2024 13th International Conference on Information and Electronics Engineering
(ICIEE 2024)

2024 2nd International Conference on Mechatronics, Control and Robotics
(ICMCR 2024)

Jeju, South Korea (GMT +9)

February 27-29, 2024

Ramada Plaza Jeju

Add.: 66 Tapdong-ro, Samdo 2-dong, Jeju-si, Jeju-do

Tel.: 064-729-8100, Mail: ramadajeju@ramadajeju.co.kr

Website: https://www.ramadajeju.co.kr/

Co-sponsors

Sensors and Systems Society of Singapore

제주대학교 JEJU NATIONAL UNIVERSITY

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제주대학교 JEJU NATIONAL UNIVERSITY

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FIT Fukuoka Institute of Technology 福岡工業大学

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Welcome Address

Dear Distinguished Delegates,

It is our great pleasure to welcome you to Jeju, South Korea to attend 2024 13th International Conference on Information and Electronics Engineering (ICIEE) and 2024 2nd International Conference on Mechatronics, Control and Robotics (ICMCR) during February 27 to 29, 2024.

This event will be a good opportunity for international experts in various fields to gather to discuss major issues and find solutions. Conference will offer an extensive program of interest to academia and industry. It will include several keynote speeches, invited speeches, breakout sessions and university visit. A series of exciting speeches to develop skills in and advance awareness of requirements engineering practices is of particular interest to industry. It is an opportunity for researchers and practitioners to meet together and discuss the recent trends.

The breakout sessions cover topics including Modern Electronic Systems and Control Technology; Digital Circuit and System Design; Intelligent Agent System Control and Robotics; Image based Intelligent Detection and Classification; Advanced Electronic Devices and Equipment Development and Intelligent Robot and System Control Model Analysis.

To put a successful conference together could have only been achieved through a team effort. In this view, we thank all the committee members who have made every effort to promote the conference. The appreciation goes to all the authors who submit their papers and cooperate with organizing committee to complete conference affairs. We also would like to express the deepest appreciation to the technical program committee members and session chairs for sacrificing their precious time supporting paper review and evaluation work.

Finally, we wish to thank all authors and attendees for participating in the conference. Hope you have a fruitful and memorable experience. Enjoy your staying in Jeju!

Yours sincerely,
ICIEE&ICMCR Conference Committee

Committee

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Prof. Ljiljana Trajkovic, Simon Fraser University, Canada

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Dr. Yujia Li, Institute of Blood Transfusion, Chinese Academy of Medical Science, China
Dr. Chunhui Yang, Institute of Blood Transfusion, Chinese Academy of Medical Science, China

Guideline

Guideline for Onsite Participation

◆ **Conference Venue**

Ramada Plaza Jeju

Add.: 66 Tapdong-ro, Samdo 2-dong, Jeju-si, Jeju-do
Tel.: 064-729-8100
Contact Manager: Jeff
Email: jeff-8888@naver.com
https://www.ramadajeju.co.kr/

◆ **Registration & Material Collection**

Date: **February 27, 2024**
Time: 10:00-16:00
Location: Ramada Plaza Jeju Hotel (Refer to the sign)

◆ **Campus Visit (**Jeju National University**)**

Date: **February 27, 2024**
Time: 14:00-16:00
Assembling Place: Registration Reception (Ramada Plaza Jeju Hotel)

◆ **Instructions for Presentation**

✧ **Regular Oral Presentation:** 15 minutes (including Q&A). Get your presentation PPT or PDF files prepared. Please copy your presentation file to the desktop before session starts.

✧ **Devices Provided by the Conference Organizer:**
Laptop (with MS-Office & Adobe Reader), projector, screen, laser pointer

◆ **Time Zone**

UTC/GMT+9

◆ **Average Temperature in February in Jeju**

Average daily minimum to maximum temperature： 8℃- 15℃

◆ Bank and Foreign Exchange

The Currency is Korean won here.

◆ Important Information

♣ Please take care of your belongings in public area. For your personal and property safety, delegates are suggested to wear representative card during conference and not to lend it to those unconcerned to enter event rooms. Conference does not assume any responsibility for loss of personal belongings of participants.

♣ Don't stay too late in the city, don't be alone in the remote area. Be aware of the strangers who offer you service, signature of charity, etc., at scenic spots. You can search more Tourist Information and Security tips online.

◆ Emergency Numbers

Medical Emergency: 119 Police: 112 Fire: 119

Guideline for Online Participation

◆ ZOOM Download Link ZOOM

https://zoom.us/download

https://zoom.com.cn/download (for Chinese authors)

◆ Meeting Rooms

ZOOM ID: 860 3619 2252,

Password: 7842

https://us02web.zoom.us/j/86036192252?pwd=RlZLMllzUXBVcGNWYWlxK0V3aXVhUT09

◆ Time Zone

The conference is arranged based on **Korea Time (GMT+9).**

Please carefully check your presentation time, and join the conference 10 minutes in advance.

◆ Equipment Needed

A computer with Internet connection and camera

Headphones

Stable Internet connection

A quiet place and proper background

◆ Test Your Presentation

Date: **February 27, 2024**

Prior to the formal meeting, online presenters shall join the test room to ensure everything is on the right track. Please check your test time on this program.

◆ Author Oral Presentation

✓ Timing: a maximum of 15 minutes in total, including 2-3 minutes for Q&A. Please make sure your presentation is well timed.

- ✓ Please join the meeting room 10 minutes in advance.
- ✓ Stay online during Keynote & Invited speeches and your own sessions.
- ✓ English only during the conference.
- ✓ Certificates will be emailed to you after conference
- ✓ Please rename as:
  Author: Paper ID + Name
  Delegate: delegate + Name
  Speaker: Speaker + Name
  Committee: Position + Name

◆ Conference Recording

The whole conference will be recorded. We appreciate you proper behavior and appearance. The recording will be used for conference program and paper publication requirements. The video recording will be destroyed after the conference and it cannot be distributed to or shared with anyone else, and it shall not be used for commercial nor illegal purpose. It will only be recorded by the staff and presenters have no rights to record.

Agenda

All the schedule will process in Korea Time (GMT+9).

Day 1- February 27,2024 (GMT+9)

Onsite Registration

Time	Event	Venue
10:00-16:00	Onsite Registration	Ramada Plaza Jeju Hotel (Refer to the sign)
14:00-16:00	Campus Visit	Jeju National University **Assembling Place**: Registration Reception (Ramada Plaza Jeju Hotel)

Online Test Session

Time	Participants	ZOOM ID
9:00-10:00	Committee Members, Keynote Speakers, Session Chairs, Invited Speakers	**860 3619 2252** **PW: 7842** https://us02web.zoom.us/j/86036192252?pwd=RlZLMllzUXBVcGNWYWlxK0V3aXVhUT09
9:00-12:00	**Online Participants :** SK1009, SK1014, SK1013, SK1015, SK2008, SK2021, SK2025, SK2035, SK2014, SK2020, SK2003-A, SK2029	

Day 2- February 28,2024 (GMT+9)

Opening Ceremony, Keynote Speeches

1. Onsite：Chuja Hall -2F (RAMADA PLAZA Hotel)

2. Online Session Zoom: **860 3619 2252**

Password: 7842

https://us02web.zoom.us/j/86036192252?pwd=RlZLMllzUXBVcGNWYWlxK0V3aXVhUT09

Time	Event
09:00-9:05	**Welcome Message** **Prof. Dong-Won Jung (Conference Chair)** Jeju National University, South Korea
09:05-09:10	**Opening Remarks** **Prof. Yungcheol Byun (Conference Co-chair)** Jeju National University, South Korea
09:10-09:15	**TPC Address** **Prof. Neil Bose (Program Chair)** Memorial University, Canada
09:15-09:55	**Keynote Speech I** **Prof. Ahmed Chemori** University of Montpellier, France ***Speech Title: Motion Control of Parallel Kinematic Manipulators for Industrial Applications***
09:55-10:15	**Group Photo & Coffee Break**
10:15-10:55	**Keynote Speech II** **Prof. Xiaoqing WEN** Kyushu Institute of Technology, Japan ***Speech Title: LSI Testing: A Core Technology to a Successful Semiconductor Industry***
10:55-11:35	**Keynote Speech III** **Dr. Ji-Hong Li** Korea Institute of Robotics and Technology Convergence, Republic of Korea ***Speech Title: Trajectory Tracking of Underactuated Marine Vehicles***
11:35-12:15	**Keynote Speech IV** **Prof. Ljiljana Trajkovic** Simon Fraser University, Canada ***Speech Title: Machine Learning for Detecting Internet Traffic Anomalies***
12:15-14:00	**Lunch & Break**

Day 2- February 28,2024 (GMT+9)

Breakout Sessions

1. Onsite：Chuja & Mala Hall-2F (RAMADA PLAZA Hotel)

2. Online Session Zoom I: **860 3619 2252**

Online Session Zoom II: **856 4775 4681**

Password: 7842

Zoom I: https://us02web.zoom.us/j/86036192252?pwd=RlZLMllzUXBVcGNWYWlxK0V3aXVhUT09

Zoom II: https://us02web.zoom.us/j/85647754681?pwd=K3ljSnA0V0N5YUVrcXZ4WnRMeUl0Zz09

Time	Online Room	Onsite Room	Event
14:00-15:45	ZOOM ID **860 3619 2252** **Password: 7842**	Chuja Hall	**Onsite Session 1 –Modern Electronic Systems and Control Technology** **Chaired by:** Dr. Warinthorn Kiadtikornthaweeyot Evans, Thammasat University, Thailand SK2002, SK2004-A, SK1019, SK2006-A, SK2034, SK2011, SK2005
14:00-16:00	ZOOM ID **856 4775 4681** **Password: 7842**	Mala Hall	**Onsite Session 2 –Digital Circuit and System Design** **Chaired by:** Dr. Abdul Nasir Bin Abd. Ghafar, University Malaysia Pahang, Malaysia SK1008, SK1002-A, SK1007-A, SK1003, SK1020-A, SK1024-A, SK1016, SK1006-A
16:00-16:15	**Coffee Break**		
16:15-17:45	ZOOM ID **860 3619 2252** **Password: 7842**	Chuja Hall	**Onsite Session 3 –Intelligent Agent System Control and Robotics** **Chaired by:** Dr. Ji-Hong Li, Korea Institute of Robotics and Technology Convergence, Republic of Korea SK2028, SK2031, SK2017, SK2012, SK2013, SK2030-A
16:15-18:25	ZOOM ID **856 4775 4681** **Password: 7842**	Mala Hall	**Onsite Session 4 –Image Based Intelligent Detection and Classification** **Chaired by:** Prof. Neil Bose, Memorial University, Canada Invited Speech, SK1004, SK1021, SK2018, SK1022-A, SK2022, SK2033, SK1023-A
18:40-20:00	**Dinner Banquet**		

Day 3- February 29,2024 (GMT+9)

Online Breakout Sessions

Time	Online Room	Event
9:30-11:40	ZOOM ID **860 3619 2252** **Password: 7842**	**Online Session 1 –Intelligent Robot and System Control Model Analysis** **Chaired by:** Dr. Hung Duc Nguyen, University of Tasmania, Australia Invited Speech, SK2025, SK2035, SK2014, SK2020, SK2003-A, SK2029, SK1015
11:40-13:30	**Break Time**	
13:30-14:45	ZOOM ID **860 3619 2252** Password: **7842**	**Online Session 2 –Advanced Electronic Devices and Equipment Development** **Chaired by:** Prof. Dr. Badrul Hisham bin Ahma, Universiti Teknikal Malaysia, Malaysia SK1014, SK1009, SK1013, SK2008, SK2021

Keynote Speaker

Prof. Ahmed Chemori
University of Montpellier, France

9:15-9:55 (GMT+9) | February 28, 2024
Conference Room: Chuja Hall
Zoom ID: **860 3619 2252** Password: **7842**
https://us02web.zoom.us/j/86036192252?pwd=RlZLMllzUXBVcGNWYWlxK0V3aXVhUT09

Speech Title: Motion Control of Parallel Kinematic Manipulators for Industrial Applications

Biography: Ahmed Chemori received his M.Sc. and Ph.D. degrees, both in automatic control from Polytechnic Institute of Grenoble, France, in 2001 and 2005 respectively. During the year 2004/2005 he has been a Research and Teaching assistant at Laboratoire de Signaux et Systèmes (LSS - Centrale Supelec) and University Paris 11. Then he joined Gipsa-Lab (Former LAG) as a CNRS postdoctoral researcher. He is currently a senior CNRS researcher in Automatic control and Robotics for the French National Center for Scientific Research (CNRS), at the Montpellier Laboratory of Computer Science, Robotics and Microelectronics (LIRMM). His research interests include nonlinear (robust, adaptive and predictive) control and their real-time applications in different fields of robotics (underactuated robotics, parallel robotics, underwater robotics, humanoid robotics and wearable robotics). He is the author of more than 160 scientific publications, including international journals, patents, books, book chapters and international conferences. He co-supervised 19 PhD theses (including 17 defended) and more than 40 MSc theses. He served as a TPC/IPC member or associate editor for different international conferences and he organized different scientific events. He is IEEE Senior member, and IFAC TC1.2, TC4.2 and TC7.2 member.

Abstract: Serial robotic manipulators consist of a set of sequentially connected links, forming an open kinematic chain. These robots are mainly characterized by their large workspace and their high dexterity. However, despite these advantages, in order to perform tasks requiring high speeds/accelerations and/or high precision; such robots are not always recommended because of their lack of stiffness and accuracy. Indeed, parallel kinematic manipulators (PKMs) are more suitable for such tasks. The main idea of their mechanical structure consists in using at least two kinematic chains linking the fixed base to the travelling plate, where each of these chains contains at least one actuator. This may allow a good distribution of the load between the chains. PKMs have important advantages with respect to their serial counterparts in terms of stiffness, speed, accuracy and payload. However, these robots are characterized by their high nonlinear dynamics, kinematic redundancy, uncertainties, actuation redundancy, singularities, etc. Besides, when interested in high-speed robotized repetitive tasks, such as food packaging and waste sorting applications, the key idea lies in looking for short cycle-times. This means obviously to look for short motion and short stabilization times while guaranteeing the robustness and performance with respect to disturbances and changes/uncertainties in the operational conditions. Consequently, if we are interested in control of such robots, all these issues should be taken into account, which makes it a bit challenging task. This talk will give an overview of some proposed advanced control solutions for high-speed industrial applications of PKMs in food packaging, waste sorting, and machining tasks. The proposed solutions are mainly borrowed from nonlinear robust and adaptive control techniques and have been validated through real time experiments on different PKM prototypes.

Keynote Speaker

Prof. Xiaoqing WEN
Fellow of IEEE, Associate Editor for IEEE Transactions on Very Large Scale Integration Systems (TVLSI)
Kyushu Institute of Technology, Japan

10:15-10:55 (GMT+9) | February 28, 2024
Conference Room: Chuja Hall
Zoom ID: **860 3619 2252** Password: **7842**
https://us02web.zoom.us/j/86036192252?pwd=RlZLMllzUXBVcGNWYWlxK0V3aXVhUT09

Speech Title: LSI Testing: A Core Technology to a Successful Semiconductor Industry

Biography: Xiaoqing WEN received a B.E. degree from Tsinghua University, China, in 1986, a M.E. degree from Hiroshima University, Japan, in 1990, and a Ph.D. degree from Osaka University, Japan, in 1993. He was an Assistant Professor with Akita University, Japan, frrom 1993 to 1997, and a Visiting Researcher with the University of Wisconsin–Madison, USA, from Oct. 1995 to Mar. 1996. He joined SynTest Technologies Inc., USA, in 1998, and served as its Vice President and Chief Technology Officer until 2003. He joined Kyushu Institute of Technology, Japan, in 2003, where he is currently a Professor of the Department of Computer Science and Networks. He founded Dependable Integrated Systems Research Center at Kyushu Institute of Technology in 2013 and served as its Director until 2015. He is a Co-Founder and Co-Chair of Technical Activity Committee on Power-Aware Testing under Test Technology Technical Council (TTTC) of IEEE Computer Society. He is an Associate Editor for IEEE Transactions on Very Large Scale Integration Systems (TVLSI) and Journal of Electronic Testing: Theory and Applications (JETTA). He co-authored and co-edited two popular books, VLSI Test Principles and Architectures: Design for Testability (2006) and Power-Aware Testing and Test Strategies for Low Power Devices (2009). His research interests include design, test, and diagnosis of VLSI circuits. He holds 43 U.S. Patents and 14 Japan Patents. He received the 2008 Society Best Paper Award from the Information Systems Society (ISS) of the Institute of Electronics, Information and Communication Engineers (IEICE). He is a Fellow of IEEE for his pioneering work in low capture power test generation, a Senior Member of Information Processing Society of Japan (IPSJ), and a Senior Member of IEICE.

Abstract: The semiconductor industry is exposed to shrinking feature sizes, growing circuit complexity, increasing clock speeds, and decreasing power supply voltages. In addition to significant impact on LSI design and manufacturing, these factors also have a profound impact on LSI testing, a complex process for separating defective chips from defect-free ones. The major challenges to LSI testing are low test quality, high test cost, and excessive test power. These challenges have led to new chances of innovations in LSI testing, characterized by cell-aware test generation, test compression, and power-aware testing. This talk will review these challenges and chances. Furthermore, this talk will reveal the role of LSI testing in the semiconductor business chain, so as to explain why LSI testing is a core technology to a successful semiconductor industry.

Keynote Speaker

Dr. Ji-Hong Li
Chief Researcher
Korea Institute of Robotics and Technology Convergence, Republic of Korea

10:55-11:35 (GMT+9) | February 28, 2024
Conference Room: Chuja Hall
Zoom ID： **860 3619 2252** Password: **7842**
https://us02web.zoom.us/j/86036192252?pwd=RlZLMllzUXBVcGNWYWlxK0V3aXVhUT09

Speech Title: Trajectory Tracking of Underactuated Marine Vehicles

Biography: Ji-Hong Li is a chief researcher in Korea Institute of Robotics and Technology Convergence, Republic of Korea. He received his B.S. in physics from Jilin University, China, in 1991; M.E. in 1999 and Ph.D. in 2003 both in Electronics Engineering from Chungnam National University, Korea. Dr. Li currently is an adjunct professor in Pukyong National University, Korea, and a guest professor in Shenyang Institute of Automation, Chinese Academy of Sciences, China. He has published more than 150 peer-reviewed papers. His current research interests mainly focus on the navigation, guidance, and control of various marine robotics. He is the winner of 26th Korean "Ocean Day" Minister Award, Ministry of Oceans & Fisheries, Korea, and the winner of 2021 Korean Top 100 Outstanding R&D Achievements, and as well as several best paper awards in the marine robotics related academic conferences. In addition, he is the board member of Korea Marine Robot Technology Society, Korea Institute of Unmanned Systems, as well as IEEE senior member, and IFAC TC2.3, TC7.2 members.

Abstract: This talk addresses the trajectory tracking problem for a class of underactuated marine vehicles. By introducing certain coordinates transformations, the vechicle's tracking model can be reduced to a form of full actuated system, which, unfortunately, is not guaranteed to be in the strict-feedback form. An EMO (exponential modification of orientation) concept is introduced for the purpose of avoiding possible singularity during the recursive controller design using general backstepping method. Proposed scheme can be directly applicable to the system regardless of if it's minimum or non-minimum phase.

Keynote Speaker

Prof. Ljiljana Trajkovic
Fellow of IEEE, Editor-in-Chief, IEEE Transactions on Human-Machine Systems
Distinguished Lecturer of the IEEE Circuits and System Society,
Distinguished Lecturer of the IEEE Systems, Man, and Cybernetics Society
Simon Fraser University, Canada

11:35-12:15 (GMT+9) | February 28, 2024
Conference Room: Chuja Hall
Zoom ID: **860 3619 2252** Password: **7842**
https://us02web.zoom.us/j/86036192252?pwd=RlZLMllzUXBVcGNWYWlxK0V3aXVhUT09

Speech Title: Machine Learning for Detecting Internet Traffic Anomalies

Biography: Ljiljana Trajkovic received the Dipl. Ing. degree from University of Pristina, Yugoslavia, the M.Sc. degrees in electrical engineering and computer engineering from Syracuse University, Syracuse, NY, and the Ph.D. degree in electrical engineering from University of California at Los Angeles. She is currently a professor in the School of Engineering Science, Simon Fraser University, Burnaby, British Columbia, Canada. Her research interests include communication networks and dynamical systems. She served as IEEE Division X Delegate/Director, President of the IEEE Systems, Man, and Cybernetics Society, and President of the IEEE Circuits and Systems Society. Dr. Trajkovic serves as Editor-in-Chief of the IEEE Transactions on Human-Machine Systems and Associate Editor-in-Chief of the IEEE Open Journal of Systems Engineering. She served as a Distinguished Lecturer of the IEEE Circuits and System Society and a Distinguished Lecturer of the IEEE Systems, Man, and Cybernetics Society. She is a Fellow of the IEEE.

Abstract: Border Gateway Protocol (BGP) enables the Internet data routing. BGP anomalies may affect the Internet connectivity and cause routing disconnections, route flaps, and oscillations. Hence, detection of anomalous BGP routing dynamics is a topic of great interest in cybersecurity. Various anomaly and intrusion detection approaches based on machine learning have been employed to analyze BGP update messages collected from RIPE and Route Views collection sites. Survey of supervised and semi-supervised machine learning algorithms for detecting BGP anomalies and intrusions is presented. Deep learning, broad learning, gradient boosting decision tree, and reservoir computing algorithms are evaluated by developing models based on collected datasets that contain Internet worms, power outages, and ransomware events.

Invited Speaker

Gisung Kwon
Founder and Chief Executive Officer
Sheco Co., Ltd, Republic of Korea

16:15-16:40 (GMT+9) | February 28, 2024
Conference Room: Mala Hall

Zoom ID： **856 4775 4681** Password: **7842**

https://us02web.zoom.us/j/85647754681?pwd=K3ljSnA0V0N5YUVrcXZ4WnRMeUl0Zz09

Speech Title: Sheco Ark - The Future Technology of Marine Recovery, Innovative Marine Recovery Robot

Biography: Gisung Kwon is a founder and chief executive officer of Sheco Co., Ltd, Republic of Korea. He is also a member of Incheon Innopolis(The R&D Innovation Cluster) from Korea Innovation Foundation and Drone Special Area in Gunsan city. He received his bachelor's degree in department of trade from Incheon University in 2017. He is selected as a representative young entrepreneur of South Korea from P4G in Denmark, and SE focused entrepreneurs from SK Innovation. He has been invited to various lectures which are World Ocean Forum, Inchoen International Ocean Forum, SOVAC Open Innovation of SK Innovation and etc. He received a letter of appreciation from Korea Coast Guard, Shinhan Square Bridge and etc. He has won many awards in innovation fields such as Grand Prize at Social Venture Competition Aisa(SVCA), Gold Prize at Geneva International Inventions, Grand Prize at Maritime Defense Technology Innovation Idea Competition, Grand Prize at Maritime Defense Technology Innovation Idea Competition and etc.

Abstract: Every year, numerous oil spill incidents occur worldwide, and the response to these spills is mostly carried out manually. Sheco introduces a technology that can effectively reduce manual labor in marine spill response: the "Sheco Ark," a marine spill response robot. This session will present the journey from the inception of the world's first mass-produced marine spill response robot to its commercialization and future vision. The marine recovery robot technology presents how Sheco is opening a new chapter in marine spill response technology, protecting our oceans, and contributing to the creation of a sustainable marine ecosystem.

Invited Speaker

Prof. Mehmet Emir KOKSAL
Ondokuz Mayis University, Turkey

9:30-9:55 (GMT+9) | February 29, 2024

Zoom ID: **860 3619 2252** Password: **7842**

https://us02web.zoom.us/j/86036192252?pwd=RlZLMllzUXBVcGNWYWlxK0V3aXVhUT09

Speech Title: Fractional Order Thinking and Modeling

Biography: Mehmet Emir is a Professor of Mathematics at the Ondokuz Mayis University. He received his Ph.D. in Mathematics from Gebze Institute of Technology, Turkey in 2009. After receiving his Ph.D., he studied as a Postdoctoral Researcher at the Department of Mathematical Sciences, Florida Institute of Technology, Melbourne between 2009 and 2010. In 2014, he passed the exam held by The Presidency of the Inter-University Council of Turkey and received the title of Associate Professor in Mathematics. He was a Visiting Professor at the Chair Mathematics of Systems Theory in the Department of Applied Mathematics at the University of Twente from 2022 to 2023. In 2023, he also became associate professor of electrical and electronics engineering and in Turkey, he is the first scientist who has become an associate professor of electrical and electronics engineering whilst being a mathematics professor.

His research interests are in systems and control theory, circuit and system theory, differential equations, and numerical analysis. The main focus is on the development and analysis of commutativity conditions of time-varying systems, feedback systems, decomposition and transitivity properties of commutativity, and applications of commutativity in physical systems using differential and difference equations. He also studies ordinary and partial differential equations, their numerical solution methods, and mathematical modeling and analysis of various engineering problems using differential equations. He has published many research papers in eligible international journals, and he has many proceedings presented at famous international conferences. He reviewed over 200 manuscripts for 60 different international peer-reviewed journals and 40 different international conferences. His research has been mainly supported by the Scientific and Technological Research Council of Turkey. In this field, he has led two national projects, one of which was awarded a project performance award. He has been a keynote speaker, invited speaker and a member of the organizing and scientific committees of many well-known international conferences.

Abstract: Fractional calculus has become very famous and popular subject in recent years. It is used as a powerful and important mathematical modelling tool, for defining, investigating, analyzing, solving, and discussing many different types of engineering, physical, chemical, statistical, and social problems in real life. In fact, fractional order dynamic models simulate characteristics of real dynamic systems better than the integer order models. In this lecture, I will introduce basic concepts of fractional calculus, present various applications in distinct areas of science and engineering, and predict possible future research trends on this topic.

A three-dimensional (3D) graphical method is developed to tune the gain parameters of the fractional-order proportional-integral-derivative (FOPID) controller knowing the fractional orders.

The controlled plant itself is also fractional order and it may have a time delay. For special cases, the method is applicable for integer-order PID controller design for integer and fractional-order systems with or without time delay. Some graphical design tools are used beneficially in the literature using 2D plots. Although the use of some minor 3D plots has appeared, they are based on shifting 2D plots to the third dimension, which makes the approach semi- or quasi-3D. Mathematical formulations of five design specifications in accordance with the 3D drawing with programming implementations by Matlab are presented. For designing controllers by using the introduced 3D graphical method, system design specifications such as phase margin (PM), gain margin (GM), phase flatness (PF), low-frequency output disturbance rejection (LFODR) and high-frequency noise rejection (HFNR) are considered and their important characteristics are shown. The requirements are mapped in the 3D Euclid space by 3D surfaces and/or lines so that the proportional, integral, derivative control coefficients can be chosen to meet the given specifications in an optimum way and to allow trade-off or compromise.

Onsite Session 1 -Day 2

Time/Date: 14:00-15:45 (GMT+9) 28 February, 2024
Location: Chuja Hall (2F)
Online ROOM: 860 3619 2252
https://us02web.zoom.us/j/86036192252?pwd=RlZLMllzUXBVcGNWYWlxK0V3aXVhUT09
Password: 7842
Topic: Modern Electronic Systems and Control Technology
Chaired by: Dr. Warinthorn Kiadtikornthaweeyot Evans, Thammasat University, Thailand

SK2002
14:00-14:15

Design Concept of a Magnetic Levitation Multifunction Mechanical Testing Device
Authors: Mengyi Ren, Koichi Oka
Presenter: Meng Ren, Kochi University of Technology, Japan

Abstract: This article proposes a noncontact multi-function mechanical testing device using magnetic levitation mechanism, in which a specimen can be tested in various ways (Tension, compression, bending and torsion) while the specimen and few parts are being levitated. This article mainly focuses on the design of the magnetic levitation mechanism, tension mechanism, compression mechanism, bending mechanism and torsion mechanism. Furthermore, FEM (Finite Element Method) analyses were conducted to calculate the loading capacities of the devices. Moreover, control simulations were performed to examine the stability and robustness of the levitation under the maximum tension force, compression force, bending force and torque. Finally, control simulation results demonstrated that the levitation control system has good stability and robustness under the maximum tension force, compression force, bending force and torque.

SK2004-A
14:15-14:30

Testing an AUV adaptive mission for hydrocarbon seep investigation in Baffin Bay
Authors: Jimin Hwang
Presenter: Jimin Hwang, Memorial University , Canada

Abstract: This project tests an innovative solution to enable an autonomous underwater vehicle (AUV) to conduct hydrocarbon seep investigations with minimal human oversight. Designed for dynamic deep ocean environments where there is often limited prior knowledge about the target of interest, we developed the autonomy of our AUV (See Figure 1) is equipped to adeptly carry out its mission tasks by responding to real-time inputs from its sensors. The anticipated target from natural seepage was a mixed-phase oil plume comprising discrete oil droplets and methane gas bubbles suspended in the water column. To enhance detection accuracy, the vehicle was fitted with multiple sensors: a scanning sonar (Ping360) and fluorometers (UviLux: PAH and CDOM), positioned atop the vehicle. Each sensor was designated to detect a distinct characteristic of the oil plume.

The AUV team at Memorial University used an adaptive sampling approach encompassing three sequential modules: Search, Survey, and Sample. Utilizing real-time sensor data, the AUV can select and execute these modules adaptively. Initially, the Search module employs the sonar to scan a relatively wide region either side of the vehicle path, adhering to designated waypoints, aiming to locate a vertical hydrocarbon stream. The collected acoustic data is analysed to identify regions with high hydrocarbon potential and information about these locations is handed over to the subsequent module. Following this, the Survey module guides the AUV back to these pinpointed zones, with the UviLux fluorometer continuously gauging fluorescence concentration, with the aim to affirm hydrocarbon presence en route. Once the hydrocarbon presence is validated, the Sample module activates a multi-water sampler (8 × 100ml) to obtain seawater samples from each location authenticated by the Survey module.

This system underwent successful validation during a 2023 North Atlantic mission near the natural hydrocarbon seeps adjacent to Scott Inlet, Baffin Bay, Canada. Seven missions were executed, resulting in the retrieval of four water samples from depths of 0m, 20m, and 200m. These samples were then subject to laboratory-based chemical analysis for data verification.

SK1019

14:30-14:45

Study of Sea Level Rise by Using Signal Analysis Method

Authors: Hui-Ming Fang, Hsing-Yu Wang, Ting-Chieh Lin, Yun-Chih Chiang
Presenter: Hsing-Yu Wang, University of Science and Technology, Taiwan

Abstract: Climate change exerts a significant influence on terrestrial and aquatic environments on a global scale. The ongoing global warming has increased sea levels, raising concerns about potential alterations to the characteristics of tides, waves, and ocean currents in coastal regions. This research employs a harmonic analysis framework and uses three distinct methods: Spectral Analysis (SMA), Empirical Mode Decomposition (EMD), and Ensemble Empirical Mode Decomposition (EEMD) to scrutinize the phenomenon of sea-level rise. The simulations conducted in this study reveal that the estimated sea-level rise, as determined by SMA, is approximately 17.68 mm, accompanied by an average annual sea-level rise rate of 0.98 mm/year. EMD analysis yields a sea-level rise estimate of around 51.20 mm, with an average yearly sea-level rise rate of 2.84 mm/year. Applying EEMD results in an estimated sea-level rise of roughly 57.73 mm, with an average annual sea-level rise rate of 3.21 mm/year. Among these methods, the EEMD analysis identifies the highest sea-level rise, reaching 57.73 mm.

SK2006-A

14:45-15:00

A Distributed Synchronous Control Technique for Multiple Electro-Hydraulic System

Authors: Qing Guo, Xing Ren, Zhenlei Chen
Presenter: Qing Guo, University of Electronic Science and Technology of China, China

Abstract: Different from most centralized mechatronic system, the distributed transmission mechanism has the significant advantage such that realize task only based on small amount neighbor nodes with low computational complexity. In this study, a distributed synchronous control is presented in multiple electrohydraulic system (MEHS) to guarantee the follower electrohydraulic nodes synchronize to the leader motion based on a directed spanning tree. Firstly, the EHS model with 3-orders nonlinear dynamics is feedback linearized by Lie derivatives. Meanwhile, the unknown load disturbance of EHS is estimated by a disturbance observer. To address the communication delay of network topology, a distributed synchronous controller is designed by Lyapunov-Krasovskii and LMI techniques to guarantee the synchronous errors asymptotically convergence to a zero neighborhood. Finally, the effectiveness of the proposed distributed synchronous controller is verified by both simulation and experimental results with different communication delays.

SK2034

15:00-15:15

Parameter Identification and Optimal Speed Controller Design for BLDC Motor Using the Genetic Algorithm

Authors: Jakkrit Pakdeeto, Saruta Wansungnoen, Kongpan Areerak
Presenter: Jakkrit Pakdeeto, King Mongkut's University of Technology North Bangkok, Thailand

Abstract: This paper presents the parameter identification of the brushless direct current (BLDC) motor using the Genetic Algorithm (GA) with the multi-speed range objective function in which the black-box model will be proposed. The unknown coefficients of the model will be identified by the proposed algorithm until the errors between the model and experimental responses are at the minimum. For the model validation, the response from the proposed model will be compared with different speeds used in the objective function to confirm the model accuracy. The resulting system parameters will then be used for the speed controller design. In this paper, the GA is also, however, used for the PID controller design to regulate the motor speed. In the controller design process, the control signal will be set as the constrain in the objective function. The simulation results via Simulink of MATLAB program show that the PID controller from the proposed design can regulate the motor speed with better speed response performance.

SK2011	Revolutionizing Indoor Thermal Comfort: Iris Damper Integration with Step-based Control in Central Air Conditioning System
15:15-15:30	Authors: Nur'Amirah Binti Busu, Norasikin Binti Mat Isa, Azian Binti Hariri, Mohamed Bin Hussein **Presenter**: Nur'Amirah Busu, Universiti Tun Hussein Onn Malaysia Johor, Malaysia

Abstract: This research addresses the challenge of uneven temperature distribution in central air conditioning systems, causing discomfort for occupants. The proposed solution involves a novel step-based control mechanism in an iris damper, dynamically adjusting its aperture in response to changing temperatures. An experiment demonstrates the effectiveness of this method in maintaining indoor temperature within a specified range of 23.5℃ to 24.5℃, leading to improved temperature uniformity throughout the indoor spaces. The findings suggest that integrating the step-based control in iris dampers enhances thermal comfort, offering a practical solution and efficient avenue for rectifying temperature-related issues in buildings equipped with conventional variable air volume (VAV) systems in central air conditioning. This approach has the potential to revolutionize temperature regulation, providing a cost-effective means to enhance occupant satisfaction in various building types.

SK2005	Increasing System Engineer Competence Through In-House Tracking Antenna Development
15:30-15:45	Authors: Warinthorn K. Evans, Nawattakorn Kaikaew, Narat Srisawatpong, Pramin Phichitkarnk **Presenter**: Warinthorn Kiadtikornthaweeyot Evans, Thammasat University, Thailand

Abstract: Thaichote launched in 2008 is the first earth observation satellite owned by Thailand. Since then, Geo-Informatics and Space Technology Development Agency or GISTDA has gained experience in satellite operation and initiated many projects in-house with the objective to increase the capabilities of engineers. Recently small satellites operating in Low Earth Orbit for communication purposes are a significant focus by many companies worldwide. Consequently, automatic tracking antenna are necessary for new communication satellites. This paper presents the hands-on capacity building of system engineers to develop a small automatic tracking antenna. Enhancing the competence of system engineers in this project involves a combination of designing, implementing and improving problem solving, technical & communication skills, also team working to ensure that systems meet the requirements. The prototype has been developed according to the project management plan. The prototype consists of two subsystems, the tracking antenna and the monitoring-control system. The function test results reveal that the prototype can operate automatically according to the satellite location and display the status of the system correctly.

Onsite Session 2 -Day 2

Time/Date: 14:00-16:00 (GMT+9) 28 February, 2024
Location: Mala Hall (2F)
Online ROOM: 856 4775 4681
https://us02web.zoom.us/j/85647754681?pwd=K3ljSnA0V0N5YUVrcXZ4WnRMeUl0Zz09
Password: 7842
Topic: Digital Circuit and System Design
Chaired by: Dr. Abdul Nasir Bin Abd. Ghafar, University Malaysia Pahang, Malaysia

SK1008	Desing of a Double-Layer Electromagnetic Shielding Door for 10 kHz to 18 GHz
	Authors: Daeyeon Kim, Daeheon Lee and Up Namgoong
14:00-14:15	**Presenter**: Daeheon Lee, Electronics and Telecommunications Research Institute, Republic of Korea

Abstract: We designed, fabricated, and verified a double-layer shielding door with high shielding effectiveness (SE) using a conductive thin-fabric from 10 kHz to 18 GHz. The doublelayer structure was studied through analytic and numerical calculations. The study clarified the relationship between the double-layer gap and operating frequency, identifying the frequency range that induces performance degradation. Moreover, it confirmed that the double-layer structure is more effective than a thick single-layer material in the view of implementing high SE. We designed and fabricated a double-layer shielding door using a conductive thin-fabric. The fabric-to-fabric gap was adjusted using the thickness of the metal frame and foam gaskets in the middle layer. It was designed to be 5 mm, which is less than the half-wavelength at 18 GHz. The SE measurement for the door was conducted following standards based on operating frequency ranges. The SE of the double-layer shielding door met the MIL-STD-188-125-1 requirements (over 80 dB up to 18 GHz). This paper demonstrated that the double-layer shielding door using a conductive thin-fabric can provide an alternative shielding solution for infrastructure facilities.

SK1002-A	A 0.5-V 3-GHz Digital PLL with a Subfeedback Loop Technique
	Authors: Bo-Jun Huang, Wen-Yuan Tsai and Jen-chieh Liu
14:15-14:30	**Presenter**: Bo-Jun Huang, National United University, Taiwan

Abstract: A digital bang-bang phase-locked loop (BBPLL) designs for low-supply-voltage applications. This digital BBPLL utilizes a five-stage ring oscillator with a forward interpolator sub-feedback loop to achieve higher output frequencies at low supply voltages. The digital controlled oscillator (DCO) is divided into two parts. The coarse-tuned controlled unit adopts PMOS varactors to obtain a wide tuning range of DCO. The fine-tuned controlled unit consists of a PMOS array to adjust the output frequency and achieve high linearity. The proposed DCO incorporates a 2-bit delta-sigma modulator to enhance jitter performance to extend a high timing resolution.
The proposed digital BBPLL was implemented by the TSMC 90nm 1P9M CMOS process. This digital BBPLL can operate at supply voltages of 0.4V and 0.5V, with the chip and core areas of 350μm×418μm and 67μm×73μm, respectively. In the simulated results, the digital BBPLL achieved the operating frequencies of 1.5GHz at 0.4V and 3GHz at 0.5V. When the BBPLL operated at a frequency of 3GHz, the peak-to-peak and RMS jitters were 206fs (0.062%) and 28.4fs (0.0084%) under the supply voltage of 0.5V. The power consumptions were 113.5μW (1.5GHz) and 370.8μW (3Ghz). Thus, this BBPLL will be useful for the clocking systems at low-supply-voltage applications.

SK1007-A	A Crystal-less Clock Generator Using a Relaxation Oscillator
	Authors: Wen-dong Ke and Jen-chieh Liu
14:30-14:45	**Presenter**: Miao Li, National United University, Taiwan

Abstract: A crystal-less clock generator (CLCG) adopts a relaxation oscillator and bandgap reference circuit to provide the temperature-insensitive clock source. The bandgap reference circuit adjusts the CLCG frequency to achieve the target frequency via a comparator for the temperature variations. In the trimming process, the resistor array adopts mutual compensation to achieve the CLCG's target frequency for the process and voltage variations. The resistor array also has positive and negative temperature coefficient resistors to avoid the temperature effect for CLCG frequency. The CLCG adopts a divider-by-2 circuit to calibrate the duty cycle of CLCG output. This CLCG output produces the target frequency of 10 MHz, at the 1.8 V supply voltage. The core area of the test chip is 98 × 251 μm2 in a 180 nm CMOS process. When the temperature range is from −20 to 100 °C, the frequency accuracies of CLCG are less than 15.5 ppm/°C in the five-corner simulated results. The RMS and peak-to-peak jitters are less than 13.83 and 107.91 ps, respectively. The power consumption at 10 MHz is 378 μW at the TT corner.

SK1003	A Study of High-speed Hamming Distance Detection Circuit Utilizing a Neuron CMOS Inverter
	Authors: Daishi Nishiguchi, Yujiro Harada, Mitsutoshi Yahara, and Kuniaki Fujimoto
14:45-15:00	**Presenter**: Daishi Nishiguchi, Tokai University, Japan

Abstract: The technology of rapidly retrieving data similar to input data from a huge amount of data stored in databases has been used in all kinds of situations. To realize this process in real-time, associative memory, a type of functional memory, has been actively studied. In the minimum Hamming distance search associative memory, which searches the most similar reference data using the Hamming distance as an index, the Hamming distance detection circuit, which detects the Hamming distance between two data is a very important functional circuit. Authors have proposed a Hamming distance detection circuit by utilizing a neuron CMOS inverter. However, this circuit has a problem in that the detection time increases with each increase in the number of data bits. In this study, we proposed a new method of Hamming distance detection circuit using neuron CMOS inverters, which can achieve faster operation than the conventional Hamming distance detection circuit. It is also confirmed using HSPICE, a circuit simulator, that the proposed circuit can achieve the desired operations.

SK1020-A	An All-Digital Delay-Locked Loop with Efficiency Management Design
	Authors: Kuan-Yu Shen, Wei-Hua Chen, Zhen-Jie Hong
15:00-15:15	**Presenter**: Zhen Jie Hong, Feng Chia University, Taiwan

Abstract: Synchronization of clock signals has always been an important issue in a System-on-chip (SoC), affecting whether various circuits in the System-on-chip can work harmoniously. In recent years, the demand for mobile devices has increased significantly, and SoC has also been widely used in developing and applying mobile devices. Many circuit functions are integrated into a single chip. However, mobile devices have significantly increased power consumption and size restrictions. Reducing power consumption will be an important issue in mobile devices to increase usage efficiency and prolong product life.Dynamic voltage and frequency scaling (DVFS) technology is used to reduce power consumption in the system. Restarting after entering sleep mode and waiting for it to return to a stable operating frequency will easily cause additional power consumption. Hence, the all-digital delay locking circuit (ADDLL) with fast locking is quite suitable for this type of system. In response to changes in the voltage source, the delay unit in the ADDLL is affected, thereby affecting the system resolution. This paper uses a multiplexer path selection delay unit to design different paths for different voltage sources to maintain a certain circuit resolution. Reduces the error band of the lock to account for changes in the voltage source. The ADDLL proposed in this paper is simulated under the TSMC CMOS 90nm process. The operating frequency range is 400 MHz ~ 1000MHz, and the locking time is less than 23 cycles. With the high resolution of VDL, the ADDLL locking phase can reach within 0.01 (UI). The circuit power consumption, the Jitterpk-pk, and Jitterrms are 5.212 mW, 4.7 ps, and 3.58 ps at 1 GHz, respectively.

SK1024-A **15:15-15:30**	Improved Sensitivity of MXene Chemiresistive Sensor with Zero Bias Operation via Lignin Hybridization Authors: I Ketut Gary Devara, Dhananjay D. Kumbhar, Mi Ji Kwon, Su-Yeon Cho, Dong-Jun Kwon, and Jun Hong Park **Presenter**: I Ketut Gary Devara, Gyeongsang National University, South Korea

Abstract: The requirement for very precise and sensitive environmental monitoring equipment that can fulfill the needs of certain gas sensing applications while using low power consumption is growing as the world becomes more urbanized. The goal of this work is to increase the sensitivity of MXene-based chemiresistive sensors so they can operate in zero-bias mode and detect CO2(g) and NO2(g). Since bare MXenes have near-conductivity, MXene-based chemical sensors do not respond as well electrically to chemical stimuli as other solid-state chemiresistive devices. The results of this work demonstrate that lignin hybridization is an efficient way to boost the sensitivity of a Ti3C2Tx MXene-based chemiresistive sensor. Under zero-bias operation, lignin hybridization raises the sensitivity to 15 ppm CO2(g) and NO2(g) by 297.95% and 157.38%, respectively. When sensing different target gas concentrations at room temperature, the sensor exhibits high responsiveness and reproducibility.

SK1016 **15:30-15:45**	A Compact, Polarization-Insensitive, Double Negative (DNG) Perfect Metamaterial Absorber for Electromagnetic Energy Harvesting Applications Authors: Najeeb Ullah, Lini Lee, Md. Shabiul Islam, and Mohammad Tariqul Islam **Presenter**: Lini Lee, Multimedia University, Malaysia

Abstract: This paper presents the construction and investigation of a compact electromagnetic metamaterial (MM) absorber that is polarization-insensitive and provides wide-angle coverage. The absorber is designed specifically for energy harvesting purposes. The proposed MM absorber is created on an FR4 dielectric substrate and consists of three split-ring resonators (SRRs). The proposed structure demonstrates a significant absorption rate of 98% and 99% at two distinct resonance frequencies: 4.63 GHz and 5.827 GHz, respectively. Furthermore, the absorber can provide a broad absorption range for various polarization angles, extending up to 45°. Most incident EM energy is primarily dissipated through resistors rather than the dielectric substrate. The device is characterized by negative permittivity, permeability, and refractive indexes within the frequency range of 4.5 GHz to 5 GHz, which classifies it as a Double Negative material (DNG). The proposed device can potentially enhance the conversion of incident energy into usable electrical power, resulting in increased efficiency.

SK1006-A **15:45-16:00**	Design of PLL with a Power-down Scheme Authors: Ruei-Cheng Ai, Zhe-yuan Jin and Jen-chieh Liu **Presenter**: Ruei-Cheng Ai, National United University

Abstract: The phase-locked loop (PLL) proposes a power-down scheme for low-power applications. In the standby mode, the power-down scheme can reduce the leakage current of the PLL. The MOS transistor and the current path of PLL will be cut off to obtain a low leakage current. The PLL consists of a phase frequency detector (PFD), a charge pump (CP), a loop filter (LPF), a voltage control oscillator (VCO), and a frequency divider. The PFD compares the phase error between the input and feedback signals to control the output voltage of CP. The VCO frequency is adjusted via CP output. Finally, the VCO frequency is divided as the feedback signal. To repeat this process, the input and feedback signals will be synchronized. The PLL output will be locked to the target frequency.

The proposed PLL was simulated by a TSMC 90nm 1P9M CMOS process. The core area and chip area were 155μm×370μm and 455μm×665μm, respectively. When the operating frequency was 100MHz at 1.2V, the active-power mode was 221.86μW, and the standby mode was 2.57μW (1.16%), respectively. The power consumption can be reduced by 99%. The RMS jitter and peak-to-peak jitter of PLL were 1.66ps (0.017%) and 6.06ps (0.061%), respectively. Thus, this PLL can be useful for clocking systems that have a standby mode.

Onsite Session 3-Day 2

Time/Date: 16:15-17:45 (GMT+9) 28 February, 2024
Location: Chuja Hall (2F)
Online ROOM: 860 3619 2252
https://us02web.zoom.us/j/86036192252?pwd=RlZLMllzUXBVcGNWYWlxK0V3aXVhUT09
Password: 7842
Topic: Intelligent Agent System Control and Robotics
Chaired by: Dr. Ji-Hong Li, Korea Institute of Robotics and Technology Convergence, Republic of Korea

SK2028
16:15-16:30

Predefined-Time Tracking Control of Second-Order Multi-Agent Systems with State Constraints
Authors: Chaoqun Guo, Jiangping Hu, Ju H. Park, Bijoy Kumar Ghosh
Presenter: Chaoqun Guo, University of Electronic Science and Technology of China, Yeungnam University, Republic of Korea

Abstract: The predefined-time tracking control of an uncertain second-order multi-agent system is studied in this paper. To tackle both the unconstrained and constrained situations simultaneously, a uniform nonlinear transformation function is proposed. In addition, a time base generator (TBG) function is constructed to facilitate designing a predefined-time control. Moreover, to simplify the computational complexity of the controller design, a predefined-time characteristic filter is proposed by utilizing the TBG function. And also based on the TBG function, an adaptive law is developed to estimate the unknown norms of the fuzzy weights. Consequently, a predefined-time tracking controller based on the TBG technique is designed to achieve the state constraints and consensus tracking. At last, to validate the predefined-time control strategy for the uncertain nonlinear multi-agent system, the simulations are presented.

SK2031
16:30-16:45

Real-Time Object Drop Prevention for Improving Robotic Grasping Systems
Authors: Syukran Hakim, Devin Babu, Norain Binti Abdullah, Abdul Nasir
Presenter: Devin Babu, University Malaysia Pahang Al-Sultan Abdullah, Malaysia

Abstract: In industrial robotic grasping systems, performing robotic tasks, such as pick-and-place, needs a specific control and hardware design to achieve a desired task successfully. The main problem addressed in this paper is the real-time object slip detection in robotic grasping systems. This research work aims to improve the capability of robotic grasping systems for adaptive grasping in terms of object drop prevention. Therefore, a real-time slip detection algorithm was proposed and incorporated into the force controller of the robotic grasping system utilizing Force Sensing Resistor (FSR) sensor. Slippage signal was detected by real-time monitoring of tactile feedback, i.e., grasping force, where a notable variation occurs in the force signal generated by FSR sensor. The proposed slip detection method was implemented on a three-fingered pneumatic robot hand to grasp five object categories cup, tube, chip can, and metal can. Object slippage was 100% successfully detected and successful drop-prevented grasping was achieved for all proposed objects. In addition, the experimental results achieved a human-like response time at 86 ms improving robotic grasping capability in terms of object drop prevention. For future research work, the proposed object slip detection algorithm can be integrated into industrial assembly robots that utilize two-finger grippers such as Selective Compliant Assembly Robot Arm (SCARA).

SK2017 **16:45-17:00**	Distributed Continuous-time Algorithm for Time-varying Quadratic Programming with Coupled Equality Constraint Authors: Yuanyuan Yue and Qingshan Liu Presenter: Yuanyuan Yue, Southeast University, China

Abstract: This paper describes a distributed algorithm that employs the distributed average tracking approach to address time-varying quadratic programming problem. The problem involves time-varying coupled equality constraint and is based on continuous-time multi-agent system. The local objective functions' Hessian matrices are time-varying and different from one another. The basic purpose is to minimize the sum of time-varying objective functions through local interaction with each agent possessing knowledge of its own objective function. The dynamics of multi-agent system makes sure that the states of all agents will find and follow the optimal solutions. Finally, the efficacy of the proposed approach is successfully showcased through a numerical example with simulations.

SK2012 **17:00-17:15**	ULSMeD: Assisted Measurement Device for Quantitative Evaluation of Upper Limb Spasticity Authors: Khairunnisa Johar, Noor Ayuni Che Zakaria, Wan Nurshazwani Wan Zakaria, Nurul Atiqah Othman, Fazah Akhtar Hanapiah, Natiara Mohamad Hashim, Cheng Yee Low, Jingye Yee **Presenter**: Khairunnisa Johar, Universiti Teknologi MARA, Malaysia

Abstract: Spasticity, a common clinical complication after stroke, is conventionally assessed using qualitative methods, leading to inter and intra-rater variability. This paper proposed the Upper Limb Spasticity Measurement Device (ULSMeD), designed to assist clinicians in quantifying upper limb spasticity using the Modified Ashworth Scale. ULSMeD combines force and angle sensors with Internet of Things (IoT) connectivity for real-time data monitoring through a mobile app. This device offers a solution to the limitations of current assessment methods, addressing variability in spasticity evaluations. Experimental validation demonstrated strong correlations between ULSMeD and commercial sensors, with p-values (> 0.0309) for slow assessment and (> 6.8838e-04) for fast assessment. ULSMeD represents a significant advancement in the accurate assessment of spasticity, offering clinicians a reliable and user-friendly tool for upper limb spasticity measurement. This innovation contributes to improved patient care and tailored treatment strategies.

SK2013 **17:15-17:30**	Advancements in Spasticity Management: A Design Framework with PID Integration for Upper Limb Spasticity Training Device (ULSTraD) Authors: Nurul Atiqah Othman, Noor Ayuni Che Zakaria, Fazah Akhtar Hanapiah, Natiara Mohamad Hashim Mohamad Hashim, Khairunnisa Johar Johar, Cheng Yee Low, Jingye Yee Yee, Muhammad Afiq Mohd Zohadi **Presenter**: Nurul Atiqah Othman, Universiti Teknologi MARA, Malaysia

Abstract: The upper limb spasticity training device (ULSTraD) is a simulator designed to replicate various spasticity behaviors observed in patients with upper limb spasticity. Through a systematic development process involving requirements analysis, clinical data collection, conceptual design, prototyping, and integration of a ProportionalIntegral-Derivative (PID) controller, the ULSTraD achieves precise control over servo motors. The PID controller, in conjunction with the PWM Controller PCA9885 and real-time feedback from the FSR 406 force sensor, enables accurate spasticity behavior emulation. Optimal PID gains (Kp = 0.9, Ki = 1.0, and Kd = 0.00) were determined through tuning, resulting in the desired target position. By incorporating FSR 460 and conducting tests at various angles using the PID controller, ULSTraD displayed real-time responsiveness to external forces, enhancing its stability and accurately emulating upper limb spasticity behaviors. Guided by anthropometric measurements and clinical data, the ULSTraD closely resembles a real human arm affected by spasticity. The prototyping process involved 3D printing, welding, and assembly, leading to a functional prototype refined through iterative testing. To assess the similarity in range of motion (ROM) between ULSTraD and the human arm, a Paired Sample T-test was conducted, comparing the flexion and extension movements. The obtained p-value from the test was 0.9087, which indicates that there is no statistically significant difference in ROM between ULSTraD and the human arm during both flexion and extension

movements. This validates ULSTraD's ability to replicate the human arm's range of motion affected by spasticity.

SK2030-A	Grasping System of Irregular Objects for Prosthetic Robotic Arm
	Authors: Abdul Nasir, Devin Babu, Nor Ain Binti Abdullah, Mohd Hanafi Muhammad
17:30-17:45	**Presenter**: Devin Babu, University Malaysia Pahang Al-Sultan Abdullah, Malaysia

Abstract: This study presents the comprehensive analysis result of grasping system of 3D printed prosthetic robotic arm to grasp irregular objects. The prosthetic robotic arm is developed to meet the purpose of overcoming disability cause by amputation or permanent injury, supports regular activities, and promoting independence for disabled individuals. For this work, it will be focused on robotic prosthetic arm for children. The goal of this study is to analyze the grasping behavior and its mechanism on selected irregular objects, create an affordable, user-friendly robotic prosthetic robotic arm that can improve the quality of life for disabled children. The prosthetic robotic arm was constructed by using 3D printing technology to make it more affordable than current market options. The proposed robotic prosthetic arm is controlled by a compact microcontroller (ESP32) and a force sensor that detects muscle flex activity, allowing for responsive objects grasping. The ability to grasp objects is crucial for disabled children to improve their quality of life and maintain independence, which is why the development of a prosthetic robotic arm with grasping capabilities is essential. Based on the experimental results, it shows that the proposed prosthetic arm can successfully grasp selected irregular shape objects. In conclusion, the results of this study suggest that a prosthetic robotic arm can successfully be used by children with limb disabilities.

Onsite Session 4 -Day 2

Time/Date: 16:15-18:25 (GMT+9) 28 February, 2024
Location: Mala Hall (2F)
Online ROOM: 856 4775 4681
https://us02web.zoom.us/j/85647754681?pwd=K3ljSnA0V0N5YUVrcXZ4WnRMeUl0Zz09
Password: 7842
Topic: Image Based Intelligent Detection and Classification
Chaired by: Prof. Neil Bose, Memorial University, Canada

Invited Speech	Sheco Ark - The Future Technology of Marine Recovery, Innovative Marine Recovery Robot
16:15-16:40	**Invited Speaker**: Gisung Kwon (Founder and Chief Executive Officer), Sheco Co., Ltd, Republic of Korea

Abstract: Every year, numerous oil spill incidents occur worldwide, and the response to these spills is mostly carried out manually. Sheco introduces a technology that can effectively reduce manual labor in marine spill response: the “Sheco Ark,” a marine spill response robot. This session will present the journey from the inception of the world’s first mass-produced marine spill response robot to its commercialization and future vision. The marine recovery robot technology presents how Sheco is opening a new chapter in marine spill response technology, protecting our oceans, and contributing to the creation of a sustainable marine ecosystem.

SK1004	Food Volume Prediction and Classification Using Multi-Task Learning
	Authors: Yuita Arum Sari, Atsushi Nakazawa, Akio Gofuku
16:40-16:55	**Presenter**: Yuita Arum Sari, Graduate School of Interdisciplinary Science and Engineering in Health Systems, Okayama University, Okayama, Japan

Abstract: Food volume prediction is critical for calculating calories in food analysis and nutritional evaluation. However, obtaining data and measuring volume from the 3D sensor camera concurrently is time-consuming. Additionally, high computing power is necessary to compute the volume. Therefore, machine learning techniques are employed to extract specific data collected from the data collection process for learning purposes to save time. In this study, we employ Multi-Task Learning to predict volume and categorize food due to their interdependence simultaneously. We evaluate several backbones and find that ResNet50 attains the best performance with an MAE of 4.87 for volume prediction and 100% food classification accuracy. Our proposed method showcases outstanding results, aided by an efficient volume measurement methodology.

SK1021	Dual Stream Deep Neural Network for Joint Sperm Morphology and Motility Estimation
	Authors: Sigit Adinugroho and Atsushi Nakazawa
16:55-17:10	**Presenter**: Sigit Adinugroho, Okayama University, Japan

Abstract: Morphology and motility are vital features to evaluate sperm quality, which is essential for estimating the success of assisted reproduction. Current standards from the World Health Organization (WHO) suggest that human operators are needed to perform sperm quality assessments. However, human assessment is proven to be subjective and leads to variability in the results. To cope with that problem, an automated approach is needed. This study aimed to perform a joint motility and morphology estimation via a single model that has never been done before. The model takes a stack of optical flow images and a grayscale image to be processed by motion and appearance stream. The outputs from each stream are combined and further processed by a regressor to estimate the morphology and motility. The proposed approach performed better than similar methods by achieving mean average errors of 4.495% and 7.865% for morphology and motility estimation, respectively.

SK2018

17:10-17:25

Secure Leader-Follower Consensus for Multi-Agent Systems under Asynchronous DoS Attacks via State Estimation Methodr

Authors: Han-Yu Wu and Qingshan Liu

Presenter: Han-Yu Wu, Southeast University, China

Abstract: This paper investigates the secure consensus problem of multi-agent systems (MASs) under Denial-of-Service (DoS) attacks, in which the attacks is asynchronously launched in communication and control channels. For these two channels, three categories of possible scenarios for asynchronous attacks are introduced in the paper. Considering the complexity and potential infeasibility of directly obtaining the system state, a state estimator is designed to estimate system state using local output information. Furthermore, a leader-follower consensus criterion is presented by developing distributed controller based on estimated state. Finally, a simulation example is given to illustrate the validity of the obtained secure consensus criterion

SK1022-A

17:25-17:40

Stress and Affect Classification based on Heart Rate Variability of ECG Signals Using ASMP Model

Authors: Gengjia Zhang, Zhiqiang Liu, Jihun Lee, Daegil Choi, and Jaehyo Jung

Presenter: Gengjia Zhang, Chosun University, Korea

Abstract: In this study, an Auto-adaptive Streamlined Multilayer Perceptron (ASMP) model was proposed that can complete training automatically without many hyperparameter configurations and allows the model to be lightweight while guaranteeing a certain accuracy. The WESAD dataset was used in the experiment, employing only the ECG signals recorded by 15 subjects during the laboratory study by wearing a wearable device. Heart Rate Variability (HRV) features were extracted from it for stress and affect classification. In addition, by improving with a traditional multilayer perceptron, the ASMP model can adaptively adjust the structure of the model itself according to the training accuracy while reducing the dependence of hyperparameters on the algorithm itself. In the two-classification case (stress and non-stress), the overall accuracy is 86%. In this case, the accuracy of detecting stress is 83%, followed by 87% for detecting non-stress. In the three-classification case ("neutral", "stress" and "relaxation"), the overall accuracy was 75%. In this case, the accuracy in classifying the "stress" category was 81%, followed by 79% in classifying the "relaxation" category and finally, 71% in classifying the "neutral" category. The prediction ability of the model is expected to be further improved through the optimization of feature vectors and models.

SK2022

17:40-17:55

A Smart Sign Language Interpreter for Medical Environments using Deep Learning: Morocco Case Study

Authors: Oumaima Ben Soultane, Zaynab Amine, Yassine Salih-Alj

Presenter: Oumaima Ben Soultane, Al Akhawayn University, Morocco

Abstract: This paper presents a smart system that aims to improve communication for individuals who primarily use sign language and those who do not master it. Innovative solutions in gesture recognition can effectively address and bridge the communication gap that exists between hearing individuals and people who are deaf, deafened, hard of hearing, or non-verbal. The proposed system integrates surface electromyography (EMG) and Inertial Measurement Unit (IMU) sensors with Convolutional Neural

Networks (CNN) to accurately interpret Moroccan Sign Language (MSL) and convert it into spoken language. The system of interpretation of sign language holds the overarching goal of contributing to the social integration of individuals with disabilities in medical and hospital environments.

SK2033 **17:55-18:10**	OGM based Real-time Obstacle Detection and Avoidance using Multibeam FLS Authors: Han-Sol Jin, Hyungjoo Kang, Min-Gyu Kim, Mun-Jik Lee, Seongho Jin, Gun Rae Cho, Ji-Hong Li **Presenter**: Han-Sol Jin, Korea Institute of Robotics & Technology Convergence, Republic of Korea

Abstract: In this paper, we present an obstacle detection/ avoidance algorithm based on OGM (occupancy grid map) method and its experimental studies. At each time step, the current frame of FLS (forward looking sonar) image is used to upgrade the OGM, according to which the desired vehicle heading to avoid obstacle(s) are calculated using general potential field method. A series of experimental studies have been carried out in the sea port environment, whereas we can investigate and analysis the effects of the design parameters in both of OGM construction and obstacle avoidance algorithms. This paper shows some of these results.

SK1023-A **18:10-18:25**	Mental stress classification using ECG data Based on Convolutional Neural Network Jihun Lee, Zhiqiang Liu, Daegil Choi, Gengjia Zhang, and Jaehyo Jung **Presenter**: Jihun Lee, AI Healthcare Research Center, Department of IT Fusion Technology, Chosun University, Korea

Abstract: Stress is a mental and physical reaction that people can feel, and if excessive stress continues, it causes chronic diseases such as myocardial infarction, high blood pressure, and diabetes. Numerous researchers have an interest in using ECG-based HRV for pressure detection. An electrocardiogram is the electrical activity of the heart based on temporal changes, and stress can be detected through the characteristic shape and morphological characteristics of the signal. Previous studies use PQRST waveforms to analyze changes within a cycle, but this study used the CNN model to identify heart patterns by paying attention to changes from the beginning of the heartbeat to the beginning of the next heartbeat using the R-R interval. The proposed Light CNN model can recognize changes between key points well within the R-R interval. To remove baseline noise, power line interference, and muscle noise from the ECG signal, a Butterworth high-pass filter, band-pass filter, and low-pass filter are used, and a median filter is used to remove noise from the signal. After detecting the R-R interval, the entire signal is divided into each R-R interval. The divided signal is converted into gray-tone images and used as input data for the convolutional neural network. To evaluate the performance of the proposed model, a confusion matrix and ROC curve were used, and an AUC score of 0.85% was achieved. In the future, it is expected that the performance of the model will be further improved by removing the noise of the signal using the moving average filter, wavelet transformation, and Savitzky-Golay, and classifying the stress in the frequency domain through Fourier transformation.

Online Session 1-Day 3

Time/Date: 9:30-11:40 (GMT+9) 29 February, 2024
Online ROOM: 860 3619 2252
https://us02web.zoom.us/j/86036192252?pwd=RlZLMllzUXBVcGNWYWlxK0V3aXVhUT09
Password: 7842
Topic: Intelligent Robot and System Control Model Analysis
Chaired by: Dr. Hung Duc Nguyen, University of Tasmania, Australia

Invited Speech

Fractional Order Thinking and Modeling

9:30-9:55

Invited Speaker: Mehmet Emir KOKSAL, Ondokuz Mayis University, Turkey

Abstract: Fractional calculus has become very famous and popular subject in recent years. It is used as a powerful and important mathematical modelling tool, for defining, investigating, analyzing, solving, and discussing many different types of engineering, physical, chemical, statistical, and social problems in real life. In fact, fractional order dynamic models simulate characteristics of real dynamic systems better than the integer order models. In this lecture, I will introduce basic concepts of fractional calculus, present various applications in distinct areas of science and engineering, and predict possible future research trends on this topic.

A three-dimensional (3D) graphical method is developed to tune the gain parameters of the fractional-order proportional-integral-derivative (FOPID) controller knowing the fractional orders. The controlled plant itself is also fractional order and it may have a time delay. For special cases, the method is applicable for integer-order PID controller design for integer and fractional-order systems with or without time delay. Some graphical design tools are used beneficially in the literature using 2D plots. Although the use of some minor 3D plots has appeared, they are based on shifting 2D plots to the third dimension, which makes the approach semi- or quasi-3D. Mathematical formulations of five design specifications in accordance with the 3D drawing with programming implementations by Matlab are presented. For designing controllers by using the introduced 3D graphical method, system design specifications such as phase margin (PM), gain margin (GM), phase flatness (PF), low-frequency output disturbance rejection (LFODR) and high-frequency noise rejection (HFNR) are considered and their important characteristics are shown. The requirements are mapped in the 3D Euclid space by 3D surfaces and/or lines so that the proportional, integral, derivative control coefficients can be chosen to meet the given specifications in an optimum way and to allow trade-off or compromise.

SK2025

Vision and Laser-Based Mobile Robot Following and Mapping
Authors: Lianghao Liu; Rui Lin; Feng Zhang

9:55-10:10

Presenter: Lianghao Liu, Soochow University, China

Abstract: This paper presents an algorithm called Real-time Vision-based Following Map (RVFM), which enables a mobile robot to perceive and track human body positions in space based on visual perception. Simultaneously, it creates a map of the environment, addressing the autonomous mapping issue for mobile robots in unpredictable environments. The algorithm utilizes the YOLOv5 algorithm for target recognition and optimizes detection results by clustering real bounding box sizes using the DBSCAN algorithm. By optimizing the loss function, detection performance is further improved. For target tracking, a combination of siamese neural networks and RPN network regression is employed, enhancing tracking accuracy and stability. In terms of path planning, the DWA algorithm is introduced, combined with a cost function representing the field of view, to achieve more accurate path planning and keep the target human within the camera's field of view center. For mapping, the algorithm is based on Gmapping and incorporates Kalman filtering and outlier removal techniques to ensure mapping accuracy and reliability. Experimental results demonstrate that the RVFM algorithm provides more accurate human body position information, achieving precise following. It also performs well in indoor path planning and obstacle avoidance, ensuring safety and efficiency during the following process.

SK2035

10:10-10:25

Dynamic deployment control for instant launch with a nonzero initial Ouadrotor
Authors: Zhenlin Lu, Zhe Wang, Jinye Rong, Hongping Lei
Presenter: Zhe Wang, Beijing Microelectronics Technology Institution, China

Abstract: An UAV dynamic deployment technology is developed for the quadrotor to realize instant launch by manually throwing it in the air, and the control method of fly-by stabilization under non-zero initial status is studied in this paper. This starting procedure allows users to throw the quadrotor with any initial attitude, and the controller immediately starts to guide it to horizontal position when the quadrotor is recognized automatically to be released from the hand of the operator. To overcome the gravity for rising after instant launching, we implemented a PID controller with feed forward compensation terms on the expected rising velocity, where the cascade control then is utilized to ensure stabilization after actual vertical velocity decaying. The experimental results show that the proposed control algorithm can achieve the effect of stabilization control from the non-zero initial status, which gets rid of the limitation that the most of the quadrotors need to be stationary from the horizontal ground take-off, and can be more suitable to be used for the future mission scenarios.

SK2014

10:25-10:40

Preliminary Study on the Rolling Locomotion of Variable Topology Truss Robot Using Dynamic Characteristics
Authors: Hanbom Kim, Jangho Bae, Mark Yim, TaeWon Seo
Presenter: Hanbom Kim, Hanyang university, Republic of Korea

Abstract: This paper presents a preliminary study on the development of dynamic rolling locomotion for Variable Topology Truss (VTT) robots. Rolling locomotion allows the robot to move in any direction, which is advantageous for various terrains. However, they are constantly affected by the relatively slow speed and impact. We propose the 2D and 3D dynamic models with a contact force simulation. Based on the calculation, the simulation model could show the movement of VTT.

SK2020

10:40-10:55

Compliant node Conceptual design and Position Estimation for Truss-like Robotic System
Authors: Hyeungyu Yoon, Jangho Bae, Mark Yim, TaeWon Seo
Presenter: Hyeungyu Yoon, Hanyang University, Republic of Korea

Abstract: This paper explores the design of Compliant Nodes to improve a modular robot called Variable Topology Truss (VTT), allowing it to change shapes automatically. The study also suggests practical methods for using these nodes effectively. In earlier VTT models, nodes were limited to spherical joints, making it challenging to maintain their shape when constraints were incomplete. This often required manual reassembly to modify the robot's structure. To overcome this, current research focuses on adding flexibility to the nodes, enabling them to reshape autonomously. In this effort, the paper examines the design concepts of the nodes and establishes conditions for their movement once new hardware is developed. The study identifies key features and shapes that nodes should have, contributing significantly to future research in the field. These proposed improvements aim to address past challenges, making it easier for the VTT robot to transform its structure seamlessly and automatically.

SK2003-A

10:55-11:10

SMILE: A Verbal and Graphical User Interface Tool for Speech-Control of Soccer Robots in Ghana
Authors: Patrick Fiati
Presenter: Patrick Fiati, Cape Coast Technical University, Cape Coast, Ghana

Abstract: SMILE (Smartphone Intuitive Likeness and Engagement) application, a portable Android application that allows a human to control a robot using speech input. SMILE is a novel open source and platform independent tool that will contribute to the robot soccer research by allowing robot handlers to verbally command robots. The application resides on a smartphone embedded in the face of a humanoid robot, using a speech recognition engine to analyze user speech input while using facial expressions and speech generation to express comprehension feedback to the user. With the introduction of intuitive human

robot interaction into the arena of robot soccer, we discuss a couple specific scenarios in which SMILE could improve both the pace of the game and autonomous appearance of the robots. The ability of humans to communicate verbally is essential for any cooperative task, especially fast-paced sports. In the game of soccer, players must speak with coaches, referees, and other players on either team. Therefore, if humanoids are expected to compete on the same playing field as elite soccer players in the near future, then we must expect them to be treated like humans, which include the ability to listen and converse. SMILE (Smartphone Intuitive Likeness and Engagement) is the first platform independent smartphone based tool to equip robots with these capabilities. Currently, humanoid soccer research is heavily focused on walking dynamics, computer vision, and intelligent systems; however human-robot interaction (HRI) is overlooked. We delved into this area of robot soccer by implementing SMILE, an Android application that sends data packets to the robot's onboard computer upon verbal interaction with a user.

SK2029

11:10-11:25

Collision Classification for Unmanned Surface Vehicle using Inertial Measurement Unit Data

Authors: Quang Nguyen, Toan Luu, Thien Tran, Chuong Nguyen, Minh Tran, Hung Nguyen

Presenter: Toan Luu, RMIT University, Vietnam

Abstract: In the development of digital twin systems for unmanned surface vehicles (USVs), collision classification is a fundamental feature to implement. Integrating collision position information into remote control systems significantly enhances operator situational awareness and facilitates effective motion control strategies even when camera visitor is compromised by challenging environmental conditions. This paper presents a three-step approach for collision classification employing onboard inertial measurement unit (IMU) data. In the first step, the sensor measures proprioceptive data during the emulated collision between the remote-controlled model scale ship and a stationary obstacle. Secondly, this time-series data is processed via wavelet transform followed prior to being fed into a deep neural network in the third step to classify collision into three types: bow-side (front), port-side (left), and starboard-side (right) collisions. The achieved classification accuracy of 96.66% shows the promising potential for integrating this approach into real-time digital twin systems.

SK1015

11:25-11:40

Real-Time Cat Breed Identifier using OpenCV and YOLOv5

Authors: Jules Darius C. Garcia, Thañel Daevid D. Tuason, Cyrel O. Manlises

Presenter: Jules Darius Garcia, Mapúa University, Philippines

Abstract: Convolutional Neural Networks (CNNs) excels at image analysis and object detection, which includes outlining objects with bounding boxes and image classification. Previous CNN-based research can only distinguish between cats and dogs. Limited research exists on detecting specific cat breeds in real time. Exploring the limits of CNNs is essential as running on limited hardware gauges its portability, and detecting similarly shaped subjects pushes its reliability. Potential applications of this study may range from tracking pets to wildlife conservation. This study aims to create and evaluate a real-time cat breed detection system using OpenCV, and You Only Look Once version 5 (YOLOv5) in a Raspberry Pi 4B. Using the OpenCV library, the live video feed taken by the device is split into frames, which is then analyzed by the YOLOv5 algorithm for detection (encasing the subject in a bounding box) and classification (displaying its predicted breed). Three cat breeds are to be detected. The breeds include Persian, Siamese, and Sphynx and an "Unidentified Cat Breed" class. Utilizing a 4x4 Confusion Matrix, the created system's overall accuracy is determined. In data gathering, three samples per breed are used, each requiring 30 frames of detection. The system, after tabulation, returned an overall accuracy of 93.06% across all three breeds and the "Unidentified Cat Breed" class.

Online Session 2-Day 3

Time/Date: 13:30-14:45 (GMT+9) 29 February, 2024
Online ROOM: 860 3619 2252
https://us02web.zoom.us/j/86036192252?pwd=RlZLMllzUXBVcGNWYWlxK0V3aXVhUT09
Password: 7842
Topic: Advanced Electronic Devices and Equipment Development
Chaired by: Prof. Dr. Badrul Hisham bin Ahma, Universiti Teknikal Malaysia , Malaysia

SK1014 | **13:30-13:45**

A LUT-based Fixed-Modulo Architecture for Efficient Multipliers of Residue Number System
Authors: Bhargava Sai Nadendla, Bobin Deng, Dan Chia-Tien Lo
Presenter: Bhargava Sai Nadendla, Kennesaw State University, USA

Abstract: Residue Number System (RNS) has demonstrated considerable potential in recent trending applications, including but not limited to AI matrix multiplications, Large Language Model (LLM) quantization, and efficiently supporting cryptography algorithm. However, the multiply-modulo circuit units within state-of-the-art RNS architectures are still considered inefficient in latency, energy, or (and) silicon area. These expensive solutions may narrow down or even eliminate the benefits provided by RNS encoding. In this paper, we proposed a LUT-based fixed-modulo architecture for RNS multipliers to optimize latency, power cost, and silicon area. Furthermore, we also propose Index Dissociation strategies to lower LUT storage requirements and decrease propagation delays. From empirical experiments, we observed that our proposed LUT-based fixed-modulo architecture with Index Dissociation gained 9.37%, 1.17%, and 10.34% reduction in delay, energy, and Energy-Delay Product (EDP), respectively.

SK1009 | **13:45-14:00**

A Gaussian maximum likelihood method for blind DSSS signal estimation at low SNR
Authors: Huaguo Zhang, Liangliang Li
Presenter: Huaguo Zhang, University of Electronic Science and Technology of China

Abstract: We present a novel method for the problem of blind direct sequence spread spectrum (DSSS) signal estimation at low SNR based on Gaussian maximum likelihood (GML). The GML estimate of the spreading waveform under stochastic model is first derived, and we then obtain a closed-form analytical solution to the GML estimator using the low signal-to-noise (SNR) approximation. The method is very efficient computationally since it does not involve iterative optimization procedures. In addition, it is robust in that it does not need to estimate the transmission delay and is not sensitive to the estimation error of symbol duration. The effectiveness of the proposed method for both short-code and long-code DSSS signals is verified via simulation experiments.

SK1013 | **14:00-14:15**

Optimal Lifespan of Electronics Component by Using Weibull distribution
Authors: Virote Pirajnanchai, Vanvisa Chatchavong, Satawat Doungpan and Kanok Janchitrapongvej
Presenter: Virote Pirajnanchai, School of Engineering King Mongkut's Institute of Technology Ladkrabang, Thailand

Abstract: Ensuring the availability and reliability of electronic components or materials during operation necessitates conducting a sampling inspection of their lifespan. This is particularly crucial when comparing equipment or materials deployed in various areas with diverse environments, conditions, and situations. Most literature employs single-parameter estimation methods, which fall short in identifying the two explicit parameters of the Weibull distribution. Moreover, inaccurate parameter estimation methods impede the attainment of reliable analysis results. Consequently, this paper introduces three analytical estimation methods to determine the parameters of the Weibull distribution. The accuracy of these methods is

evaluated using the mean square error (MSE). Furthermore, the application of the Kolmogorov-Smirnov test on real datasets confirms the presence of the Weibull distribution. Simulation results indicate that the Maximum Likelihood Estimate (MLE) surpasses other estimators by minimizing the MSE, yielding optimal parameters. These optimal parameters are then applied to real the closed-circuit television (CCTV) datasets, demonstrating a fitting match and facilitating the assessment of CCTV lifespan through the mean time to failure (MTTF), determined to be 6.6 years. This holds true even when the equipment or materials are utilized in an area with different environments, conditions, and situations.

SK2008

14:15-14:30

Nested Optimized Adaptive Linear Control

Authors: Yuxiang Zhang, Shuzhi Sam Ge

Presenter: Yuxiang Zhang, National University of Singapore, Singapore

Abstract: Optimal control theory was formulated with the implicit assumption that the system under investigation possesses inherent stabilizability. In this framework, the derived optimal control strategy not only stabilizes the system but also concurrently ensures the optimization of the designated cost function without the need for explicit separation of these two aspects. This approach is theoretically elegant and has demonstrated considerable success in various applications. However, here are some hidden dangers due to the uncertainties introduced. Particularly in the context of increasingly complex large-scale systems, this approach poses challenges. In this paper, the aspects of stabilization and optimization will be explicitly addressed in a separate manner in an endeavor to strike a balance between ensuring stability and achieving optimal control. Specifically, the nested optimized adaptive linear control framework builds upon the classical linear optimized control. This framework leverages the advantages of optimal control while also effectively addressing stability concerns. Central to these advancements is the introduction of a nested structural framework that facilitates explicit handling of the stabilization aspect. To underscore the merits of our approach, we provide illustrative examples that highlight its advantages in comparison to recent approaches of a similar nature.

SK2021

14:30-14:45

Model Predictive Control of a Soft Laparoscope using Neural Networks

Authors: Axel Céspedes, Ricardo Terreros, Sergio Morales, Aldair Huamaní, Joao Fabián, and Ruth Canahuire

Presenter: Axel Cespedes, Universidad de Ingenieria y Tecnologia, Peru

Abstract: Soft robots are an emerging alternative to traditional surgical equipment. Specifically, capabilities of these like flexibility and controlled rigidity, are exploited in enclosed environments where requirements can restrict the use of rigid apparatus. In this work, a soft robot intended to perform laparoscopic activities is used. The design of a cascade control system for this soft laparoscope is presented, composed of two control algorithms: one in charge of controlling the position of the robot and the second in charge of controlling the pressure on its inner chambers. The latter is based on a standard ON-OFF controller, and the former is based on the Model Predictive Control (MPC) methodology, where Deep Neural Networks (DNN) are used for modeling the actuator. The results show that our control system allows the soft laparoscope to reach a desired orientation with a maximum error of 0.06 rad.

MEMO