Science and Technology, Qingdao, China.

Vladimir Filaretov, Institute of Automation and Control Processes FEB RAS, 5, Radio St., Vladivostok, Russia.

Zhaojie Wang, China Ship Research and Development Academy, Beijing, China.

Lecture Title: Trajectory Tracking Control of Surface Mobile Buoys Based on A-Star – NMPC Algorithm.

Abstract: Aiming at the problems of insufficient mobility and low trajectory tracking accuracy of traditional buoys, A new type of surface mobile buoy was designed, and a trajectory tracking algorithm integrating the A* algorithm and nonlinear model predictive control (NMPC) was also designed. First of all, establish the mathematical model of the three-degree-of-freedom surface mobile buoy. Secondly, the A*-NMPC algorithm is designed. By combining the global path planning ability of the A* algorithm with the dynamic optimization

characteristics of NMPC, a collaborative control framework is formed. Finally, through conducting simulation experiments and comparing and analyzing the trajectory tracking effect with that of linear model predictive control (MPC). The results show that A*-NMPC exhibits significant advantages in the scenario of sudden course changes. The maximum longitudinal error is reduced by 50% compared with MPC, the lateral error is reduced by 80%, and it has the capabilities of dynamic obstacle avoidance and rapid response.

LiBin Du, Zhen Zhu, LiXun Hou, YunLi Nie, ChengGang Wang, and ZiHao Zhang, College of Ocean Science and Engineering, Shandong University of Science and Technology, Qingdao, China.

Aleksander Zuev, Institute of Automation and Control Processes FEB RAS, Vladivostok, Russia.

Lecture Title: Investigation into the Impact of Propellers on the Rudder Efficiency of Ships during Steering Operations.

Abstract: In order to observe the influence of the wake behind the propeller on the rudder, this paper conducts an interference experiment on the propeller-rudder system using the B4-55 propeller and the NACA0020 marine rudder, and analyzes the hydrodynamic characteristics of the rudder behind the propeller wake. The computational domain is divided into a rotational domain and a fluid domain, and the domain is discretized using cut-cell meshes. The discrete equations are solved using the model. The rotation motion of the propeller is simulated by using the slip grid. Data information is transferred through the interface to complete the hydrodynamic performance simulation of the propeller system. This paper analyzes the hydrodynamic performance of marine rudders under different rudder angles, and explores the influence of the propeller on the resistance, lift and limit rudder angle of the rudder. The distribution characteristics of the velocity field and pressure field in the computational domain were analyzed.

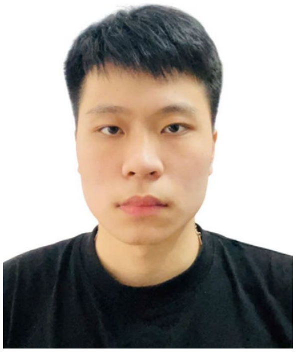
Dmitry Yukhimets and Ivan Grigorev, Institute of Marine Technology Problems; Institute of Automation and Control Processes FEB RAS, Vladivostok, Russia.

Lecture Title: A Method for Industrial Manipulators for Approximating Paths with an Excessive Number of Fly-by Points.

Abstract: Computer vision systems are often used to automatically generate paths for the working tool of an industrial manipulator. However, such paths often contain an excessive number of points and small random noises and cannot be directly used to set the movements of the manipulator. The article proposes a method for approximating such paths by a sequence of straight lines and circles to reduce the number of commands to the manipulator and to mitigate noise. The method is based on search through possible variants for dividing the path into segments and comparing the total errors when fitting a straight line or circle into each of the segments. The article provides three ways to search through possible path divisions: a complete search, the fastest search and an intermediate variant that provides the user with a choice between the speed of the search and the probability of finding the optimal combination. In addition, equations are given for calculating the

	parameters of straight lines and circles, as well as for estimating the approximation error; a method for calculating the endpoints of straight-line segments and circular arcs is shown. The efficiency of the method was tested on the path obtained from a profile laser scanner.
	**Nguyen Ngoc Tuan, Tran Van Tuyen, Tran Cong Tan, and To Xuan Dinh**, Le Quy Don Technical University, 236, Hoang Quoc Viet, Hanoi, Vietnam. **Tran Xuan Tinh**, Le Quy Don Technical University, 236, Hoang Quoc Viet, Hanoi, Vietnam. **Lecture Title:** Robust Sliding Mode Control for the Electro-Optical Observatory Drive System of a Patrol Ship. **Abstract:** Electro-optical tracking devices play a crucial role in modern civil monitoring and observation systems, such as coastal surveillance, maritime navigation assistance, and environmental monitoring. However, the tracking performance of their drive systems can be significantly degraded by external disturbances such as ocean waves, platform vibrations, and environmental uncertainties. To address these challenges, this paper proposes a robust sliding mode control (SMC) strategy integrated with a disturbance observer for the electro-optical observation drive system of a maritime monitoring platform. The proposed controller is designed to enhance robustness against nonlinearities and external disturbances while ensuring high tracking accuracy. A stability analysis is provided to guarantee convergence of the tracking error under bounded disturbances. The effectiveness of the approach is validated through numerical simulations in MATLAB/Simulink, where the proposed SMC demonstrates superior performance compared to conventional control schemes. Results confirm that the controller ensures precise tracking and robust disturbance rejection in realistic maritime conditions, making it a promising solution for improving the operational reliability of shipborne electro-optical observation systems.
Oral Session 4	
	**Van Hung Nguyen**, Control, automation in production and improvement of technology institute, Hanoi, Vietnam. **Pham Tran Quyen Anh and Xuan-Tung Truong**, Le Quy Don Technical University, Hanoi, Vietnam. **Lecture Title:** Fast Path Planning with Hierarchical Approach Based on 3D Scene Graphs. **Abstract:** In the literature on autonomous systems in general, and mobile robots in particular, the primary goal of path planning methods is to meet both completeness and real-time criteria, ensuring they can be effectively deployed in real-world systems. For Unmanned Aerial Vehicles (UAVs), the requirement for real-time performance becomes even more critical due to constraints of resources. The most of existed methods use the volumetric map combined with a single-level planning approach. This is computationally expensive even in small scenes. There were many efforts in reducing this burden of computing. The ESDF map encodes the shortest distance from every point in the environment to the nearest obstacle enabling collision-checking faster. Oleynikova et al. has tried to skeletonizing the environment and then creating sparse graph. This work suggests the use of hierarchical planning based on the novel presentation of environment, namely 3D Scene Graph (3DSG), to save

computational resources more. Hierarchical path planning is an approach that divides the pathfinding process into different levels of abstraction, allowing for more efficient and scalable solutions. The 3DSG is inherently suitable to hierarchical planning because it is organized as multi-layers at different levels of abstraction and includes the relationship between nodes at the same layer as well as across different layers. Moreover, we also did the experiments for illustrating the performance of planning on 3DSG versus sparse graph. We do A-star and D* Lite with the same configuration on 3DSG and sparse graph on some kind of environment. From the result, we figured out that the efficiency of hierarchical planning on 3DSG is superior compared to sparse graph. A summary video of the proposed system is available at https://youtu.be/6leSRoO16KQ.



Truong Giang Dao and Truong Do, Center for Environmental Intelligence and College of Engineering & Computer Science, VinUniversity, Hanoi, Vietnam.

Phi Long Nguyen, School of Electrical and Electronic Engineering, Hanoi University of Industry, Hanoi, Vietnam.

Lecture Title: Variational Autoencoder for Efficient Image Representation in Deep Reinforcement Learning for Mobile Robot Navigation.

Abstract: In this paper, we present a deep reinforcement learning (DRL) policy for autonomous mobile robot navigation in cluttered environments. A key challenge in applying DRL to vision-based navigation is the high dimensionality of raw image observations, which often leads to poor sample efficiency and unstable training. To address this issue, we propose a representation learning module based on a variational autoencoder (VAE), trained on simulated depth images to compress visual input into a compact latent representation. This encoding pre-serves essential spatial information such as obstacle boundaries and free space, while filtering out redundant details, resulting in a more structured and informa-tive observation space. The latent features, combined with odometry data, are then used as input to the DRL policy, enabling the robot to reliably reach specified targets while avoiding collisions. Extensive simulation experiments in diverse and cluttered environments demonstrate that our method achieves a success rate of approximately 66.7%, which is significantly higher than baselines trained directly on raw depth images or with FFT-based encoders under the same training budget. These results highlight the effectiveness of combining VAE-based representation learning with DRL for robust and efficient autonomous navigation.

Viet-Tiep Nguyen, Le Quy Don Technical University, Hanoi, Vietnam.

Hung Van Nguyen, Control, Automation in Production and Improvement of Technology Institute, Hanoi, Vietnam.

Tran Cong Tan, **Xuan-Tung Truong**, **Cao Huu Tinh**, Le Quy Don Technical University, Hanoi, Vietnam.

Lecture Title: An Efficient Navigation Algorithm for Unmanned Surface Vehicles in Dynamic Environments.

Abstract: Unmanned surface vehicles (USVs) are increasingly utilized in complex maritime tasks such as harbor surveillance, coastal monitoring, and port patrols. Safe navigation in congested and dynamic waters requires a unified framework for perception, mapping, planning, and control. This paper presents a fully integrated navigation system for a

	catamaran-style USV operating in crowded harbor environments. The system forms a closed loop from multi-sensor perception to motion execution. It fuses data from GPS, IMU, 3D Li-DAR, and cameras for real-time SLAM and obstacle detection. Robust localization is achieved with a LiDAR–inertial odometry algorithm (LIO-SAM) enhanced by GPS/IMU fusion via an Extended Kalman Filter. Path planning combines a global A* planner on occupancy maps with a local Dynamic Window Approach (DWA) for dynamic obstacle avoidance. Motion execution is handled by a dual-loop PID controller regulating linear and angular velocities. The framework is validated in high-fidelity Gazebo harbor simulations, demon-strating safe navigation toward waypoints while avoiding static and moving obstacles. Results show that integrating SLAM, A*-based global planning, and DWA local refinement significantly improves autonomy. The architecture emphasizes efficiency, modularity, and extensibility, supporting future vision-based perception for enhanced safety in dynamic maritime environments.
	**Nguyen An Hai, Le Tran Thang, and Pham Chi Thanh**, Control, Automation in Production and Improvement of Technology Institute (CAPITI), Academy of Military Science and Technology (AMST), Hanoi, Vietnam. **Nguyen Pham Thuc Anh**, Department of Automation, School of Electrical and Electronic Engineering, Hanoi University of Science and Technology, Hanoi, Vietnam. **Lecture Title:** EKF-FOGS Enhanced Observer for Autonomous Tracked Vehicle Control in Slippery Terrain. **Abstract:** Autonomous tracked vehicles play a crucial role in precision agriculture, automated construction, and emergency rescue operations. However, maintaining positioning accuracy under slippery terrain conditions remains a significant challenge. This paper proposes the EKF-FOGS (Extended Kalman Filter with Focused Observation for Guided Steering) observer – a state estimation solution capable of maintaining high accuracy when vehicles operate in environments with high slip ratios. The system integrates data from encoders, IMU, and depth cameras while applying an adaptive mechanism that automatically adjusts to changing terrain conditions. The Bekker-Wong soil mechanics model is employed to simulate track-terrain interaction, providing a realistic testing environment. This method addresses the error accumulation problem of odometry by incorporating absolute position references independent of inertial and distance measurements. MATLAB simulations demonstrate that EKF-FOGS significantly improves position estimation accuracy compared to traditional EKF, achieving average errors below one meter in various high-slip scenarios. These results confirm the method's potential for widespread application in GPS-denied positioning systems, particularly for high-precision outdoor tasks.



Minh-Tuan Nguyen-Thai, Hoang Nam Nguyen, and Phuong Thao Thai, Hanoi University of Science and Technology, 1, Dai Co Viet St., Hanoi, Vietnam.

Lecture Title: Path Planning for Smooth Operations of Nonholonomic Mobile Robots Using Piece-wise-Uniform Turning Maneuvers.

Abstract: Path planning for smooth operations is important for nonholonomic mobile robots to operate safely and efficiently. This study proposes an approach to design a piecewise-uniform path planning. The whole plan of the path is divided into smaller segments. Either the linear velocity or the linear acceleration of each segment is constant. Similarly, either the angular velocity or the angular acceleration of each segment is constant. Because of the uniformness, the limi-tations on the velocities and accelerations can be easily satisfied. This approach can make use of any path planning algorithm that outputs a path consisting of straight lines, for example, rapidly-exploring random tree star algorithm and A star algorithm. Piecewise-uniform turning maneuvers are then added to the raw path. They include not only the turns from one straight segment to another but also a smooth starting curve and a smooth stopping curve to satisfy the robot's pose at the beginning and the required pose at the end of the path. Two examples are presented, showing that the proposed method successfully generates appropriate paths and reduces the operation time of the mobile robot.

Ildar Nasibullayev, and Oleg Darintsev, Ufa University of Science and Technology, Ufa, Russia.

Nikita Kruglov, Ufa State Petroleum Technological University, Ufa, Russia.

Lecture Title: Methodology for Calculating the Configuration Parameters of a Modular Wheeled Mobile Robot.

Abstract: The paper presents algorithms for calculating the configuration's parameters of a modular wheeled robot when moving along an arbitrary plane trajectory. The robot is a system of two-wheeled modules, sequentially connected using a ball joint. Two variants of the module wheelset are considered: fixed and with controlled rotation relative to the vertical axis. Mathematical models of the coupling equation are constructed on the basis of continuity in a ball joint. For the first option, an iterative algorithm of the second order of accuracy relative to the time step of the leading robot is proposed. The solution of the coupling equation is carried out analytically. For modules with a controlled wheelset, the configuration is determined using an algorithm that uses a second-order numerical scheme to solve a nonlinear parametric coupling equation. It was found that when moving a robot with a fixed wheelset, the trajectories of the driven models deviate from

	the trajectory of the leading one. The magnitude of the deviation increases with the growth of the trajectory curvature and accumulates from the first module to the last. The proposed algorithms allow for kinematic studies of a modular wheeled robot. To perform dynamic studies, a computer model of the robot in the ROS environment and using the Gazebo simulator is proposed. The simulation results can be used to develop a control system for robot modules when moving along an arbitrary flat trajectory.
Oral Session 5	
	**Duc-Chi Nguyen, Duc-Huy Nguyen, Quy-Thinh Dao, and Thi-VanAnh Nguyen**, Hanoi University of Science and Technology, Hanoi, Vietnam. **Lecture Title:** Trajectory Tracking and Orientation Stability of Planar Cable Robots Using PSO-Tuned Sliding Mode Control. **Abstract:** While cable-driven parallel robots (CDPRs) feature wide workspaces, strong payload capacity, and good scalability, they are hindered by nonlinear dynamics, redundant actuation, and non-negative tension constraints. Traditional control strategies, including PID, adaptive methods, and robust nonlinear approaches, often suffer from chattering, parameter sensitivity, and difficulties in ensuring feasible cable tensions. This paper proposes a hybrid control framework that integrates Sliding Mode Control (SMC) with Particle Swarm Optimization (PSO) to achieve precise trajectory tracking and orientation stability in a four-cable planar CDPR. The SMC ensures robustness against model uncertainties and external disturbances, while PSO optimally tunes the controller gains within bounded ranges to mitigate chattering and enhance stability. A null-space–based positive tension converter is incorporated to enforce non-negative tensions, minimizing deviation from the nominal wrench. Simulation results on circular trajectories demonstrate that the proposed approach maintains tracking accuracy with position errors below 3%, suppresses angular deviations within 0.34°, and ensures feasible tension profiles within 0–60 N. The framework highlights the effectiveness of PSO-optimized SMC in addressing robustness, stability, and physical constraints, offering practical insights for deploying CDPRs in automated and precision tasks.
	**Hong Nguyen Thi**, Department of Electrical-Electronics Engineering, Hanoi College of High Technology. **Le Thi Thuy Nga**, Department of Cybernetics, University of Transport and Communications, Hanoi, Vietnam. **Lecture Title:** Distributed Swarm Robot Control Using Fuzzy Logic, Chaos Theory, and the Drag-onfly Algorithm. **Abstract:** When swarm robots move in an environment with obstacles to search for unknown targets, the challenge is that each individual must be able to maintain swarm cohesion, avoid obstacles, and achieve the widest possible coverage of the search space. Therefore, this paper proposes a solution that combines fuzzy logic, chaos theory, and the Dragonfly Algorithm (DA) to address this problem. Fuzzy logic is applied to determine the steering angle of robots in the swarm, enabling collision avoidance and regulating robot distribution in the environment. Chaos theory, using the logistic map, is integrated to allow robots to avoid obstacles smoothly, increase the diversity of motion trajectories,

	and escape local traps. At the same time, the DA is employed to optimize fuzzy rules, enhancing adaptability and coverage capability of the swarm. Simulation results in Matlab show that with the integrated Fuzzy–Chaotic–DA controller, the coverage rate exceeds 80% and collisions are significantly reduced compared with control based only on fuzzy logic, thereby confirming the effectiveness and stability of the proposed controller.
	**Pham Quang Hung**, **Pham Duy Hung**, VNU-University of Engineering and Technology, Hanoi, Vietnam. **Trung Dung Ngo**, University of Prince Edward Island, Charlottetown, Canada. **Lecture Title:** Optimizing Contact Positioning Configuration of Multi-Robot System for Object Manipulation and Transportation. **Abstract:** This paper addresses a method for optimizing contact positioning configuration for cooperative pushing-force multi-robot system (CPF-MRS) with object manipulation and transportation tasks. It is challenging to search for optimal contact positionings of only pushing mobile robots around an anyshape object boundary for maximum wrenches when they cooperatively manipulate and transport such an object along a predefined path under frictional constraints. In this study, a Particle Swarm Optimization (PSO) framework is proposed to determine the optimal contact positioning surrounding the object boundary. Combining criteria derived from the grasp and Gram matrix analysis, a comprehensive cost function for PSO is generated to optimize cooperative pushing force-generated wrenches guiding the multi-robot system toward stable and controllable configurations. Based on optimized contact positioning configuration, a simple PID-based controller is employed to regulate desired wrenches of CPF-MRS for path tracking during the object manipulation and transportation. The simulation results demonstrate that the strategy has successfully optimized contact point configuration enabling the controlability and stability of CPF-MRS when performing object manipulation and transportation.
	**Hoang Duc Long**, Department of Automation and Computer Engineering, Institute of Control Engineering, Le Quy Don Technical University, Hanoi, Vietnam. **Lecture Title:** Design of Synergetic Controller based on Nonlinear State Observer for Twin Rotor MIMO System. **Abstract:** This paper presents the design of a robust controller for the Twin Rotor MIMO System (TRMS) by integrating Synergetic Control Theory (SCT) with a Nonlinear State Observer (NSO). TRMS is a benchmark system widely used to evaluate advanced control algorithms due to its highly nonlinear dynamics, strong coupling, parameter uncertainties, and susceptibility to external disturbances. Conventional controllers often struggle to ensure both stability and precise trajectory tracking under such conditions. To overcome these challenges, the proposed method leverages SCT to guarantee convergence of pitch and yaw angles to desired trajectories while preserving system stability in the presence of unknown disturbances. Since synergetic control laws require full state information, a nonlinear state observer is developed to estimate unmeasured states with high accuracy. The stability of both the controller and observer is rigorously proven using Lyapunov functions. Simulation results demonstrate that the combined SCT–NSO approach effectively eliminates disturbances, achieves fast convergence, and

ensures accurate trajectory tracking, outperforming traditional methods. The proposed framework provides a promising solution for robust control of complex nonlinear systems such as TRMS and paves the way for further extensions to terminal synergetic control designs.

Andrei Konstantinov and Lev Utkin, Peter the Great St. Petersburg Polytechnic University, St. Petersburg, Russia.

Lecture Title: Set-Input Trees: An Interpretable Multiple Instance Learning Architecture for Robotics.

Abstract: Multiple Instance Learning (MIL) is a powerful framework for robotic perception and decision-making, where labels are associated with sets of instances rather than individual data points. We propose gradient-based Set-Input Trees, a novel tree-based architecture for MIL that addresses both classification and regression, with significant potential for application in robotics. Unlike conventional methods relying on fixed aggregation (e.g., min/max pooling), the proposed architecture integrates gradient-based trees with an attention mechanism: instances are processed independently, while leaf embeddings are pooled via learned attention weights. Furthermore, a decision tree ensemble is trained as an aggregation function to handle bag-level embeddings. This preserves interpretability, crucial for ensuring safety and trust in robotic systems, while simultaneously capturing bag-level structure inherent in complex robotic environments. For regression tasks, common in robot control, we introduce a synthetic MIL formulation, feature-to-bag conversion, enabling evaluation on continuous targets. Experiments show outperformance of the proposed algorithms on standard MIL benchmarks comparing to tree-based models. The model's tree-based design ensures scalability and transparency, bridging instance-level decisions with set-valued predictions. Codes implementing the proposed algorithms are publicly available.

Hung Viet Bui, Sy Van Do, and Hiep Xuan Trinh, Faculty of Mechanical Engineering, Le Quy Don Technical University, Hanoi, Vietnam.

Lecture Title: Toward Collaborative Robots: Hybrid Slider–Crank with Variable-Stiffness Soft Rod.

Abstract: Robots designed for human interactions require not only precision but also adaptability and safety during physical contact. Traditional rigid robots perform well in structured industrial environments but are limited in collaborative applications because of their inherent lack of compliance. Soft robots, by contrast, offer intrinsic safety and adaptability but struggle with accurate modeling and controllability. To address these limitations, this paper proposes a novel design strategy for robotic mechanisms that integrates rigid and soft components to exploit the advantages of both principles. This strategy is demonstrated through a hybrid slider–crank mechanism incorporating a soft, variable stiffness connecting rod into the conventional rigid framework. The soft connecting rod, constructed as a pneumatic pressure–responsive elastomer composite, allows active stiffness modulation: elevated pressure increases rigidity for accurate force transmission, whereas reduced pressure enhances compliance for safer interaction. A theoretical model of the mechanism is developed to describe stiffness variation, dynamic force transmission under different pressurization levels. The design and fabrication process of the soft connecting rod is presented, followed by indentation tests to characterize pressure-dependent stiffness and dynamic experiments to evaluate force transmission in the hybrid mechanism. Ex-perimental results confirm that pneumatic pressurization effectively tunes the stiffness of the connecting rod, leading to controllable changes in dynamic re-sponse and output force. This work demonstrates the feasibility of embedding soft variable-stiffness elements into core structural components of classical mechanisms, paving the way for collaborative robots that combine precision, adaptability, and safety.

Oral Session 6

Kamil Aida-zade, Institute of Control Systems of the Ministry of Science and Education of Republic of Azerbaijan; Azerbaijan University of Architecture and Construction, Baku, Azerbaijan.

Vugar Hashimov, Institute of Control Systems of the Ministry of Science and Education of Republic of Azerbaijan; National Aviation Academy, Baku, Azerbaijan.

Lecture Title: Synthesis of Process Dynamics Control Using Current and Previously Conducted Measurements of Its State.

Abstract: The article investigates a method for synthesizing optimal control of processes (objects, systems) with lumped parameters described by systems of nonlinear autonomous differential equations with ordinary derivatives. To synthesize current process control values, it is proposed to use information about its state both at the current and past moments of time. For the values of control actions, a linear dependence on the measured process states is proposed and used. To determine the optimal values of the feedback parameters involved in these dependencies, the corresponding formulas for the gradient of the objective functional were obtained. Computer experiments were conducted using gradient-type optimization methods. An analysis of the influence of the number of measurements used for feedback on the quality of control is made.

Kamil Aida-zade, Institute of Control Systems of the Ministry of Science and Education of Republic of Azerbaijan; Azerbaijan University of Architecture and Construction, Baku, Azerbaijan.

Samir Guliyev, Institute of Control Systems of the Ministry of Science and Education of Republic of Azerbaijan; Azerbaijan State Oil and Industry University, Baku, Azerbaijan.

Lecture Title: Feedback Control Approach Based on Classes of Zonal Control Actions.

Abstract: This paper presents a feedback control synthesis approach for nonlinear dynamic systems with lumped parameters under partial observability and time delays. We propose a zonal feedback control framework, where the state space of observable components is partitioned into finitely many zones, each associated with constant or linear feedback gains. Unlike conventional feedback laws that depend continuously on the instantaneous state, the control input here changes only when the system transitions between predefined zones. This reduces what is conceptually an infinite-dimensional feedback design problem (searching over continuous state-feedback functions) to a finite-dimensional parametric optimization problem, allowing for efficient computation of control parameters. The control design problem is formulated as the minimization of an objective functional that accounts for both the system's dynamic response and control energy, averaged

	over uncertain initial conditions and parameter variations. To solve this problem, we derive analytical formulas for the gradient of the objective functional with respect to the zonal feedback parameters by employing perturbation techniques and adjoint systems. These gradient formulas allow the implementation of first-order optimization methods, such as the projected gradient algorithm, to determine optimal zonal gains while satisfying control constraints. The presented approach has potential applications in robotics, autonomous systems, and other domains where real-time computation and robustness to uncertainties are critical.
	**Oleg Stepanov and Yulia Litvinenko**, ITMO University, St. Petersburg, Russia. **Lecture Title:** Research of Nonrecursive Federated Filtering Algorithms under Non-White Noise Measurement Errors. **Abstract:** The paper considers the design of the algorithms estimating the dynamic system state under the presence of non-white noise measurement errors. The estimators can be based on centralized or on decentralized schemes. The main advantage of centralized filter (CF) is its ability to provide mean-square optimal estimate of the linear system state. The described decentralized processing methods are based on federated filtering algorithms (FFA), where the state vector of dynamic system is estimated by weighting the estimates of the local filters (LF), processing the local measurements, in the master filter (MF). The FFA are computationally simpler and immune to false measurements, however, they generally fail to provide optimal estimates. The proposed FFA is based on nonrecursive processing of measurements in LF. It has been shown that when LF tuning conditions are met, the MF estimates and covariance matrices coincide with the estimates and covariance matrices for the optimal CF. It has been noted that the use of a nonrecursive measurement processing scheme creates a good background for applying factor graph optimization (FGO) methods in the problem of nonlinear measurements processing using FFA. The obtained results are illustrated by the example of navigation system correction.
	**Nguyen Xuan Chiem, Nguyen Cong Dinh, Nguyen Van Xuan, Le Minh Kien, and Nguyen Cong Binh Nguyen**, Department of Automation and Computing Techniques, Le Quy Don Technical University, Vietnam. **Lecture Title:** Robust Control for Line-Following Robots with Model Uncertainties and Dynamic Disturbances. **Abstract:** This paper proposes a robust nonlinear control law for line-following robots under dynamic disturbances caused by model uncertainties. The control objective is to ensure that the robot accurately tracks the desired trajectory, even in the presence of line paths with varying curvature. The control strategy is designed based on a cascade structure, consisting of two loops: the kinematic loop and the dynamic loop. The outer loop, corresponding to the kinematic controller, is developed using a Lyapunov function. The dynamic control law in the inner loop is derived from differential geometric methods and guarantees finite-time stability. System uncertainties and disturbances are compensated by introducing a predefined term in the control law. The closed-loop stability is rigorously proven using Lyapunov theory. Simulation results, along with comparisons to the LQR controller, demonstrate the effectiveness and robustness of the proposed approach,

	highlighting its fast convergence, small tracking error, and strong disturbance rejection capability.
	**Dmitrii Cherginets, Aleksei Vedyakov, and Andrei Motorin**, ITMO University, St. Petersburg, Russia. **Lecture Title:** Comparison of Methods for Covariance Estimation for Factor Graph Optimization of the Bayesian Estimation Problem. **Abstract:** Factor graphs optimization is becoming a common approach to states and parameters estimation in navigation tasks due to the simplicity of the system description and combining various measurement sources, as well as the high accuracy of estimates. To obtain the best estimate, it is necessary that the noise covariance matrices of the corresponding measurements are known a priori. However, in practice, this is very difficult to achieve due to the complexity of methods for estimating noise parameters and the non-stationarity of these pa-rameters, which may require the evaluation or correction of the covariance ma-trices used. Recently, several approaches have been presented to obtain an esti-mate of the covariance matrix in relation to factor graph optimization, but no comparison has been made with other approaches. This paper is devoted to comparing two methods for estimating measurement and system noise covariance matrices. First is a factor graph method where both covariances and state vector are estimated using algorithms based on factor graph, second is a combined Bayesian – factor graph method where a sequential nonlinear Bayesian algorithm is used to estimate covariances and factor graph is used to estimate the state vector. The following metrics were used for comparison: the mathematical expectation and the standard deviation of the estimates of covariance, and a coefficient of accuracy of the system state estimates with the obtained estimates of covariance.
	**Van Tien Bui, Do Van Minh, Tran The Hung, and Tran Dinh Thanh**, Le Quy Don Technical University, Hanoi, Vietnam. **Pham Van Duy**, Hanoi University of Science and Technology, Hanoi, Vietnam. **Tran Van Nam**, Naval Missiles and Guns Faculty, Naval Academy, Nha Trang, Vietnam. **Lecture Title:** Aerodynamic Characteristics and Dynamic Modeling of Long Endurance Unmanned Aerial Vehicle. **Abstract:** This paper investigates the aerodynamic characteristics and dynamic behavior of a long endurance unmanned aerial vehicle (UAV). The aerodynamic parameters were analyzed using simulation tools including Ansys Fluent, Missile Datcom, and OpenVSP. The results indicate that the UAV achieves optimal flight efficiency within the angle of attack range of 4°–6°, with stall occurring at 12°. Based on these findings, a longitudinal dynamic model was developed by the classical method with motion equations to evaluate the influence of aerodynamic and dynamic parameters on flight stability. The study demonstrates that the UAV maintains controllability and reliability under various flight conditions. The aerodynamic forces and moments are consistent well among different measurement methods. These findings provide practical implications for UAV design, manufacturing, and improvement, thereby contributing to the foundation for mastering and advancing modern aviation technology in the future.

Venue and Format of the Conference

10th International Conference on Interactive Collaborative Robotics (ICR 2025) will be held in a hybrid format: face-to-face participation taking place on Le Quy Don Technical University (LQDTU), Hanoi, Viet Nam (236 Hoàng Quốc Việt, Cổ Nhuế, Bắc Từ Liêm, Hà Nội, Viet Nam) and an online video conference. The conference programme with link on video conference is available on the website too: https://icr.nw.ru/2025/.

The official language of the conference is English.

One link for video conference for Tutorials, Opening ceremony, Sessions, Closing ceremony is: **https://us06web.zoom.us/j/83782678933?pwd=SE9EUlhxdnpsbWVENEJ2aEhrWXJDdz09**.

NB: Please, be so kind to write all your questions to speakers in chat.

The time of the videoconference is indicated in the time zone of **Hanoi / Viet Nam time zone (UTC + 7)**.

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