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THE 6TH IEEE INTERNATIONAL CONFERENCE ON UNIVERSAL VILLAGE

PROGRAM BOOK

OCTOBER 22-25 | BOSTON AND VIRTUAL

Post-Pandemic Reflection on Health, Harmony, and Sustainability: Mobility and Virtual Connection; Diversity and System Efficiency Responsiveness and Resilience; Inclusiveness and Integration

THE 6TH IEEE UV2022 INTERNATIONAL CONFERENCE ON UNIVERSAL VILLAGE

https://universalvillage.org

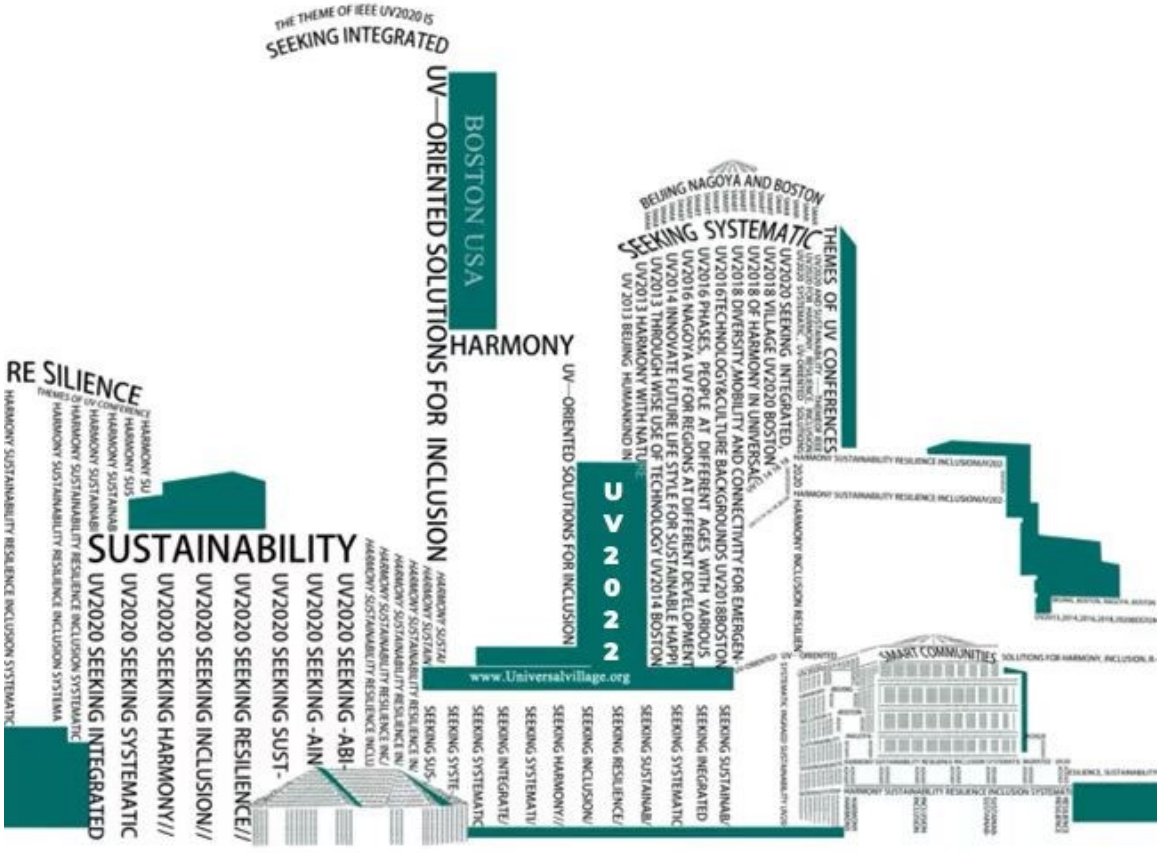
THE 6TH IEEE

UV 2022

www.Universalvillage.org

10/22-10/25

BOSTON USA



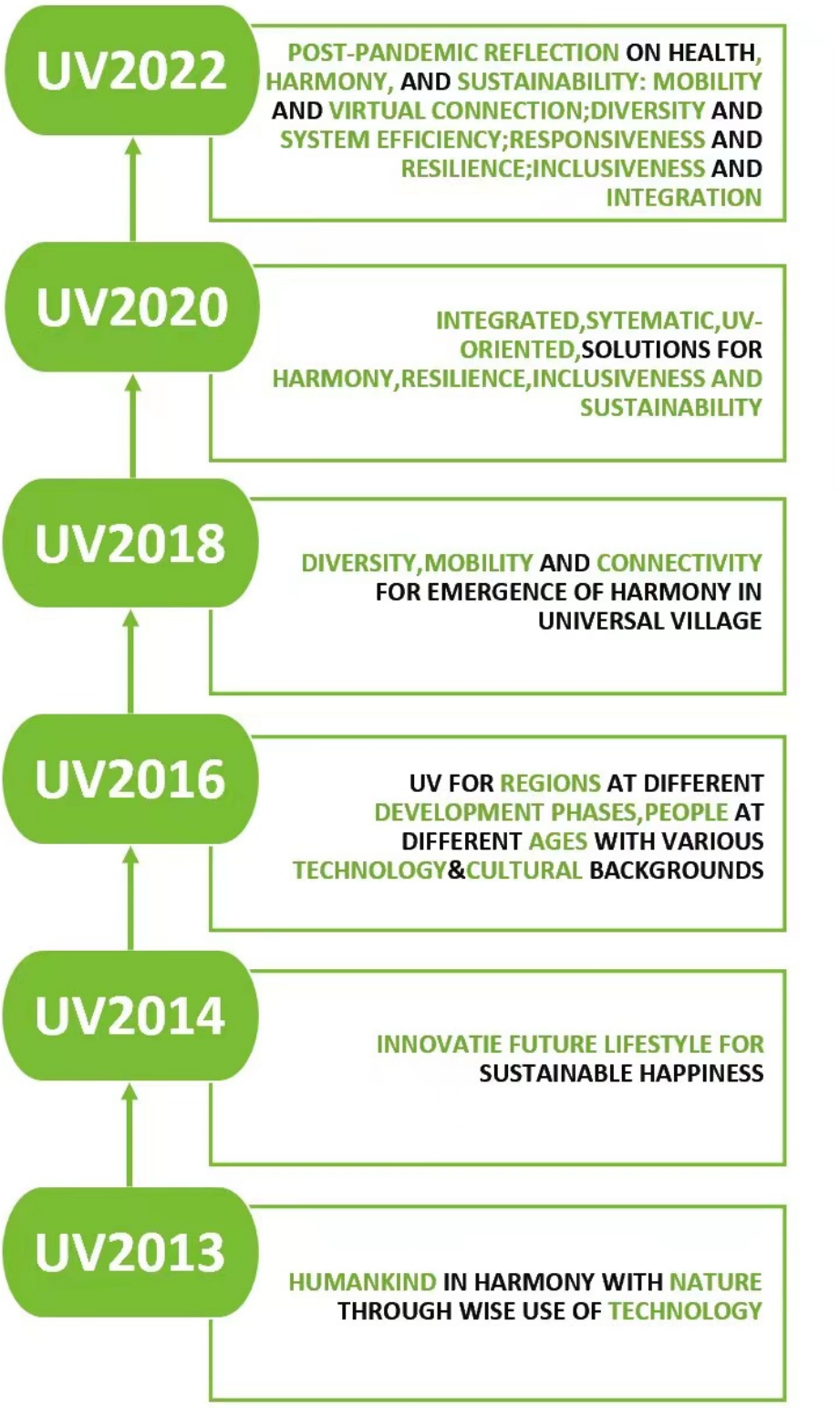
THE 6TH IEEE UV2022 Seeking integrated, systematic, UV–oriented solutions for harmony, resilience, inclusion and sustainability

The 6th International Conference Universal Village

IEEE UV2022
Program Book

October 22nd-25th, 2022
Virtual and Boston, USA

UV Theme


UV2022
POST-PANDEMIC REFLECTION ON HEALTH, HARMONY, AND SUSTAINABILITY: MOBILITY AND VIRTUAL CONNECTION;DIVERSITY AND SYSTEM EFFICIENCY;RESPONSIVENESS AND RESILIENCE;INCLUSIVENESS AND INTEGRATION
UV2020
INTEGRATED,SYTEMATIC,UV-ORIENTED,SOLUTIONS FOR HARMONY,RESILIENCE,INCLUSIVENESS AND SUSTAINABILITY
UV2018
DIVERSITY,MOBILITY AND CONNECTIVITY FOR EMERGENCE OF HARMONY IN UNIVERSAL VILLAGE
UV2016
UV FOR REGIONS AT DIFFERENT DEVELOPMENT PHASES,PEOPLE AT DIFFERENT AGES WITH VARIOUS TECHNOLOGY&CULTURAL BACKGROUNDS
UV2014
INNOVATIE FUTURE LIFESTYLE FOR SUSTAINABLE HAPPINESS
UV2013
HUMANKIND IN HARMONY WITH NATURE THROUGH WISE USE OF TECHNOLOGY

CONTENTS

GREETINGS FROM CONFERENCE CHAIRS

General Chairs

Roy E. Welsch, Kazuya Takeda, Lionel C. Kimerling, Shuguang Zhang and Xiong Zhang





Welcome to the 6th International Conference on Universal Village, UV2022. The Universal Village (UV) represents our vision for a future society that delivers sustainable happiness to its residents. To build this UV, we adopt a top-down, or in other words, a system-oriented approach as opposed to a bottom-up or element-oriented approach.

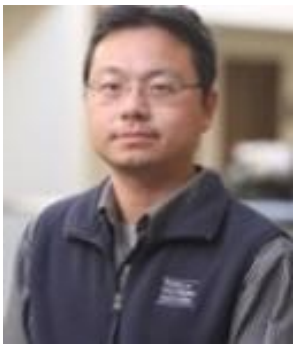
Throughout this development process, overarching objectives such as the sustainable happiness of residents inform and define more specific objectives. These include environment protection, energy management, communication, healthcare, transportation, and other related systems. Feedback mechanisms from bottom to top also play a critical role in this integrative and collaborative process.

I sincerely hope this conference stimulates various kinds of collaborations. Thank you for joining us at this conference!

International Chairs

Yajun Fang, Xiaoman Duan and Yasha Yi



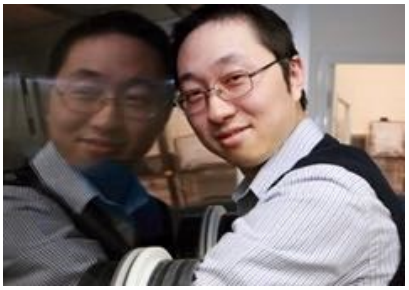


On behalf of the Universal Village International Conference Committee, we warmly welcome you to the 6th Universal Village International Conference. We are gathering from around the world with a singular purpose: to make this world a better place, a Universal Village that we can all call home. We are here to confront environmental problems threatening our quality of life; to share our advanced research findings and experiences working within the framework of the Universal Village; to discuss challenges encountered in our research endeavors, collectively find potential solutions, and pose new questions. Lastly, we are here to strategize on creating milestones for the Universal Village through innovation, technology, and the boundless human capacity for learning and discovery.

We are profoundly grateful for your significant contributions to UV2022. Without you, UV2022 would not be happening today. It is your efforts that will ensure the success of UV2022 and give our "Universal Village" a brighter future. Please accept our deepest appreciation from the UV International Committee.

Conference Chairs

Lin Zhang, Juejun Hu and Canan Dagdeviren

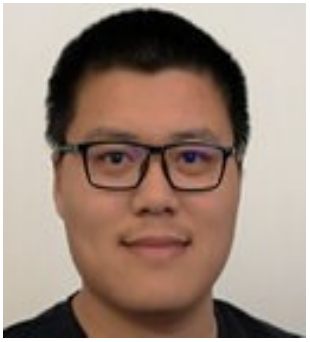




As Conference Chairs, we welcome you to UV2022, the 6th International Conference on Universal Village. Universal Village (UV) represents our desired future society, designed to provide its residents with sustainable happiness. In order to develop UV, we take a top-down, or, in other words, a system-oriented approach, rather than a bottom-up or element-oriented approach. During the development process, higher-level objectives such as the sustainable happiness of residents inform lower-level objectives, which include environment protection, energy management, communication, healthcare, transportation, and other related systems. Feedback from the bottom to the top is crucial in this process of integration and collaboration. We hope that this conference will stimulate various forms of collaboration. As we conclude our greeting, we would like to extend a hearty "Congratulations!" to everyone who contributed to the initiation of this conference. Please enjoy the conference. Thank you very much!

Local Chairs

Lin Zhang, Wei Wang and Longfei Zhou



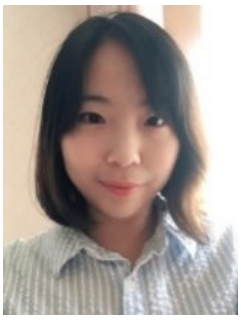


It is our greatest pleasure to welcome you to the 6th International Conference on Universal Village (UV2022). As your local conference chairs, we're here to provide support! A wealth of information from multidisciplinary fields will be presented during this four-day conference, encouraging collaboration among researchers from diverse backgrounds beyond the traditional boundaries of their individual research fields. We hope that by the end of this conference, you will have found systematic, coordinated, and long-term solutions for the future of humanity and nature. As the theme for UV2022, we aspire to broaden our horizons: exploring UV for regions at different developmental stages, and for people of different ages and diverse technological and cultural backgrounds. Lastly, we want to extend our sincere gratitude to those who have made UV2022 a success by devoting their time and energy. Thank you very much for attending UV2022.

Program Chairs

Shengsheng Cao, Hao Sheng, Wenya Du, Lijuan Su and Hirofumi Aoki





It is with great pleasure and honor that we welcome you to the 6th Universal Village Conference, UV2022! On behalf of the program committee, we would like to extend our heartfelt appreciation to all the participants. Thanks to the diligent efforts of the organizing committee, we proudly present a series of attractive events and technical sessions as part of UV2022. We hope all participants will enjoy the technical presentations and engage actively in discussions throughout the conference. Once again, thank you for your significant support and active participation in UV2022.

CONFERENCE COMMITTEE

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- **Kelly Zhang (UVS, USA)**

K-12 Challenge Committee

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- **Houjun Ji (UVS, USA)**
- **Xuan Liu (UVS, USA)**
- **Mukun Zhou (UVS, USA)**
- **Ailun Liu (UVS, USA)**
- **Sophia Chin (UVS, USA)**
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- **Chenyi Wang (UVS, USA)**

GENERAL INFORMATION

Following great success in China (Beijing, UV2013), the United States (Boston, UV2014), Japan (Nagoya, UV2016), and three additional times in the United States (Boston, UV2018 and UV2020), the 6th International Conference on Universal Village (UV2022) will once again be held in Boston, United States. UV2022 aims to broadly illustrate a desired future society that seeks harmony between humans and nature through the thoughtful application of advanced technologies. The concept represents an evolved and advanced form of Smart Cities, signifying our commitment to follow universal laws in order to protect the environment and ecosystems, while innovating new lifestyles to sustain happiness for humanity's future.

UV2022 will persistently appeal for collective efforts across multi-disciplinary fields. The goal is to develop a platform where researchers of diverse backgrounds can collaborate beyond traditional field boundaries and discover a systematic, coordinated, long-term solution for the future of humankind and Mother Nature.

The subjects for UV2022 include, but are not limited to, the following topics:

- Systematic methodologies to advance UV technologies and to develop UV systems, including, intelligent transportation, intelligent environment & communities, intelligent healthcare, intelligent food systems, etc.
- New life styles enabled by IT / New energy sources / New materials / Effective microorganism technology and environmental protection.
- Suitable paths of design, development, implementation, engineering and integration appropriate for different regions.
- Ways to benefit governments, companies, universities as well as societies on specific UV topics as well as practical UV solutions.
- The theme for UV2022 is “Post-Pandemic Reflection on Health, Harmony, and Sustainability".

Due to safety concerns arising from the COVID-19 pandemic, the 6th International Conference on Universal Village (IEEE UV2022) will be held as an online conference via Microsoft Teams from October 22nd to 25th, 2022.

UV2022 Website

https://universalvillage.org/

Contact Information

Please contact us at this email address whenever you have any questions:
uv.conf.committee@universal-village.org

PROGRAM AT A GLANCE

IEEE UV2022 Program at a Glance (October 22-25th, 2022, EDT)

Date (US EDT)	Time (US EDT)	Session ID	Description	Meeting Teams (Join in Microsoft Teams)
10/21, 2022 (Friday)	19:00-23:00	[SF]	Student Forum - UV Introduction & Workshop	[SF] IEEE UV2022 Student Forum
10/22, 2022 (Saturday)	7:30-12:55	[SF]	Panel Discussion /Round table discussion	[SF] IEEE UV2022 Student Forum
	10:00-10:30	[K12C]	K12 - Kahoot Quiz Game	[K12C] IEEE UV2022 K-12 Competition
	10:30-12:00		K12 - Current News Table Talk	
	13:00-14:30		K12 - Spotlight Talks	
	20:30-00:30	[CF]	Digital City Forum	[CF] IEEE UV2022 Digital City Forum
	20:00-21:25	[TS4-A,4-B]	Renewable Energy and Smart Energy Management & Smart Materials and Devices	[TS4-A,4-B] IEEE UV2022 Session
	20:30-3:40 (10/23)	[TS9-C] [TS9-D]	Integrated Solutions for Smart Humanity	[TS9-C,9-D] IEEE UV2022 Session
			Smart Design and Design Ethics	
	21:00-23:00	[TS11-C]	Advance in Distributed Energy System: Design, Simulation and Operation	[TS11-C] IEEE UV2022 Session
10/23, 2022 (Sunday)	8:00 - 12:00	[TS1-A] [TS1-B]	Vision for Universal Village and UV Indices	[TS1-A,1-B] IEEE UV2022 Session
			Development Status of Universal Village	
	8:00 - 12:00	[TS1-C]	Digital Analytics, Digital Transformations and UV Index Evaluation	[TS1-C] IEEE UV2022 Session
	9:50 - 12:10	[TS8-A]	Ultrasound Technologies for Biomedical Application	[TS8-A] IEEE UV2022 Session
	8:00 - 11:05	[TS10-A] [TS10-B]	Responsible and Ethical Data Management and Processing	[TS10-A,10-B] IEEE UV2022 Session
			Learning Algorithm Development, Analysis and Interpretability	
	20:00-21:00	[TS11-A]	Education Systems in the Universal Village City of the Future	[TS11-A][PE] IEEE UV2022 Session
	13:00 - 00:30	[SF]	Student Forum - Research Presentation	[SF] IEEE UV2022 Student Forum
	10:00-12:00	[K12C]	K12 - Research Presentation	[K12C] IEEE UV2022 K-12 Competition
	13:00-14:00		K12 - Innovation Competition	
	14:00-14:30		K12 - Talent Show	
10/24, 2022 (Monday)	8:00-12:10	[PS]	Opening Ceremonty & Plenary Session 1	[Main] IEEE UV2022
	12:30-18:00		Plenary Session 2 & 3	
	20:00-23:00	[TS6-A] [TS6-B]	Smart Ecological and Environmental Systems	[TS6-A, 6-B] IEEE UV2022 Session
			Mobility Enabled Material Cycles, the Circular Economy, Trash and Scrap Collection, Processing, Reuse, and Recycling	
	20:00-23:00	[TS7-A] [TS7-B]	Smart Homes and Community, Virtual Living	[TS7-A,7-B] IEEE UV2022 Session
			Mobility, Connectivity, and Innovative Lifestyles	
10/25, 2022 (Tuesday)	8:00-12:00	[TS2-B]	Intelligent Modeling, Simulation, and System Analysis	[TS2-B] IEEE UV2022 Session
	8:00-9:40	[TS3-A]	Intelligent Transportation, Urban Planning, and Smart City Infrastructure	[TS3-A,3-B,3-C,3-D] IEEE UV2022 Session
	9:40-10:00	[TS3-B]	Intelligent Vehicles, Mobility Support for Vulnerable Groups	
	10:00-10:20	[TS3-C]	Crowd Management, Smart Response Systems for City Emergencies	
	10:20-10:40	[TS3-D]	Information Flow, Communication, Networks, and Security	
	8:00-10:00	[TS5-A]	Smart Manufacturing	[TS5-A] IEEE UV2022 Session
	8:00-13:00	[TS5-B]	Smart Argriculture	[TS5-B] IEEE UV2022 Session
	8:00-11:45	[TS8-B]	Smart Medicine and Smart Healthcare	[TS8-B] IEEE UV2022 Session
	21:00-00:30	[TS9-A] [TS9-B]	Urbanization and Smart Communities	[TS9-A,9-B] IEEE UV2022 Session
			Smart Government and Social Services	
	23:45-00:30	[PS]	Paradigm Shift from IHuman-Computer Interaction (IICI) to IHuman-Engaged Computing (IIEC)	[Main] IEEE UV2022
10/26, 2022 (Wednesday)	00:30-1:30	[PS]	Closing Ceremony	[Main] IEEE UV2022

[DSC] Data Science Competition

[Introduction] The 1st International "Vision Meets Algae" Challenge (VisAlgae) is a part of IEEE 6th Village International Conference on Universal Village. It is held to encourage participants to pay attention to marine environment and use computer vision methods to better monitor marine biology. The task is to develop an object detection algorithm to detect 8 classes of microalgaes (*Bacillariophyta, Chlorella pyrenoidosa, Platymonas, Dunaliella salina, Chrysophyta,* Normal *Symbiodiniacea,* Translating *Symbiodiniacea,* and Bleaching *Symbiodiniacea*) in obtained microscopy images.

[PC] Pitch Competition

[Aims] UV Student Forum encourages students to share their entrepreneurial ideas and to transform their ideas and research results into meaningful products that can make the world better.

[Contents] Talent selection, research guidance, and innovation incubation.

[Topics]

♦ Coordinated UV Solutions for Epidemic Prevention and Control

♦ Coordinated UV Solutions for Trash and Scrap Collection, Processing, Reuse, and Recycling

♦ Integrated, systematic, UV-oriented solutions for harmony, resilience, inclusion and sustainability

♦ UV Subsystems

♦ UV Impacting Factors

Oct. 23rd: [K12C] K-12 Challenge

[Aims] Inclusive, education-oriented special session

[Contents] All K-12 students who care about harmony between humans and nature are welcome to participate in this challenge.

[Events]

♦Online Game

♦Research Presentation

♦Innovation Competition

♦Talent Shows

♦Current News Table Talk

♦Spotlight talks

Oct. 22nd-25th: [SF] UV Student Forum

[Aims] Increase awareness among the young generation about the challenges and dilemmas humans are facing, cultivate young people's creativity and leadership, encourage students' entrepreneurial enthusiasm, and contribute to building a better world.

[Contents] Students will exchange their research experience and visions with peers, host round-table discussion, propose future plans for UV student clubs and participate in interactive activities.

[Events]

Theme 1: Science & Technology

- ♦ UV Introduction
- ♦ UV workshop
- ♦ Data Science competition
- ♦ UV Mathematical modeling competition
- ♦ UV Research Project Report
- ♦ Round-table meeting
- ♦ In-depth Panel Discussion

Theme 2: Art, Humanity & Design

- ♦ City Evaluation
- ♦ UV Philosophy & Stories Sharing
- ♦ Talk Show
- ♦ Art & Technology Exhibition
- ♦ Talent Shows and Online Games

Theme 3: Management & Entrepreneurship

- ♦ UV Pitch Competition
- ♦ UV Club and Roadmap

Oct. 24th: Plenary Session

[Aims] UV encourages interdisciplinary cooperation for a coordinated and systematic solution to future human-nature harmony

[Contents] Researchers across multi-disciplinary fields will share their novel ideas pursuing intelligent technologies for harmony, resilience, inclusiveness, and sustainability.

[Events]

♦ Opening Ceremony
♦ Keynote Speech

Oct. 22nd-25th: Technical Program

[Theme] Integrated, Systematic, UV-Oriented Solutions for Harmony, Resilience, Inclusiveness, and Sustainability

[Sessions] Research Reports

♦ Session TS1-A Vision for Universal Village and UV Indices
♦ Session TS1-B Development Status of Universal Village
♦ Session TS1-C Evaluation of Smart City-Related Methods, Technologies, and Systems
♦ Session TS2-A Systematic and Integrated Frameworks for UV Subsystems and Contributing Factors
♦ Session TS2-B Intelligent Modeling, Simulation, and System Analysis
♦ Session TS3-A Intelligent Transportation, Urban Planning, and Smart City Infrastructure
♦ Session TS3-B Intelligent Vehicles, Mobility Support for Vulnerable Groups
♦ Session TS3-C Crowd Management, Smart Response Systems for City Emergencies
♦ Session TS3-D: Information Flow, Communication, Networks, and Security
♦ Session TS4-A: Renewable Energy and Smart Energy Management

- Session TS4-B: Smart Materials and Devices
- Session TS5-A: Smart Manufacturing
- Session TS5-B: Smart Agriculture
- Session TS6-A: Smart Ecological and Environmental Systems
- Session TS6-B: Mobility Enabled Material Cycles, the Circular Economy, Trash and Scrap Collection, Processing, Reuse, and Recycling
- Session TS7-A: Smart Homes and Community, Virtual Living
- Session TS7-B: Mobility, Connectivity, and Innovative Lifestyles
- Session TS8-A: Ultrasound Technologies for Biomedical Application
- Session TS8-B: Smart Medicine and Smart Healthcare
- Session TS8-C: Public Health, Epidemic Prevention and Control
- Session TS9-A: Urbanization and Smart Communities
- Session TS9-B: Smart Government and Social Services
- Session TS9-C: Integrated Solutions for Smart Humanity
- Session TS9-D: Smart Design and Design Ethics
- Session TS10-A: Responsible and Ethical Data Management and Processing
- Session TS10-B: Learning Algorithm Development, Analysis and Interpretability
- Session TS11-A&PE: Education Systems in the Universal Village City of the Future
- Session TS11-B: UV Data Science Competition: Algorithm Report Session
- Session TS11-C: Advance in Distributed Energy System: Design, Simulation and Operation
- Session CF: Digital City Forum
- Session AF: UV Art Forum
- Session PE1: UV Poster
- Session PE2: UV Exhibition: Art & Technologies that present the UV concept
- Session WS-UV: UV Workshop
- Session RMD: UV Roadmap Discussion
- Session PD: UV Panel Discussion
- Session RTB: UV Round Table Discussion

PLENARY SESSION

Meeting Room (Microsoft Teams): [Main] IEEEUV2022->[20221024]Plenary

Opening Remarks

Time: 8:00am-8:10am, **October 24th, U.S. Eastern Daylight Time**

Host by Lin Zhang (BUAA) & Xiaoman Duan (UVS)

- Welcome by Conference Chair

  Lin Zhang (BUAA)

- Opening Speech

  *Kazuya Takeda (*Nagoya University)

  Yajun Fang & Xiaoman Duan (UVS)

  Lin Zhang (MIT), Longfei Zhou (Duke University)

Keynote Speeches

Agenda

IEEE UV2022 Opening Ceremony & Plenary Session Agenda (October 24th, 2022, EDT)

No.	Time	Name	Organization	Topics
	Opening Ceremony Host: Lin Zhang (BUAA) & Xiaoman Duan (UVS)			
1	8:00-8:10	Lin Zhang	Beihang University	Welcome by Conference Chair
		Kazuya Takeda	IEEE ITSS - Nagoya University	Opening Speech by General Chair
		Yajun Fang, Xiaoman Duan	UVS	Opening Speech by International Chairs
		Lin Zhang, Longfei Zhou	MIT / Duke University	Opening Speech by Local Chairs
	Plenary Session 1 Host: Lin Zhang (BUAA) & Longfei Zhou (Duke U.)			
2	8:10-8:50	Kazuya Takeda	IEEE ITSS - Nagoya University	AI technology for mitigating the risk of AI
3	8:50-9:30	Gang Luo	MEEI Harvard University	Usage of visual aids by visually impaired people during global COVID-19 Lockdowns
4	9:30-10:10	Clinton Andrews	Rutgers University	Urban Robotics
5	10:10-10:50	Dominic Mentor	Columbia University	I'm-Learning everyday: M-Class Planet Battle of the Apps
6	10:50-11:30	Julian Togelius	New York University	What can we learn about AI and intelligence from games?
7	11:30-12:10pm	Zhishun Wang	Columbia University	Brain Imaging and Deep Learning in Studying Brain Networks and Psychiatry
	12:10-12:30	**Break**		
	Plenary Session 2 Host: Lin Zhang (MIT) & Longfei Zhou (Duke U.)			
8	12:30-13:10	Shuguang Zhang	MIT	Curiosity-driven Research: The QTY Code for Protein Design
9	13:10-13:50	Jose Campos	San Francisco Office of Community Investment and Infrastructure	The importance of "placemaking" for successful urban development
10	13:50-14:30	Audrey Amsellem	Columbia University	Interaction, Equity, and Inclusivity in the Smart City and the Response City
11	14:30-15:10	Agnis Stibe	EM Normandie	Hyper-Performing Cities with Human Artificial Intelligence
	15:10-15:20	**Break**		
	Plenary Session 3 Host: Lin Zhang (MIT) & Longfei Zhou (Duke U.)			
12	15:20-16:00	Lin Zhang	MIT	Conformable piezoelectric devices for biomedical application
13	16:00-16:40	Zili Li	MIT / University College Cork (UCC), Ireland	Universal Village: Underground Infrastructure Society
14	16:40-17:20	Longfei Zhou	Duke University	Impact of Public Transportation Routes on the Spread of COVID-19
15	17:20-18:00	Jagannath Aryal	University of Melbourne	Earth Observation and Digital Transformation: an outlook from Infrastructure Engineering

Morning Plenery-1:

Host by Lin Zhang (BUAA) & Longfei Zhou (Duke U.)

Kazuya Takeda

Professor and Vice President, Nagoya University, Japan

Title: **AI technology for mitigating the risk of AI**

Time: 8:10am-8:50am, **October 24th, U.S. Eastern Daylight Time**

Abstract: As Autonomous Driving (AD) becomes a societal reality, technical, legal, and ethical systems that can mitigate damage caused by the inevitable errors of humans or autonomous systems become crucial. However, due to their highly complex and sometimes 'black-box' nature, how an AI for AD interprets the current traffic context can be difficult to articulate. This is particularly true for perception; illustrating the attention heatmap is often used to share the AI's 'understanding' of the situation with humans. However, detecting risk is impossible with visual cues alone. The AD system must fully comprehend the situation to effectively avoid risk.

As the first step, we built a signal transcription system which converts the multi-modal sensor signal sequences used by AD – consisting of a frontal camera, kinematic sensor and the vehicle control channel – into the natural language sentences. The generated sentences represent how the AD understands the current traffic context and human beings can share its understanding. We are currently trying to apply this to AD risk management in the insurance business, for the digital aid of the human risk analysts. In this talk, I will introduce details of this project and future research goals that include describing a set of standard traffic scenarios which spans 99% of urban traffic.

Gang Luo

Associate Professor, Harvard Medical School, USA

Title: Usage of visual aids by visually impaired people during global COVID-19 Lockdowns

Time: 8:50am-9:30am, October 24th, U.S. Eastern Daylight Time

Abstract: Millions of individuals with visual impairments use vision assistance apps to help with their daily activities. We conducted a comprehensive big data analytics study to investigate how the usage of visual aids may have changed during the COVID-19 lockdowns. The findings can help us understand their visual needs both at home and outside.

We retrospectively reviewed the use of a free vision assistance app by 38,000 monthly active users worldwide from the year 2018 to 2022. It was discovered that app usage, when adjusted for seasonal changes, was 8.6% lower during weekends than during weekdays.

During the global COVID-19 lockdowns in April 2022, the app usage experienced an 11% decline. This suggests that activities at home were different and less visually demanding.

We monitored users' travel distances in 2021 and found their mobility to be similar to the commute distance of people with normal vision. The findings suggest that these users primarily use the visual aid at home, and approximately one-tenth of visual aid use cases occur outside the home.

Clinton Andrews

Professor, Center Director, and Associate dean, E.J. Bloustein School of Planning and Public Policy, Rutgers University

Title: Urban Robotics

Time: 9:30am-10:10pm, **October 24th, U.S. Eastern Daylight Time**

Abstract: According to one definition, “a robot is an autonomous machine capable of sensing its environment, carrying out computations to make decisions, and performing actions in the real world.” Such a definition would include many urban systems that are not normally associated with robotics, such as lighting and thermal comfort systems in smart buildings and sensor-driven traffic signals on roads. The lines are blurring between autonomous machines and the increasingly intelligent environments in which they are embedded. Automotive engineers have developed standard definitions for levels of automation in autonomous vehicles from “full human control” to “fully autonomous control;” but the third locus of control—the intelligent environment—is less frequently considered to be part of the story. Practical engineering concerns regarding which computing to do at the edge (in the robot) or centrally (in the environment) place very real constraints on the feasible degree of autonomy for a given robotic functionality. Ethical concerns regarding the preservation of human autonomy in smart environments that also host robots make this an important topic for humanity’s urban future. How does the responsibility of the designer change when the human is inside the robot (as in a building or vehicle) compared to when the human is located outside and perhaps adjacent to it? What urban governance structures are needed to preserve human dignity and an ability to

make choices in a city with ubiquitous automation? Who is responsible when intelligent urban systems fail or get hacked? Which aspects of ubiquitous urban intelligence should be regarded as infrastructural versus open to marketplace competition or factional conflict? This presentation unpacks the contradictions in urban robotics, suggests—following Asimov's "laws" and the Hippocratic Oath—how to avoid doing harm to humans, and encourages critical discussion about which version of the intelligent urban future we are building.

Dominic Mentor

Professor, Columbia University, New York, USA

Title: I'm-Learning everyday: M-Class Planet Battle of the Apps

Time: 10:10am-10:50am, **October 24th, U.S. Eastern Daylight Time**

Abstract: While teaching English and incorporating computer-assisted hypermedia methods for language learning, I observed mobile devices becoming more prevalent. Despite initial resistance to leveraging these devices for learning, a Fulbright opportunity allowed me to pioneer mobile learning (mLearning) at Columbia University. Since then, I have successfully integrated mLearning in a US-based national training nonprofit, startups, and corporations. Initially, mLearning was met with skepticism, but it has since been adopted with award-winning results.

Owing to the ubiquity of mobile devices, many individuals consider themselves user experts. However, for a successful mLearning initiative, the practical application of learning theories provides a solid foundation to support goals and objectives. The appropriate use of relevant theories can also cater to our multiscreen lifestyles. Additionally, these theories can support various educational contexts, encourage essential collaboration, and bring content to life in a dynamic way for impactful learning. To begin with, mLearning should be incorporated into every higher education institution worldwide. Further expansion also needs to occur in other sectors where mLearning can benefit society.

Corporations, libraries, the medical field, and all other aspects of our lives impacted positively and negatively by mobile devices require mLearning as a discipline.

During the pandemic, we saw an increase in eLearning and mLearning, yet few programs are leveraging mLearning. mLearning courses teach pedagogical and andragogical considerations that should inform mLearning initiatives. Feedback from both pre-graduate and post-graduate courses reveals that even though mobile devices are ubiquitous, self-rated prior knowledge about mLearning theories is low and grows with experience and practice. Many people unfamiliar with mLearning still have reservations and questions. How can mLearning enhance and strengthen educational and/or training engagement for better results? How should mLearning be integrated into formal and informal learning environments? This presentation will address these questions with examples.

Julian Togelius

Associate Professor, the Department of Computer Science and Engineering, New York University, USA

Title: What can we learn about AI and intelligence from games?

Time: 10:50am-11:30am, **October 24th, U.S. Eastern Daylight Time**

Abstract: Games have been crucial for the development of artificial intelligence, and key techniques have been invented specifically in the context of game playing. Gradually, the AI community has moved on from the classic board games that used to define the research frontier. While Chess and Go have been extremely useful for developing tree search and reinforcement learning methods, games such as StarCraft, Minecraft, and Dota 2 are increasingly being used as environments in which to develop new algorithms. In this talk, I want to take a step back and ask what we can learn from these developments. Artificial intelligence is not only a set of algorithms that can solve hard problems; it is also, and perhaps primarily, a long quest to better understand the ill-defined set of human capabilities we call intelligence. What have we learned about intelligence from developing methods for playing and designing games? Has this brought us closer to general intelligence?

Zhishun Wang

Associate Professor, Department of Psychiatry, Columbia University

Title: Brain Imaging and Deep Learning in Studying Brain Networks and Psychiatry

Time: 11:30am-12:10pm, **October 24th, U.S. Eastern Daylight Time**

Abstract: The human brain governs cognitive processes and behavior. It is the most complex organ in nature, composed of 100 billion neurons within the gray matter. Each neuron functions as a computational unit. These neurons are interconnected either through fibers in the white matter, through information coupling, or by neurotransmitter modulation. This intricate organization forms vast multi-modal, multi-state, multi-level, multi-scale neural networks, or "super networks," that perform distributed computations and dynamically evolve along temporal and spatial dimensions. These networks support human cognitive processes. State-of-the-art study of such networks may uncover how the brain works, providing great theoretical and practical value of profound significance.

This study is multidisciplinary and multilevel, operating in a positive feedback manner. To accurately study the human brain, we need to master and continually improve the most advanced multidisciplinary theories and algorithms, such as neuroscience, brain imaging, computational algorithms, and machine learning. This includes the development of revolutionary new theories and algorithms. Conversely, we can apply what we have learned from studying the human brain to improve human-made networks such as deep learning networks, making these networks or AI-based techniques more self-developed and

intelligent. This talk will introduce the background of these topics, the state-of-the-art brain imaging techniques, including multimodal magnetic resonance imaging (MRI) and deep learning, and their applications in revealing neural circuits that underlie human cognitive processes and mental disorders.

The goal of psychiatry research is to gain a better understanding of the common and distinct neural mechanisms underlying psychiatric disorders, such as depression and schizophrenia. This knowledge could enable the delivery of more effective, person-tailored treatments. To this end, it appears that the analysis of experimental samples using conventional statistical approaches has largely failed to capture the heterogeneity underlying psychiatric phenotypes. Cutting-edge algorithms and approaches from machine learning, particularly deep learning, provide new tools to address these issues given their outstanding predictive performance in other disciplines. The strength of deep learning algorithms lies in their ability to implement very complicated, and theoretically arbitrary, predictor-response mappings efficiently. We have applied state-of-the-art deep learning algorithms to brain imaging datasets acquired from participants with and without various types of psychiatric disorders, in order to classify these disorders and predict risk of developing these disorders. We will present some of these works in this talk.

Afternoon Plenery-1:

Host by Lin Zhang (MIT) & Longfei Zhou (Duke U.)

Shuguang Zhang

Professor, Media Lab, Massachusetts Institute of Technology, USA

Title: **Curiosity-driven Research: The QTY Code for Protein Design**

Time: 12:30pm-1:10pm，**October 24th, U.S. Eastern Daylight Time**

Abstract: There are two classes of proteins: water-soluble proteins, which include hemoglobin and insulin, and water-insoluble proteins, that encompass integral membrane proteins. G protein-coupled receptors (GPCRs), such as chemokine receptors, are a family of integral membrane proteins. These proteins are embedded in the lipid bilayer of cell membranes, and they transduce extracellular stimuli into cellular responses.

GPCRs are vital for a wide array of biological functions, including vision, smell, taste, and aging. They are also implicated in numerous diseases such as cancer metastasis, autoimmune diseases, asthma, addiction, immune system disorders, neurological disorders, autism, and more. GPCRs constitute some of the most important targets of medicinal drugs. Therefore, tools that facilitate GPCR studies, or technologies and therapies based on GPCRs, are crucial to develop.

We have devised a protein design tool called the QTY code. This code enables the replacement of hydrophobic amino acids, such as Leu, Ile, Val, and Phe, with Gln (Q), Thr

(T), and Tyr (Y). This substitution creates functional, water-soluble equivalents of membrane proteins.

In this talk, I will discuss not only the scientific basis of the QTY code but also its application in the design of detergent-free chemokine receptors that retain ligand-binding activities. This includes water-soluble chimeric chemokine receptors with tunable ligand affinity and water-soluble Fc-fusion cytokine receptors. The QTY code can be applied to various α-helical membrane proteins, potentially aiding in the development of other applications, including clinical therapies. Gaining a deeper understanding of protein design will likely stimulate the establishment of knowledge-based companies and contribute to the new economy.

Jose Campos

Office of Community Investment and Infrastructure, San Francisco, CA

Title: The importance of "placemaking" for successful urban development

Time: 1:10pm-1:50pm, **October 24th, U.S. Eastern Daylight Time**

Abstract: Placemaking is a significant concept, the understanding of which is crucial as it carries profound implications for urban design and land use principles. This process involves the utilization of fiscal and financial tools for its implementation. These tools often encompass the development of civic amenities and the creation of complete communities. To facilitate successful placemaking, the adoption of specific regulatory approaches is essential.

Audrey Amsellem

Music Humanities, Columbia University

Title: **Earth Observation and Digital Transformation: an outlook from Infrastructure Engineering**

Time: 1:50pm-2:30pm, **October 24th, U.S. Eastern Daylight Time**

Abstract: Audrey Amsellem is a Core Lecturer in Music Humanities at Columbia University. She received her Ph.D. in Ethnomusicology from Columbia University in 2022. Amsellem's research interests lie at the intersection of music, law, and science and technology studies. Her dissertation, titled "Sound and Surveillance: The Making of the Neoliberal Ear," was advised by Professor Fox and investigates non-creative recording practices in the neoliberal age. Amsellem's work has been published in interdisciplinary journals such as Surveillance & Society and Law Text Culture. She has presented her work at numerous conferences, including the Society for Ethnomusicology. Amsellem is the recipient of the Doctoral Dissertation Research Improvement in Science and Technology Studies National Science Foundation Grant and the 2021 SSN Early Career Researcher Award. She is a current member of the Open Voice Network at the Linux Foundation. In terms of teaching, Amsellem instructs the core class "Masterpieces of Western Music," and has also taught a Teaching Scholar course she designed, titled "Music, Sound and the Law." She is the co-founder of the Organization of Music Graduate Students, which she led for two years, and is also a member of the Music Humanities Working Group.

Agnis Stibe

Artificial Intelligence Program Director and Professor of Transformation, EM Normandie Business School

Adjunct Professor of Human-City Interaction, the University of Oulu

Title: Hyper-Performing Cities with Human Artificial Intelligence

Time: 14:30-15:10, **October 24th, U.S. Eastern Daylight Time**

Abstract: While artificial intelligence has the potential to facilitate fundamental transformations, it's crucial to remember that people remain at the core of achieving hyper-performing cities. Why? Because human factors, such as decision-making and behavioral choices, persistently influence and determine the level of success in most societies. As such, artificial intelligence must be equipped to manage the intricacies of human psychology and neurology.

Currently, artificial intelligence assists cities in managing the rising tide of data that's growing exponentially. This capability enables rapid recognition of behavioral patterns, helping to identify and pinpoint groups of people exhibiting distinct behavioral deviations. Such insights illuminate the possibility of a shared attitudinal barrier behind their underperformance.

This keynote will provide an engaging deep dive into the science and practice of designing transformative solutions. These solutions efficiently blend technological advancements with human nature. They are enriched with insightful videos that reveal our true selves and

present a convincing vision of a prosperous future supported by harmonious human-artificial intelligence integration.

Afternoon Plenery-2:

Host by Program Chair Longfei Zhou

Lin Zhang

Scientist, Media Lab, Massachusetts Institute of Technology, USA

Title: Conformable piezoelectric devices for biomedical application

Time: 3:20pm-4:00pm, **October 24th, U.S. Eastern Daylight Time**

Abstract: Piezoelectric-based electronics, including sensors, harvesters, and transducers, have been widely used for healthcare monitoring, energy harvesting, bio-signal decoding, and various biomedical applications. However, current technologies are often unsuitable for continuous, portable monitoring or for use on highly curvilinear regions of structural inspection and the human body, which exhibit poor sensing and monitoring performances. In recent years, conformable electronics, which can be seamlessly attached to human tissue, have been intensively studied. This talk will discuss conformable piezoelectric electronics for recording signals on the skin, in the shallow tissue under the epidermis, and imaging from deep organs. The design strategies, novel microfabrication methods, and advanced data acquisition technologies of two-dimensional conformable piezoelectric devices will be summarized and discussed. Several biomedical applications, such as decoding facial strains for predicting facial kinematics, continuous monitoring of the central blood pressure waveform, and continuous monitoring of bladder volume, will be illustrated to demonstrate how conformable piezoelectric electronics function in practical applications.

Zili Li

Tenured Lecturer, Geotechnics from University College Cork (UCC), Ireland
Visiting
Assistant Professor, Massachusetts Institute of Technology (MIT), USA

Title: Universal Village: Underground Infrastructure Society

Time: 4:00pm-4:40pm, **October 24th, U.S. Eastern Daylight Time**

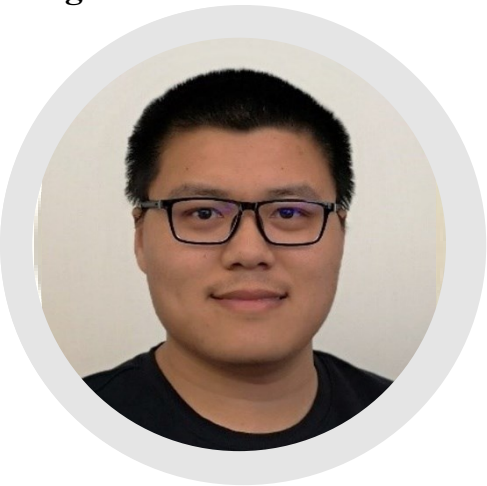
Abstract: Advances in global urbanization and the development of universal societies demand not only surface buildings but also substantial underground infrastructures. In many modern cities worldwide, underground spaces have already been extensively developed, with varying depth levels consisting of pipelines near the ground surface, vehicle tunnels within tens of metres, deep caverns for energy storage, and many other underground sites.

Within this underground geo-system, each geo-structure does not function independently; instead, they act as members of a 'society', interacting with other geo-structures embedded within an ambient hydrogeological environment. This complex interaction involves hydrogeological, thermomechanical elements, and spans the design, construction, operation, maintenance, and de/recommission stages of the entire lifecycle.

Such complexity in a long-distance underground infrastructure, such as a city-scale tunnel network, necessitates novel monitoring tools capable of handling big data and the

corresponding data analytics. This presentation will introduce a toolbox of innovative monitoring technologies and their applications to large-scale underground infrastructure. The extensive field monitoring data collected clearly indicates the deterioration and performance of underground structures, subject not only to natural hazards such as climate change and concrete degradation, but also to the influence of adjacent geo-structure 'members' in the universal village of underground societies.

Longfei Zhou



Postdoctoral Associate, Carl E. Ravin Advanced Imaging Laboratories, Duke University

Title: **Impact of Public Transportation Routes on the Spread of COVID-19**

Time: 4:40pm-5:20pm, **October 24th, U.S. Eastern Daylight Time**

Abstract: The emphasis on the spread of infectious diseases has been underscored by COVID-19. Public transportation, being a prevalent means of travel, becomes an important subject for studying the transmission of infectious diseases. However, there have been no studies comparing the transmission of these diseases across different public transportation routes. This paper examines the propagation of infectious diseases based on the quantity of public vehicles and their direction of travel within a given system.

A simulation model is constructed to analyze different scenarios, thereby addressing the above-stated problem efficiently. We subsequently propose a function known as the Weighted Integral of Passenger Close Contacts (WIPCC) to assess the spread of infectious diseases. The WIPCC function takes into account the number of cumulative passengers on every bus on the route at any given time.

Our analysis reveals that having a greater number of buses on a loop can significantly decrease transmission. We deduce that the transmission of infectious diseases is directly related to the efficiency of any public transportation system. If buses are not all traveling in the same direction, the WIPCC function will yield a higher value than that of a loop where all buses travel in the same direction.

Through some cost-effective changes, the spread of infectious diseases can be mitigated. We anticipate alterations in public transportation routes as required to minimize disease transmission. We believe that these findings will prove beneficial to city planners overseeing public transportation systems.

Jagannath Aryal

Department of Infrastructure Engineering, University of Melbourne

Title: **Earth Observation and Digital Transformation: an outlook from Infrastructure Engineering**

Time: 5:20pm-6:00pm, **October 24th, U.S. Eastern Daylight Time**

Abstract: This talk presents the development of earth observation data and platforms, their practices, and their wider applications, with a focus on digital infrastructure engineering. In the digital infrastructure engineering space, we cover how digitalization has revolutionized the way we live and practice in designing our cities. The case study examples from city design encompass object recognition, interpretation, and the accurate and precise capture of these elements to integrate them into digital models. The digital models include urban building footprints and their extraction, urban trees and their changes over time, urban transportation and its simulation, as well as the contributions of the Internet of Things (IoT), including industrial IoT. These digital capabilities and their importance will be discussed. The talk will also emphasize the importance of digital protection and knowledge transformation capture, highlighting the future of cities and our lives. Lastly, the talk will conclude with an outlook on digitalization from infrastructure engineering perspectives.

TECHNICAL PROGRAM

Session [TS1-A] [TS1-B]: Vision for Universal Village and UV Indices & Development Status of Universal Village

Time: 8:00am-12:00pm, October 23th, U.S. Eastern Daylight Time
Meeting Room (Microsoft Teams): [TS1-A,1-B] IEEE UV2022 Session
Chair(s): Yifan Yu (Tongji University)
Assistant(s): Haihan Wang

Meet Our Speakers

Session Overview: This joint session (TS1-A&TS1-B) will explore the past, present, and prospects of the development of the Universal Village (UV), a concept proposed by the MIT UV program that highlights the employment of intelligent technologies to improve the quality of life across the globe. The session will provide a platform to facilitate interdisciplinary dialogues and collaboration on systems thinking for a better future. The topics include emerging concept models in urban development, quantifiable measures of the built environment, urban analytics based on geospatial big data, and the vision for digital urban transformation.

[TS1-A&B-1] Smart Sharing City for Sustainable Society: The Strategies for Integrating Compact and Smart city

Speaker(s): Akinori Morimoto
Time: 8:10am-8:45am, October 23th, U.S. Eastern Daylight Time

Abstract: Compact, people-friendly cities that prioritize the environment have been proposed as an urban model to achieve a sustainable society. However, the emergence of the smart city concept, utilizing Information and Communication Technology (ICT), may have the opposite effect by promoting sprawling suburban development instead of compact cities. For instance, suburban residents can efficiently utilize resources and access various services at a low cost through ICT.

Therefore, it is crucial to consider these different concepts in terms of city planning. This speech will address a new concept known as the "Smart Sharing City," which aims to resolve these issues by implementing a management system in cities. I will discuss integration methods between land use and transportation planning, providing case studies from Japan.

[TS1-A&B-2] Geometric Intelligence - Estimating Wider Economic Impacts of Transport Infrastructure Investment

Speaker(s): Alain Chiaradia
Time: 8:45am -9:20am, October 23th, U.S. Eastern Daylight Time

Abstract: Recent work on transport and the economy has focused on the 'Wider Economic Impacts' (WEIs) of infrastructure investment, which refers to the impacts, other than time savings, that benefit those using the transport network. Estimating the wider economic impacts (WEIs) of transport infrastructure investment involves examining the differential effects of transportation infrastructure investment by mode, such as urban rail and road, within the framework of WEIs. However, there is limited research on the impacts of other modes, such as walking.

This study presents estimates of WEIs related to productivity from the full rail, road, and walking transport networks in Hong Kong in 2016. We employ complex network science geometric indicators as spatial cognition weighted accessibility, which combines the full urban rail network, road network, and pedestrian network, to capture the WEIs. We adopt an instrumental variable approach to identify the causal effect of transport network centralities on productivity, measured by gross value added.

The analysis, including the pedestrian network specification, reveals that both pedestrian and rail networks have a statistically significant positive impact on productivity, while roads play a less significant but still meaningful role.

[TS1-A&B-3] Behavior and Computation: Future of Urban Mobility

Speaker(s): Jinhua Zhao
Time: 9:20am -9:55am, October 23th, U.S. Eastern Daylight Time

Abstract: Prof. Zhao will present the behavioral foundation for urban transportation and develop the "behavior-system-policy" framework. This framework will examine the emotional, social, and perceptual aspects of travel behavior, develop mobility systems with a behavioral perspective, and assess transportation policies from the perspectives of equity, acceptance, and compliance. Prof. Zhao integrates behavioral and computational thinking to shape travel behavior, design multimodal systems, and improve transportation policy. Examples will include a behavioral nudging system, mobility sensing and prediction systems, and AI-enabled integrated autonomous vehicle (AV) and public transit (PT) systems.

[TS1-A&B-4] Big Data Driven Quantitative Urban Analysis: Methods and Practices

Speaker(s): Dejing Dou
Time: 10:00am -10:35am, October 23th, U.S. Eastern Daylight Time

Abstract: Cities are complex emergent systems. The critical issue in promoting the development of sustainable cities is how to use big data to measure, analyze, and monitor urban livelihoods. In this talk, we will present our research on utilizing various multi-modal big data to conduct quantitative analysis of a city. Specifically, we will provide several case studies illustrating how environmental conditions can affect urban livelihoods, such as climate change and air pollution. Additionally, we will introduce practical applications in quantitative urban analysis, including the creation of city indexes from different perspectives of urban residents' happiness and the quantitative analysis of the development progress of Xiong'an, which is intended to represent China's vision of future cities.

[TS1-A&B-5] Children in Urban Settings – Challenges and Way Forward

Speaker(s): Thomas George
Time: 10:35am -11:10am, October 23th, U.S. Eastern Daylight Time

Abstract: The presentation will focus on children living in urban areas: the magnitude of the issue, the challenges they face, and the priority actions needed to address them. Additionally, the presentation will focus on children living in slums and informal settlements.

SESSION 1-C: Digital Analytics, Digital Transformations and UV index Evaluation

Time: 8:00am-12:00pm, October 23th, Eastern Daylight Time
Meeting Room (Microsoft Teams): [TS1-C] IEEE UV2022 Session
Chair(s): Guoping Zhang (Nankai & Harvard Univ. and Xiaoman Duan (UVS)
Assistant(s): Haihan Wang (UVS)

Meet Our Speakers

Session Overview: The theme of the forum covered digital transformation and digital acceleration analysis, as well as Universal Village index Evaluation and International Universal Village Proposal (IUVP). This year, the chairman and speakers will jointly discuss research papers and reports on psychological analysis of different cities' epidemic policies and investment decision-making choices, smart city assessment, big data applications of leading technology companies, and practical experiences and lessons from digital transformation of retail companies.

[TS1-C-1] Analysis of Psychological Perception of Epidemic Policy Duration and Intertemporal Choice of Investment Decision

Speaker(s): Guoping Zhang
Time: 8:00am-8:35am, October 23th, U.S. Eastern Daylight Time

[TS1-C-2] Digital Transformations in Retails: Issues, Processes and Lessons

Speaker(s): Daqing Zhao
Time: 8:35am-9:10am, October 23th, U.S. Eastern Daylight Time

[TS1-C-3] Assessment of Smart City: Related Methods and Technologies

Speaker(s): Yajun Fang
Time: 9:10am-9:45am, October 23th, U.S. Eastern Daylight Time

[TS1-C-4] Psychological Cognition of Epidemic Closure Period and Differences in Investment Decision-Making Behavior

Speaker(s): Zeyao Wang
Time: 9:45am-10:20am, October 23th, U.S. Eastern Daylight Time

[TS1-C-5] Survey Science, Application of Big Data and Solutions for Technology Company
Speaker(s): Li Tian
Time: 10:20am-10:55am, October 23th, U.S. Eastern Daylight Time

[TS1-C-6 Study on the Quality Evaluation and Countermeasures of Industrial Development in Gansu Province

Author(s): Xiaojuan Qin and Yaming Wang
Time: 10:55am-11:30am, October 23th, U.S. Eastern Daylight Time

Abstract: Industrial development is the core content of economic growth. As an underdeveloped province, promoting industrial development is the top priority of national economic construction in Gansu Province. As the heavy industry base of the whole country, Gansu Province has formed a relatively perfect heavy industry system. Gansu Province is located in the inland. Under the background of high-quality development, the demands of industrial system reconstruction and economic development mode transformation are increasing day by day, such as poor location conditions, strong dependence on heavy industry resources, difficult extensive transformation of industrial development, weak innovation ability, weak economic growth and severe ecological protection situation. In this paper, the entropy method is used to construct the quantitative evaluation index system of the quality of industrial development. And then putting forward the characteristics and problems of industrial development in Gansu Province. Overall, the industrial industry in Gansu Province presents the problems of large regional differences and insufficient innovation ability, and has made remarkable progress in green development and open development, and the overall quality of industrial development has been steadily improved. Finally, this paper puts forward some countermeasures and suggestions from the aspects of implementing the national strategy, promoting industrial transformation, developing rich people's industries, and promoting multipoint industrial layout.

Session [TS2-B]: Intelligent Modeling, Simulation, and System Analysis

Time: 8:00am-12:00pm, October 25th, U.S. Eastern Daylight Time
Meeting Room (Microsoft Teams): [TS2-A]IEEE UV2022 Session
Chair(s): Lin Zhang (Beihang Univ.) and Sicheng Liu (USST)
Assistant(s): Charles Zhang (UVS)

Meet Our Speakers

Session Overview: After over sixty years of development, modeling and simulation (M&S) technology has emerged as a significant method for humans to understand and alter the objective world, complementing theory and experiment. The application of M&S spans almost all facets of economy, society, and military, with special emphasis on critical areas related to national strength and security, such as aerospace, military, healthcare, transportation, information technology, biology, materials, energy, manufacturing, agriculture, and education, among others.

A common attribute of these fields is that the subjects of research are characterized by extremely high complexity, uncertainty, and nonlinearity. Each system possesses both quantitative and qualitative, continuous and discrete characteristics simultaneously. These attributes render it challenging to comprehensively and profoundly study the system using traditional theoretical research methods. In complex systems or specific fields, M&S technology can fulfill its unique role and, on occasion, become the sole method available. These features necessitate, or even render it the only choice, to employ M&S to examine these complex systems.

M&S combined with AI technology presents unique advantages in addressing practical problems. In the manufacturing domain, the use of M&S technology dates back to the 1950s. With decades of evolution, the application of M&S has expanded to nearly every stage of the product life cycle, including design, production, testing, maintenance, procurement, supply, sales, and after-sales services.

Currently, M&S holds a crucial role in the smart manufacturing field. By integrating with information technology, manufacturing systems have progressively evolved to become digitized, networked, collaborative, personalized, service-oriented, and intelligent. Alongside the advancement of cloud technology, its application in manufacturing is gradually becoming a trend. Cloud manufacturing is a vital component of the new generation of smart manufacturing, and the demand for M&S technology in the manufacturing industry is continually growing.

This session will introduce the key technologies of M&S and smart manufacturing, discuss their current status and pressing issues, and explore future development trends.

[TS2-B-1] Service Composition and Scheduling in Cloud Manufacturing with Deep Reinforcement Learning

Speakers: Yongkui Liu
Time: 8:10am-8:45am, October 25th, U.S. Eastern Daylight Time

Abstract: Cloud manufacturing is a service-oriented manufacturing model that offers manufacturing resources as cloud services. In cloud manufacturing, large-scale distributed manufacturing resources are encapsulated into cloud services and are provided to consumers on an on-demand basis. Service composition and scheduling are critical aspects that need careful consideration to achieve the aforementioned aim. Over the past few years,

Deep Reinforcement Learning (DRL) has gained popularity and has been successfully applied in various fields such as gaming, robotics, and manufacturing. DRL holds tremendous potential for solving service composition and scheduling issues in cloud manufacturing. In this talk, the most recent studies on service composition and scheduling in cloud manufacturing will be reviewed, especially those based on DRL. The relevant issues pertaining to DRL-based service composition and scheduling in cloud manufacturing will be discussed in detail, and the latest research results will be presented. Finally, prospects for future study will be introduced.

[TS2-B-2] Dynamic Event-Driven Service Scheduling in Cloud Manufacturing

Speaker(s): *Sicheng Liu*
Time: 8:45-9:20, October 25th, U.S. Eastern Daylight Time

Abstract: Due to individualized consumer needs, cloud manufacturing (CMfg) has been extensively employed in optimizing available manufacturing resource allocation to improve resource utilization and minimize energy consumption. However, efficiently scheduling tasks and subtasks within dynamic CMfg environments for these resources presents a challenge. This report introduces a game theory-based approach for task scheduling and model selection, effectively exploiting distributed manufacturing resources in CMfg, with the Nash equilibrium (NE) in this game theory implemented by a double ant colony optimization (DACO) algorithm. This model allows services provided by different providers to manage a batch of tasks in real-time. Additionally, to meet the varying needs of different service providers and demanders, the proposed approach considers multiple task attributes simultaneously, such as energy consumption. Simulation results demonstrate that the proposed method is not only effective in achieving the relevant optimization objective but also can perform exceptionally well in real-time CMfg environments.

[TS2-B-3] Modeling, Simulation and Optimization of the Flocking Behaviors of Large-Scale Multi-Agent Systems

Speaker(s): Yongnan Jia
Time: 9:20-9:55, October 25th, U.S. Eastern Daylight Time

Abstract: Have you ever seen flocks of birds maneuvering swiftly and precisely as a single entity at sunset? This memorable synchronization phenomenon is bound to stop you in your tracks. Nature employs its magical creativity to create an illusion akin to an enormous and dynamic sand painting, but with thousands of birds instead. Modeling has proven useful in revealing the mechanisms underlying these collective behaviors, not just in flocks of birds, but also in schools of fish, swarms of insects, and herds of mammals.
In this talk, we present a general framework for modeling a broad range of flocking scenarios under free boundary conditions. Several variants, including examples of the widely observed behavior of hierarchically interacting units, have been considered. The

models we've simulated correspond to classes of various realistic situations. For instance, we focused on constructing models based on leader-follower relationships. Indeed, our findings support the concept that hierarchical organization can be very efficient in significant practical cases, especially when the leader-follower interactions, which correspond to an underlying directed network of interactions, occur at several levels. Here, efficiency refers to the capacity to remain stable, both coherent and cohesive, even when collective motion is disrupted by random perturbations.
Our presented framework enables the study of several further complex interactions among flocking agents. Furthermore, most existing flocking models endow a single agent with a global visual field. However, in nature, an individual in a group usually has a restricted visual field, such as the 143◦ visual field of starlings. Thus, the necessity of a global visual field for forming a flock has been investigated further. Simulation results have proven that the best viewing angle for each agent in a flock increases with the population size, and this optimal viewing angle stabilizes around 155◦ when the population size exceeds 1000. These simulation data also support the conclusion that a flock of birds achieves better coordination under an optimal restricted visual field, as opposed to a global visual field.

[TS2-B-4] Study and Prospect on FPGA-based Cyber-physical Manufacturing Systems

Speaker(s): Chun Zhao
Time: 9:55-10:30, October 25th, U.S. Eastern Daylight Time

Abstract: The deep integration of the cyber-physical world with technologies such as Digital Twin, Virtual Reality, Augmented Reality, and others, lays a foundation for the digitalization and intelligent control of equipment. The perception and control of equipment also evolve in the direction of multi-material perception and multi-field control. In this context, this presentation will focus on edge computing, FPGA, and Cyber-Physical Systems (CPS), analyzing their characteristics and discussing FPGA-based Cyber-Physical Manufacturing Systems (CPMS). With the support of this system, the real world can be modeled and simulated quickly, accurately, and reliably, facilitating interactions between the virtual and real world. Furthermore, the hardware computing and reconfigurable capabilities of FPGA are employed to enhance the computing ability at each layer of the system, ensuring swift and accurate simulation cooperation of manufacturing resources in the virtual world. Lastly, drawing on foundational research in cloud manufacturing, CPS, FPGA, multi-agent simulation, and other fields, the presentation will address the pursuit of multi-field and cross-disciplinary research challenges in the future, exploring novel approaches for intelligent sensing and control.

[TS2-B-5] Stackelberg Game Based Manufacturing Service Uncertainty Scheduling Toward Intelligent Manufacturing

Author(s): Sicheng Liu, Lingyan Li and Lin Zhang
Time: 10:40-11:00, October 25th, U.S. Eastern Daylight Time

Abstract: With the coming of the third industrial revolution, multiple industries have mass manufacturing needs. In order to save production costs and maximize profit, businesses in these industries hurry to improve the level of manufacturing and carry out intelligent transformation. Thus, intelligent manufacturing has become the top priority in the modern industrial system. In addition, in the intelligent manufacturing aspect, not only cost-saving problems but also unexpected events (e.g. service broken) during the manufacturing process is a crucial challenge. Therefore, it is necessary to investigate the above problem of uncertainty scheduling mechanisms in cloud manufacturing (CMfg) as one of the important representative forms of intelligent manufacturing. This paper proposes a two-layer scheduling model based on the Stackelberg game in CMfg. In this model, a triple-layer iteration algorithm is designed to get the Nash equi- librium in the game theory. Also, to better analyze and solve the uncertainty during the manufacturing process, the main service broken cases are discussed using the real-time scheduling method, and the corresponding solutions of each case are presented. The case study verifies the efficiency and necessity of the proposed scheduling method by setting automobile manufacturing as the research case.

[TS2-B-6] Intersection Evaluation using Turning Movement Count Data and SUMO

Author(s): Mohammad Shokrolah Shirazi, Hung-Fu Chang and Shiqi Zhang
Time: 11:00-11:20, October 25th, U.S. Eastern Daylight Time

Abstract: The turning movement count (TMC) is a salient data source used for design and planning of intersections including sign, and signal installation, timing setup, as well as traffic and capacity analysis. This work presents a typical framework for utilizing the TMC data with simulation of Urban Mobility (SUMO) software to mimic realistic traffic scenarios for intersection evaluation and analysis. Due to safety and mobility concerns regarding school campus zones, three intersections around the San Jose State university are selected and their corresponding turning movement data are ported into SUMO for intersection evaluation during peak hours occurred between 8:00 - 9:00 a.m. The traffic parameters extracted from each intersection simulation with realistic scenario are vehicles waiting time, speed and network flow links which imply the effectiveness of utilizing proposed approach for decision making and targeting intersections for signal optimization.

[TS2-B-7] Provide an intelligent method to identify customer credit in the field of electronic banking using LRFM approach and dual clustering

Author(s): Vahid Ghaffari
Time: 11:20-11:40, October 25th, U.S. Eastern Daylight Time

Abstract: The LRFM model is characterized by novelty, repeatability, monetary value, and customer engagement time. In this research, customers are initially divided into different categories using clustering methods. Given that a customer may fall into multiple categories, this study employs the c-means classifier. Subsequently, new customers are

categorized using classification methods such as decision trees and neural networks. The results indicate that the proposed method has an acceptable detection rate in both the clustering and classification phases. The detection rate of the proposed model is 76%, which is considerably better compared to other methods, boasting at least a 5% higher detection rate.

[TS2-B-8] Machine Learning-based Start-up Company Lifespan Prediction: the Chinese Market as an Example

Author(s): Lei Wang, Tian-Ze Zhang, Yingting Chen, Yongyang Huang, Xitong Yin, Xiao Fan Liu, and Daning Hu
Time: 11:40-12:00, October 25th, U.S. Eastern Daylight Time

Abstract: Start-ups have emerged as key drivers of economic growth, fostering innovation, job creation, and knowledge dissemination across various industries. Accurately forecasting start-up life spans is critical for investors, policymakers, and entrepreneurs to make informed decisions and optimize resource allocation. However, existing predictive models, such as linear regression and survival analysis, face challenges in capturing the complex interactions and dynamic nature of factors influencing start-up success. This paper proposes applying the XGBoost algorithm, an advanced machine learning technique, to enhance the accuracy and reliability of start-up life span predictions.
XGBoost offers several advantages over traditional methods, including adaptability to various data types, robustness to outliers, and efficient computational performance. By incorporating a wide range of features, such as financial, organizational, and death reasons, the algorithm can effectively capture the complex relationships among these factors without explicit feature engineering. Moreover, applying SHAP values provides an additional layer of interpretability, aiding stakeholders in better understanding the factors driving start-up life span. Utilizing the IT Orange dataset, we investigate the determinants of startup life spans, offering valuable insights for stakeholders in the entrepreneurial ecosystem.

Session [TS3-A][TS3-B][TS3-C][TS3-D]: Mobility, Planning, Management, and Infrastructure Innovations to achieve safety, efficiency, and connectivity

Time: 8:00am-10:40am, October 25th, U.S. Eastern Daylight Time
Meeting Room (Microsoft Teams): [TS3-A,3-B,3-C,3-D]IEEE UV2022 Session
Chair(s): Chan Tong Lam (Macao Polytechnic University)
Assistant(s): Ziliang Lan (UVS)

Meet Our Speakers

Session Overview: A secure Information and Communication Technology (ICT) infrastructure, coupled with intelligent network connectivity, forms the cornerstone of a sustainable smart city. This includes intelligent transportation systems, autonomous vehicles, and smart emergency response systems. This session aims to serve as a platform for the exchange of novel ideas in areas such as mobility and connectivity, planning and management, as well as infrastructure innovations. The goal is to design safe, efficient, and secure connected systems that contribute to the construction of a sustainable smart city.

[TS3-A] Intelligent Transportation, Urban Planning, and Smart City Infrastructure

[TS3-A-1] A Novel Adaptive Signal Timing Control Approach for Signalized Intersections

Author(s): Fan He, Longfei Zhou, Siyu Wu, Haoliang Liu, Zehang Li, Ke Xu, Yuliang Gai, Fei Teng, Pengfe Liu
Time: 8:00am-8:20am, October 25th, U.S. Eastern Daylight Time

Abstract: Vehicular traffic congestion is a severe global problem, leading to a range of issues such as increased travel times, increased fuel consumption, and increased pollutant emissions. The signal timing of traffic lights is one of the major factors that we can change to reduce traffic congestion at signalized intersections. Most traffic lights used in real life are hard-coded which means the fixed timing is applied for traffic control. In these hard-coded signalized intersection models, we do not have much to do to deal with real-time congestion, especially for large traffic volumes. In this study, we propose an adaptive signal timing control approach to reduce traffic congestion according to real-time traffic flow situations. In this novel approach, the signal timing can be changed over time based on real-time information about traffic flows. The Eclipse SUMO is used to simulate traffic conditions at real-world intersections to optimize road traffic light control and reduce real-time traffic delays for signalized intersections. Simulation results show that the proposed method obtains better performance than typical traffic light timing control strategies.

[TS3-A-2] An Easy-to-install Rear-Mountable Intelligent Street Light with Companion App for Mitigations of Urban Traffic Problems

Author(s): Jiaxuan Li, Muxuanzi He, Patrick Cheong-Iao Pang and Chan-Tong Lam
Time: 8:20am-8:40am, October 25th, U.S. Eastern Daylight Time

Abstract: As one of the essential parts of the smart city concept, the realization of intelligent transportation has become a trendy topic, and one of the fundamental ways to realize intelligent transportation is to introduce intelligent street lights. This paper mainly presents a design of a rear-mountable intelligent street light which can be installed on light posts easily. On one hand, based on the original street lights, it can fulfill all the functions

of a street light after installation without the costs of replacing existing street lights. On the other hand, our approach can eliminate a lot of disassembly and installation procedures, which typically involve many engineering costs. On top of the functions provided by traditional street lights, we propose to include a AI-supported camera for traffic and parking monitoring, a full-coverage Wi-Fi access point, a laser sensor for intelligent monitoring of pedestrians crossing the road, and an electric car charging point. The co-development of the companion app can operate selected functions, for example, parking reservation and electric car charging, of the intelligent street lights. This proposal has been tested in a controlled lab environment which shows the feasibility of hardware selection, welding approaches, and the companion app design. Our future work aims to test our proposal against real-world environments and actual road conditions.

[TS3-A-3] Twitter-informed Prediction for Urban Traffic Flow using Machine Learning Methods

Author(s): Maryam Shoaeinaeini, Oktay Ozturk and Deepak Gupta
Time: 8:40am-9:00am, October 25th, U.S. Eastern Daylight Time

Abstract: The current traffic system requires short-term traffic forecasting to manage and control the traffic flow. Irregular traffic events, such as road closures, accidents, and severe weather, reduce the accuracy of data-driven predictive models. Social media platforms, particularly Twitter can significantly help to realize a real-traffic flow system by representing traffic events. Combining traffic data with information about road disruptions posted on Twitter can improve urban traffic parameter prediction. This paper proposes an urban traffic flow prediction by combining massive traffic, calendar, and weather data with related tweet posts. As a case study, the model is implemented on an urban traffic dataset extracted from the California Performance Measurement System (PeMS) in the USA. To provide a reliable and accurate prediction, the proposed model is evaluated with several machine learning methods. The results from the empirical study show that when Twitter features are combined with traffic, weather, and calendar features, the prediction accuracy is enhanced. As a result, we obtain around 89 percent, 95 percent, 93 percent, 91 percent, 91 percent, and 95 percent R-squared from AdaBoost regression, Random Forest, Gradient Boosting, Artificial Neural Network, Decision Trees, and KNN Regression, respectively.

[TS3-A-4] An Uncertainty Based Predictive Analysis of Smart Water Distribution System Using Bayesian LSTM Approach

Author(s): Mostafa Zaman, Maher Al Islam, Ashraf Tantawy and Sherif Abdelwahed
Time: 9:00am-9:20am, October 25th, U.S. Eastern Daylight Time
Abstract: A well-designed water distribution system is crucial for maintaining high service standards in any modern smart city. Moreover, as the population is sky-rocketing, the demand for energy and water is increasing more rapidly than a decade before. Therefore, ensuring a steady clean water supply with optimized energy and water consumption has become necessary. To accurately monitor water distribution systems, the accuracy of input

data plays a vital role in determining how accurate the system's status estimations are. There must be a way for system operators to know what is going on at any given time to make practical decisions about how reliable the data they are receiving is. The input data uncertainty can induce flow and pressure calculation inaccuracies, which can be fatal while planning for future demands and needs to be quantified. Knowing the degree of uncertainty in predicting the water distribution system's capacity or load can help people better prepare for future capacity or load predictions. Accurate uncertainty calculations are critical to time series forecasting. Probabilistic formulae are widely employed with classical time series models to estimate uncertainty. But incorporating new data and finetuning these models is a challenging task. This research paper presents a Bayesian LSTM network that computes both time series prediction and uncertainty assessment at the same time. In this paper, a real-time data set from VCU's OpenCity test bed is employed to evaluate the efficacy of the suggested strategy.

[TS3-A-5] A Novel Two-Lane Roundabout Model with Central Cross Structure

Author(s): Ke Xu, Longfei Zhou, He Fan, Siyu Wu, Haoliang Liu, Fei Teng, Zehang Li, Yuliang Gai, Pengfe Liu, and Yifan Mo
Time: 9:20am-9:40am, October 25th, U.S. Eastern Daylight Time

Abstract: With the increasing number of family cars, urban traffic congestion has become more and more common, which has a great impact on people's lives. In order to alleviate the traffic pressure caused by traffic congestion, the roundabout came into being. Compared with ordinary intersections, roundabouts are superior in traffic efficiency and traffic control. However, research has found that the number of halts per vehicle at roundabouts has increased relative to ordinary intersections, which means that there is an increased possibility of large-scale congestion and driving conflicts in today's huge traffic flow. This makes it possible to add traffic lights to the roundabout to control traffic flow to alleviate traffic congestion and driving conflicts. This paper aims to improve the traffic model of the ordinary two-lane roundabout and analyze whether different traffic light control methods are conducive to improving the traffic efficiency of the roundabout in the scenario of heavy traffic flow. Four improved models are established and compared with basic two-lane roundabout and signalized intersection. Based on two scenarios with different traffic volume, we analyze these models' performance through multiple evaluation metrics. Results illustrates that roundabout with central cross has the best performance in the two scenarios, and proves that these two traffic light control methods failed to improve the traffic efficiency of roundabout in heavy traffic scenarios.

[TS3-B] Intelligent Vehicles, Mobility Support for Vulnerable Groups

[TS3-B-1] A Multi-Hypothesis Tracker with Enhanced Appearance Model for Generic Crowed Scene

Author(s): Cui Wang, Wei Ke, Zewei Wu and Zhang Xiong
Time: 9:40am-10:00am, October 25th, U.S. Eastern Daylight Time

Abstract: Pedestrian tracking studies have been facilitated by a large amount of surveillance apparatus in the city while also raising public privacy concerns. In this paper, we propose X-Tracking, a privacy-aware pedestrian tracking paradigm designed for vision systems in Smart City. It allows low cost compatibility with existing surveillance architecture. To protect entities' privacy, X-Tracking uses video pre-processing with desensitization so that identity information is unexposed to the tracking algorithm. We implement system-level privacy protection by redesigning the tracking framework that decouples all services based on a single responsibility principle. Then, we elaborate on the roles, behaviors, and protocols used in the new system and illustrate how the paradigm strikes a favorable balance between privacy protection and convenience services. Furthermore, we propose a new tracking task that aims to track humans in masking surveillance video. It is comparable to previous tracking tasks but considering the target with a distorted appearance poses new challenges for visual tracking. Finally, we evaluate the baseline algorithm on the task with a demo dataset.

[TS3-C] Crowd Management, Smart Response Systems for City Emergencies

[TS3-C-1] X-Tracking: Tracking Human in Masking Surveillance Video

Author(s): Zewei Wu, Wei Ke, Cui Wang and Zhang Xiong
Time: 10:00am-10:20am, October 25th, U.S. Eastern Daylight Time

Abstract: Pedestrian tracking studies have been facilitated by a large amount of surveillance apparatus in the city while also raising public privacy concerns. In this paper, we pro-pose X-Tracking, a privacy-aware pedestrian tracking paradigm designed for vision systems in Smart City. It allows low-cost compatibility with existing surveillance architecture. To protect entities' privacy，X-Tracking uses video pre-processing with desensitization so that identity information is unexposed to the tracking algorithm. We implement system-level privacy protection by redesigning the tracking framework that decouples all services based on a single responsibility principle. Then，we elaborate on the roles，behaviors，and protocols used in the new system and illustrate how the paradigm strikes a favorable balance between privacy protection and convenience services. Furthermore, we propose a new tracking task that aims to track humans in masking surveillance video. It is comparable to previous tracking tasks but considering the target with a distorted appearance poses new challenges for visual tracking. Finally，we evaluate the baseline algorithm on the task with a demo dataset.

[TS3-D] Information Flow, Communication, Networks, and Security

[TS3-D-1] Probing Botnets for Circumventing Security Threats

Author(s): Vinay Varma Mudunuri and Divam Jain
Time: 10:20am-10:40am, October 25th, U.S. Eastern Daylight Time

Abstract: Developing protected systems that can repel threats have been the overarching objectives of researchers in the network security space. This research is a deep dive into the inner workings of botnets. Contemporary botnets are highly sophisticated peer-to-peer networks with some central components, and are frequently equipped with fallback mechanisms to ensure their resilience against takedown and infiltration attempts. Botmasters employ a wide range of means in order to achieve infection, download the payload bot program, and disable security systems on the compromised machine. We examine features across all stages of the bot program, as implemented by real botnets such as Zeus and ZeroAccess.

Session [TS4-A][TS4-B]: Energy and Material Innovations to achieve efficiency, safety, and sustainability

Time: 8:00pm-11:00pm, October 22nd, U.S. Eastern Daylight Time
Meeting Room (Microsoft Teams): [TS4-A,4-B]IEEE UV2022 Session
Chair(s): Xinyu Tan (Three Gorges University)
Assistant(s): Sophia Chin and Haotian Shangguan (UVS)

Meet Our Speakers

[TS4-A&B-1] Research on Functional Thin Film with Self-Cleaning and Spontaneous Radiation Cooling Characteristics under Outdoor Background

Speaker(s): Xinyu Tan
Time: 8:00pm-8:25pm, October 22nd, U.S. Eastern Daylight Time

Abstract: Hydrophobic paints that combine superhydrophobic self-cleaning and anti-acid effects can decrease pollution caused by dust. Passive radiative cooling technology provides a sustainable way of cooling by the combination of emitting heat to the cold universe and reflecting solar light with zero consumption of energy and zero emission of green gas.Endowing products used outdoor with superhydrophobicity and radiative cooling (RC) properties can decrease pollution caused by dust and heat accumulation resulting from the absorption of solar light, which is significant for prolonging the life, keeping the appearance clean and achieving zero energy consumption cooling without power consumption. This work will introduce and overview the research efforts in the context of chasing the differents kinds of coating with self-cleaning or radiative cooling or imultaneously achieve such two properties on the same film,contributing to China's early realization of carbon peak and carbon neutrality.

[TS4-A&B-2] Build a Clean City and Better World with Nanoscience and Renewable Energies: Photocatalysis, Rechargeable Battery, Hydrogen Production, CO2 Reduction/Conversion, & Others

Speaker(s): Xiaobo Chen
Time: 8:30pm-8:55pm, October 22nd, U.S. Eastern Daylight Time

Abstract: Dr. Chen will introduce and overview his past research efforts in the context of chasing the clean energy and environment dream with nanoscience and the graduate program at UMKC. That includes nanomaterials developments, photocatalytic hydrogen generation, photocatalytic pollution removal, rechargeable lithium-ion battery, fuel cells, hydrogen storage, photothermal vapor generation, electrical hydrogen production, CO2 reduction and conversion, self-cleaning superhydrophobic coating, novel microwave absorbing materials, radiative cooling, etc.

[TS4-A&B-3] Design of Optical Communication Headset Based on Visible Light Communication Technology

Author(s): Yunyan Zhang and Hui Wang
Time: 9:00pm-9:25pm, October 22nd, U.S. Eastern Daylight Time

Abstract: To overcome the disadvantages of existing infrared earphones and Bluetooth earphones, such as poor stability, low performance and much interference, an optical communication headset is designed based on visible light communication technology. The photoelectric transmission system, which takes the visible light as the carrier to transmit

the audio signal, is composed of the transmitting part and the receiving part. The modulation and demodulation of signal is realized by using a single-chip microcomputer. Experimental results show that the visible light headset system has the advantages of stability, flexibility in operation, high signal strength, and adjustable volume.

[TS4-A&B-4] Energy-saving Control System for Data Room based on High-performance AI

Speaker(s): Wei Lin and Jun Dai
Time: 9:25pm-9:50pm, October 22nd, U.S. Eastern Daylight Time

Abstract: iWin-AICooling is a product designed for energysaving in data centers. It adopts a breakthrough energy-saving method that is based on high computing power AI and precision control of cooling capacity by modeling over 50 outstanding data centers. This method effectively reduces the waste of ineffective cooling and achieves the goal of energy-saving.

Session [TS5-A]: Smart Manufacturing

Time: 8:00am-9:35am, October 25th, U.S. Eastern Daylight Time
Meeting Room (Microsoft Teams): [TS5-A]IEEE UV2022 Session
Chair(s): Yuanjun Laili (Beihang University)
Assistant: Charles Zhang (UVS)

Meet Our Speakers

[TS5-A] Welcome speech
Speaker(s): Yuanjun Laili
Time: 8:00am-8:05am, October 25th, U.S. Eastern Daylight Time
Abstract: Introduction of Session 5A

[TS5-A-1] Smart Manufacturing Considering Sustainability and UN SDGs

Speaker(s): Xi (Vencnet) Wang
Time: 8:05am-8:20am, October 25th, U.S. Eastern Daylight Time

Abstract: Sustainability is a global goal shared by both industry and society. In the context of Industry 4.0, it is possible to achieve sustainability goals through smart manufacturing systems, leveraging advanced Information and Communication Technologies (ICT). In this presentation, we will introduce cloud, function block, and human-robot collaboration technologies from the perspective of smart manufacturing. Simultaneously, we will draw connections between these technologies and the United Nations Sustainable Development Goals (UN SDGs)

[TS5-A-2] Cloud-Edge-Device Collaboration Mechanisms of Deep Learning Models in Cloud Manufacturing for Mass Personalization

Speaker(s): Chen Yang
Time: 8:20am-8:35am, October 25th, U.S. Eastern Daylight Time

Abstract: Product personalization, which has gradually become the core competency of many enterprises, poses challenges to current cloud manufacturing (CMfg) systems. In this talk, we first introduce a cloud-edge-device collaboration framework within CMfg designed to support deep learning models (DLMs) for personalized production. We then present various deployment and update mechanisms for DLMs. These mechanisms can facilitate rapid response and high-performance decision-making by taking into account factors such as data source/location, offline/online learning, data sharing, and the lifecycle of DLMs. Lastly, we showcase relevant key technologies that can serve as references for future technical research directions in this field.

[TS5-A-3] Service-Oriented IoT Gateway for Cloud Manufacturing

Speaker(s): Chao Liu
Time: 8:35am-8:50am, October 25th, U.S. Eastern Daylight Time

Abstract: Cloud manufacturing represents a service-oriented manufacturing paradigm that allows ubiquitous and on-demand access to a variety of customizable manufacturing services in the cloud. Although a vast amount of research in cloud manufacturing has focused on high-level decision-making tasks such as service composition and scheduling,

the connection between field-level manufacturing data and the cloud manufacturing platform has not been well established. The efficient acquisition, communication, storage, querying, and analysis of field-level manufacturing equipment data remains a significant challenge that impedes the development of cloud manufacturing systems. This presentation introduces a service-oriented, plug-and-play IIoT gateway solution for cloud manufacturing systems. Service-oriented data schemas for manufacturing equipment have been developed to capture just enough information about field-level manufacturing equipment, thereby facilitating efficient data storage and querying in a cloud time-series database. The practical implementation of the proposed approach is also demonstrated using a 3D printer and a machine tool. Results suggest that the proposed service-oriented IIoT gateway could accelerate the realization of the envisioned cloud manufacturing paradigm.

[TS5-A-4] Autonomous On-Site Robo-Welder for Construction Applications

Speaker(s): Yongquan Zhang
Time: 8:50am-9:05am, October 25th, U.S. Eastern Daylight Time

Abstract: On-site Robo-Welder has garnered increasing attention in recent years as a solution to labor shortages on construction sites. While robotics are commonplace in manufacturing sites, often performing repetitive tasks in enclosed environments, the demands of construction welding are more nuanced and complex. Welding robots on construction sites must navigate freely, adapting to the varying designs of the building. To address this need, the Robo-Welder, equipped with a collaborative robot that uses laser shape measurement to reconstruct the contours of a groove, has been implemented to manage the multi-layer, multi-pass welding processes on steel columns or H-shaped steel. In this context, this presentation will provide a system solution as well as a technical overview of recent advancements in Robo-Welder technology for construction sites. The remaining challenges in this field will also be highlighted.

[TS5-A-5] Robotic Disassembly and Remanufacturing Automation

Speaker(s): Yongjing Wang
Time: 9:05am-9:20am, October 25th, U.S. Eastern Daylight Time

Abstract:
Disassembly is a pivotal step in both remanufacturing and recycling, both of which are fundamental components of a circular economy. It also plays a crucial role in the repair and maintenance of machines and public infrastructure facilities, such as transport and energy systems. However, the process of robotizing disassembly presents various challenges due to the varying condition of returned products and the necessity for dexterity in robotic manipulations.

Unlike tasks that require no physical contact, such as computer visual inspections, or those involving simple contacts, such as cutting, welding, or pick-and-place operations, disassembly typically involves complex contact issues. This process stands in stark contrast to the assembly of new products, which can be deterministic given the known geometries, dimensions, and states of the components. In contrast, disassembly is more stochastic because it must accommodate used products with unpredictable shapes, sizes, and conditions.

This discussion reviews the research progress in the field of robotic disassembly at the Autonomous Remanufacturing Laboratory at the University of Birmingham, UK, and explores emerging opportunities.

[TS5-A-6] Deep Reinforcement Learning Based Dynamic Scheduling of Random Arrival Tasks in Cloud Manufacturing

Author(s): Leyao Chen, Longfei Zhou, Muer Zhou, Xilong Yu, Yipeng Zhu, Wenbo Song, Zixuan Lu and Jiayin Li
Time: 9:20am-9:35am, October 25th, U.S. Eastern Daylight Time

Abstract: Compared with the stable orders of traditional manufacturing, cloud manufacturing (CMfg) fulfilled with masses of random orders, so the CMfg server needs an algorithm with low time and space complexity to prevent the server from crashing due to excessive instantaneous data. Besides, the random changes of manufacturing resources and service must be considered when establishing a scheduling model for CMfg. To solve this problem, we propose an adaptive Deep Q-Networks (ADQN) method with a resizable network that converts cloud manufacturing scheduling problems with multiple objectives into specific reinforcement learning goal and can adapt to changing environments. Our experimental results show that ADQN is comparable to other real time scheduling methods, the average subtask completion time and the standard deviation of occupation obtained by ADQN keep at a low level.

[TS5-A-7] Sustainable Construction using B-CORE Stainless Steel

Author(s): Jeremy Zimman and Dezhi Yang
Time: 9:35am-10:00am, October 25th, U.S. Eastern Daylight Time

Abstract: Stainless Steel is one of the most sustainable and durable construction materials as measured in its Life-Cycle Assessment (LCA). Sustainability can be measured in three key LCA metrics: Durability, performance, and recyclability. The BROAD Group has conducted research into the use of stainless steel to improve the safety and durability of high-rise buildings. The research has proven the unique properties of austenitic and duplex stainless steels in particular, including the "B-CORE" sandwich structure stainless steel construction material developed by the BROAD Group, make stainless steel excellent for use in all structural load bearing members of buildings.

[TS5-A-8] Research and Development of Intelligent Tests and a Process Design System for Complex and Precision Parts of Electronic Products

Author(s): Ling Chen, Yaman Wang, Yuchen Long, Zengfeng Duan, Yanyan Li
Time: 10:00am-10:15am, October 25th, U.S. Eastern Daylight Time

Abstract: Complex precision parts of electronic products are essential to defense information technology equipment and the manufacturing industry. The workshop testing process for electronic products is crucial to ensuring their quality is qualified. Due to its multi-breed, multi-batch, and complex structure, its experimental process design is challenged by more and more indicators and complex processes. Currently, the process of detecting complex electronic products still adopts manual process document design, which is inefficient and inconsistent, and it is difficult to guarantee accuracy by manual experience. Therefore, a new intelligent test process method is designed to complete the process design. The method first automatically extracts test indicators and related parameters from the imported unstructured technical files or sop files, then automatically matches the test indicators with the test table, then automatically fills the test parameters under each index, then clusters and outputs XML test procedures for each indicator. Moreover, the key technology of each process is studied, the intelligent test process system for complex electronic products is developed, and the application of one model of microwave component products in a military industry enterprise is used as an example. The test program generated by the system can be directly used for subsequent workshop machine execution.

Session [TS5-B]: Smart Agriculture

Time: 8:00am-12:15pm, October 25th, U.S. Eastern Daylight Time
Meeting Room (Microsoft Teams): [TS5-B]IEEE UV2022 Session
Chair(s): Zhang Yu (National Agriculture and Food Research Organization)
Assistant: Allen Wang and Zhenyao Liu (UVS)

Meet Our Speakers

[TS5-B-1] What place is the Smart Agriculture Approach About to Give to the Current Knowledge of Farmers, Rooted in Tradition and Questioned by Exploratory Practices?

Speaker(s): Francis ROUSSEAUX
Time: 8:00am-8:30am, October 25th, U.S. Eastern Daylight Time

Abstract: For generations, farmers have collectively produced and maintained traditional knowledge. However, since the second half of the 20th century, rapid industrialization has disrupted these practices. This upheaval has led to the emergence of a new breed of farmers whose professions have drastically diverged from those of their forefathers, often severing the ties with old solidarity.

As digital technologies such as "Smart Agriculture" emerge, it is important to question which ecosystems they can effectively integrate into. This is especially pertinent at a time when the intensive practices of Western farmers are suspected of contributing to the degradation of soil, air, and water quality, biodiversity, and sobriety, thereby exacerbating global warming.

[TS5-B-2] Research and Application on Solar Insecticidal Lamps IoT

Speaker(s): Lei Shu
Time: 8:30am-9:00am, October 25th, U.S. Eastern Daylight Time

Abstract: Solar Insecticidal Lamps (SIL) can effectively mitigate environmental pollution and food safety issues caused by pesticide use by releasing high-voltage pulse currents to exterminate phototropic pests. These pests are drawn to the lure lamp and are killed upon contact with the metal mesh. This report presents the benefits of incorporating a wireless sensor network to boost the application of SIL in managing migratory phototropic pests in agriculture, proposing an innovative agricultural Internet of Things (IoT) paradigm: the Solar Insecticidal Lamps IoT (SIL-IoT). Subsequently, it discusses pivotal research subjects such as node deployment, energy management, pest outbreak area boundary positioning, and fault diagnosis within the SIL-IoT framework. Finally, the report summarizes and projects the application of SIL-IoT in agricultural production.

[TS5-B-3] AI-enhanced Smart Farming

Speaker(s): Yiannis Ampatzidis
Time: 9:00am-9:30am, October 25th, U.S. Eastern Daylight Time

Abstract: General agricultural management practices include nutrient management, pest and disease control, irrigation, and drainage. These practices necessitate regular field monitoring to identify problems and assess crop responses to management tactics. This is often paired with specialized laboratory analyses to evaluate crop physiological responses, which can be costly and time-consuming. Moreover, the harvesting of specialty crops is

labor-intensive, and widespread labor shortages present a significant challenge in terms of both the availability and cost of farm labor. This presentation will introduce novel artificial intelligence (AI)-enhanced technologies designed for specialty crops. Examples include robotic harvesters for fruit tree crops and vegetables, smart sprayers for precise weed management, and UAV- and AI-based tools aimed at improving production management, among others

[TS5-B-4] Disease Monitoring in Groundnut Crop Using Thermal and Multispectral Unmanned Aerial Vehicle

Speaker(s): Naveed Tahir
Time: 9:30am-10:00am, October 25th, U.S. Eastern Daylight Time

[TS5-B-5] Climate Smart Agriculture in China: From Concepts to Practices

Speaker(s): Xiaogang Yin
Time: 10:00am-10:30am, October 25th, U.S. Eastern Daylight Time

Abstract: The main contents include main challenges in current China's agricultural development, practices of climate smart agriculture in China-GEF CSSCP project, and prospects of climate smart agriculture in China and so on.

[TS5-B-6] Global Application Status of Drone-based Precision Agriculture Technology

Speaker(s): Ying Zhong
Time: 10:30am-11:00am, October 25th, U.S. Eastern Daylight Time

Abstract: Drone technology for precision agriculture has surged over the past decade. Mapping and scouting drones, spraying drones, and the utilization of imagery AI analysis and big data have benefited growers of rice, potatoes, cotton, and other crops in different regions around the world. Wing will introduce recent drone-based precision agriculture solutions and present application cases, validating the technology's feasibility and value for growers globally.

[TS5-B-7] Application of AI and Imaging Techniques to Realize High-quality Stable Production in Smart Agriculture

Speaker(s): Yu Zhang
Time: 11:00am-11:30am, October 25th, U.S. Eastern Daylight Time

Abstract: Present agricultural production faces various challenges such as labor shortages, the aging farmer population, increasing abandoned cultivated land, and decreases in yield

and quality due to the frequent occurrence of pests and diseases. Smart agriculture, powered by artificial intelligence (AI), exhibits enormous potential in addressing these issues. AI can provide farmers with real-time insights from their fields, predict the optimal times for sowing and harvesting, and identify areas in need of irrigation, fertilization, or pesticide treatment. In this presentation, I will provide a general introduction to smart agriculture and AI technology. Subsequently, in light of the current challenges in agricultural production, I will demonstrate how AI and imaging techniques can be used to detect pests and diseases, thereby protecting crop production and monitoring the growth state of crops. Furthermore, several examples will be provided to help you understand the evolution of smart agriculture using AI and imaging techniques. Finally, I will discuss the limitations and future potential of AI from my perspective.

[TS5-B-8] Design of Smart Irrigation Monitoring and Control System Based on the Internet of Things

Speaker(s): Sarwar Shahidi, Md Mahmudul Kabir Peyal, Khosru M. Salim and Mahady Hasan
Time: 11:30am-11:45am, October 25th, U.S. Eastern Daylight Time

Abstract: For agricultural production, water is a crucial resource. Because of agricultural mismanagement, groundwater is being pumped in large quantities, resulting in groundwater depletion. Surface irrigation dissolves fertilizer and pesticides in water, allowing toxins to enter groundwater and ultimately surface waters including dams, rivers, and canals. Addressing this problem this paper describes a methodical irrigation system with IoT-based monitoring for sustainable farming. One of the effective instruments for eradicating poverty is agricultural advancement. The majority of agricultural activities utilize physical material handling or outdated technology. Farmers are falling behind in terms of adequately maintaining soil and water resources, which are key components of sustainable agriculture. The proposed irrigation system is the way forward if we want to solve the problem. In this system, different sensors are placed in different places of farmland to monitor the environment and decide when irrigation is needed. The system will fetch data from API to predict the weather so that irrigation can be optimized and solve the problem of water logging and wastage of water. The water flow will be controlled by the sprinkler integrated with programmable flow valves. For user accessibility and observation, hardware will interface with a mobile app over the internet.

[TS5-B-9] Named Entity Recognition for Monitoring Plant Health Threats in Tweets: A ChouBERT Approach

Speaker(s): Shufan Jiang, Rafael Angarita, Stéphane Cormier and Francis Rousseaux
Time: 11:45am-12:00pm, October 25th, U.S. Eastern Daylight Time

Abstract: An important application scenario of precision agriculture is detecting and measuring crop health threats using sensors and data analysis techniques. However, the

textual data are still under-explored among the existing solutions due to the lack of labeled data and fine-grained semantic resources. Recent research suggests that the increasing connectivity of farmers and the emergence of online farming communities make social media like Twitter a participatory platform for detecting unfamiliar plant health events if we can extract essential information from unstructured textual data. ChouBERT is a French pre-trained language model that can identify Tweets concerning observations of plant health issues with generalizability on unseen natural hazards. This paper tackles the lack of labeled data by further studying ChouBERT's know-how on token-level annotation tasks over small labeled sets.

[TS5-B-10] The Application of Intelligent Robotic Technique in Agricultural Field

Speaker(s): Yaolun Zhang, Wenxie Zhang and Yu Zhang
Time: 12:00pm-12:15pm, October 25th, U.S. Eastern Daylight Time

Abstract: As a new intelligent agricultural machinery equipment, agricultural robot integrates advanced technologies, such as intelligent monitoring, automatic. So agricultural robot is one of the main developments of agricultural machinery. This paper not only studies the main applications of intelligent robot in the field of agricultural automation, such as grafting robots, weeding robots, picking robots, and classification robots., but also outlines the advantages and concepts of agricultural robot, comprehensively analyzes the current research situation of agricultural robot at home and abroad, then summarizes the technical characteristics. Compared with industrial robots, the key technologies and problems of agricultural robots are discussed. In conclusion, the development trend of agricultural robot is also discussed. Along with the development of robot technology from industrial robot targeted to agricultural robot, the application for animals, plants, and other nonstructured target, which is the higher-level development direction of robot technology. This paper will be beneficial to future creative design and research development of agricultural robot.

Session [TS6-A]: Smart Ecological and Environmental Systems

Time: 8:00pm-12:00am, October 24th, U.S. Eastern Daylight Time
Meeting Room (Microsoft Teams): [TS6-A, 6-B]IEEE UV2022 Session
Chair(s): Pengcheng Fu (Hainan University)
Assistant: Cheuk Wang Su

Meet Our Speakers

[TS6-A-1] Transparent and Smart Ocean for Sustainable Marine Ecosystems

Speaker(s): PengCheng Fu
Time: 8:00pm-8:40pm, October 24th, U.S. Eastern Daylight Time

Abstract: Approximately 71% of the Earth's surface is covered by water, beneath which lie vast amounts of untapped treasures. Life originated in the primal ocean, eventually evolving into the current biodiversity found on Earth. Marine ecosystems, being the most complex and fragile, suffer from marine environmental pollution, global climate change, and heightened human activities. There is an urgent need to promote the concept of a "smart ocean" through various multidisciplinary efforts, such as modeling and simulation, artificial intelligence and virtual reality, marine technology and engineering, biotechnology and nanotechnology, and environmental science and technology. The emphasis will be placed on developing technologies for a "transparent ocean." This will necessitate the adoption of emerging marine technologies, understanding and exploiting their interconnections, and integrating them with marine big data, the Internet of Things, and smart eco-chain structures to ensure ocean sustainability.

[TS6-A-2] Conservation of Soil Resources from Heavy Metal Contamination with the Profitable Phytoremediation System

Speaker(s): Kokyo Oh
Time: 8:45pm-9:30pm, October 24th, U.S. Eastern Daylight Time

Abstract: Soil contamination with toxic heavy metals poses a significant risk to soil resources, environmental quality, crop safety, and human health. Therefore, there is an urgent need to develop effective technologies for the remediation of contaminated soils to recover these valuable resources. In this study, we developed a profitable, natural-based remediation system using economically beneficial green plants. This system aims to perform phytoremediation of contaminated soils while also generating income for the owners of these sites.

We conducted model field experiments with ornamental flowers such as Chrysanthemum morifolium and biofuel crops like Zea mays in soils contaminated with toxic heavy metals, including cadmium, zinc, and copper. The results demonstrated that these phytoremediation systems were effective for soil remediation and income generation for the owners of the contaminated sites. We also discovered that these economically viable crops were easy to manage due to their large biomass, and they exhibited comparable remediation rates to the toxic heavy metals. This indicates that our strategy is a reasonable choice for the remediation of sites contaminated with heavy metals. This study was supported by JSPS KAKENHI No.16H05633.

[TS6-A-3] Marine Microalgae Detection in Microscopy Images: A New Dataset

Speaker(s): Juntao Jiang
Time: 9:30pm-10:15pm, October 24th, U.S. Eastern Daylight Time

Session [TS6-B]: Mobility Enabled Material Cycles, the Circular Economy, Trash and Scrap Collection, Processing, Reuse, and Recycling

Time: 8:00pm-11:00pm, October 24th, U.S. Eastern Daylight Time
Meeting Room (Microsoft Teams): [TS6-A, 6-B] IEEE UV2022 Session
Chair(s): Tian Tan (Doctor Scrab)
Assistant: Haotian Shangguan (UVS)

Meet Our Speakers

Session Overview: Recycling is a considerably old and somewhat outdated industry. The ambiguity and non-digitized nature of scrap is the primary reason the recycling industry has largely remained disconnected from modern technology. Information is difficult to circulate within the current recycling system as the industry's common "language" is primarily based on images rather than text. This presents an opportunity for AI and Computer Vision (AI+CV) to decode scrap images and convert all obscured scrap information into numerical data. Digitization, powered by AI, is poised to construct a new paradigm for the recycling industry.

[TS6-B-1] How AI Could Change Recycling Industry

Speaker(s): Tian Tan
Time: 10:15pm-11:00pm, October 24th, U.S. Eastern Daylight Time

Abstract: Recycling is a very old and perhaps outdated industry. The scrap's unknown and non-digitized nature is the primary reason why the recycling industry is largely disconnected from modern technology. Information transmission is challenging in the current recycling system, as the common "language" in the industry is photographic imagery rather than text. This offers AI and Computer Vision an opportunity to decode scrap photos and convert all concealed scrap information into numerical data. Digitization, powered by AI, is poised to revolutionize the recycling world.

Session [TS7-A][TS7-B]: Lifestyle Innovations to achieve mobility, connectivity, efficiency, and happiness

Time: 8:00pm-12:00am, October 24th, U.S. Eastern Daylight Time
Meeting Room (Microsoft Teams): [TS7-A,7-B] IEEE UV2022 Session
Chair(s): Yue Wang (Xi'an University of Architecture and Technology)
Assistant: Haotian Shangguan (UVS)

Meet Our Speakers

Session Overview: Population aging is a prominent social issue in the world today, representing a comprehensive societal phenomenon. Addressing and resolving the many challenges and problems of an aging society requires comprehensive countermeasures, the enhancement and collaboration of various systems and mechanisms, and the coordination of multiple forces such as government, the market, non-profit organizations, communities, and families. Collectively, these entities must respond to the issue. Increasingly, people are realizing that solving the problems associated with an aging society necessitates interdisciplinary collaboration, aiming to provide solutions that blend innovative wisdom with technological empathy. The discussions at the IEEE UV2022 conference, featuring experts from different backgrounds, strengthened our conviction that artificial intelligence products and technologies, particularly in the realm of smart elder care, will undoubtedly ease and enrich the lives of the elderly.

[TS7-A&7-B] Welcome and Introduction

Speaker: Yue Wang
Time: 8:00pm-8:20pm, October 24, U.S. Eastern Daylight Time

[TS7-A&B-1] Exploiting Voice Assistant Systems for Early Detection of Cognitive Decline

Speaker: Xiaohui Liang
Time: 8:20pm-8:50pm, October 24, U.S. Eastern Daylight Time

Abstract: Voice Assistant Systems (VAS) enable users to voice commands for interaction with a vast range of in-home and third-party services via their smartphones, tablets, computers, and smart speakers. VAS passively collects sparse time-series speech from users while delivering services, incurring minimal usability issues. VAS has soared in popularity in recent years and has enhanced the quality of life. In this talk, I will present our recent project, "Exploiting Voice Assistant Systems for Early Detection of Cognitive Decline," funded by the NIH. Early detection of cognitive decline in Alzheimer's Disease and Related Dementia (ADRD) in older adults living alone is vital for developing, planning, and initiating interventions and support systems that improve patients' everyday functioning and quality of life. Conventional, clinic-based methods for early diagnosis are expensive, time-consuming, and impractical for large-scale screening. We are addressing a significant and complex data science question: will collecting long-term speech patterns of individuals at home enable us to develop innovative speech-analysis methods for early detection of this formidable disease? Our team hypothesizes that changes in the speech patterns of individuals using voice assistant systems may indicate a decline in memory and function over time. Our project aims to develop a low-cost, passive, and practical VAS-based cognitive assessment method by examining sparse time-series speech and human cognition using novel data mining techniques. We will discuss some preliminary results from our project and related studies.

[TS7-A&B-2] Multimedia Story Telling in Architecture History

Speaker: Chenchen Lu
Time: 8:50pm-9:50pm, October 24, U.S. Eastern Daylight Time

[TS7-A&B-3] Thinking of Life Style based on Environmental Aesthetics

Speaker: Zimo Li
Time: 9:50pm-10:50pm, October 24, U.S. Eastern Daylight Time

[TS7-A&B-4] Little by Little Rehabilitation, Recovery of Caishikou Community 2017-2022

Speaker: Bing Zhu
Time: 10:50pm-11:20pm, October 24, U.S. Eastern Daylight Time

Abstract: From 2017 to 2022, we completed the transformation of the Beijing Caishikouxi community, and this year it was awarded the title of the best urban renewal practice in Beijing. In just six years, the community has gone from decline to revival. Therefore, we have chosen the title: "Little by Little: Rehabilitation and Recovery of the Caishikou Community 2017-2022". The Caishikou community is a relatively concentrated and representative area of Xuannan culture, with profound historical and cultural significance. The community includes Menlou Lane, Vinegar Chapter Hutong, Xizhuan Hutong, Yuyang Hutong, and Fayuan Temple Back Street. Our goal is to awaken Xuannan's memory and restore the historical blocks, revitalizing the soul of Caishikou community development through Xuannan culture. We aim to further update its functions and enhance the popularity and vitality of the entire Caishikou community.

[TS7-A&B-5] Age Appropriate Growth of Humanized Elderly Care Buildings in the Intelligent Era

Speaker: Yue Wang
Time: 11:20pm-11:50pm, October 24, U.S. Eastern Daylight Time

Abstract: From the origin of civilization to the 21st century, human living spaces have gradually evolved from humble caves to water, electricity, and WiFi-equipped residences. They have transformed from simple shelters into comprehensive, comfortable, and practical habitats. The development of social productivity has prompted a change in human lifestyle, shifting from passive dependence on nature to gradually utilizing and actively transforming it. With the continuous advancement in building spaces, materials, equipment, and facilities, the human living environment is becoming increasingly comfortable and healthy. According to the seventh national census, the population over 65 accounts for nearly 13.5%, and the proportion of the elderly age group

is increasing year by year. More people have come to realize that addressing the challenges of an aging society requires interdisciplinary cooperation, relying on artificial intelligence products and technologies to provide smart care for the elderly. This approach aims to offer innovative scientific and technological solutions infused with wisdom and technological advancements. Through humanized architecture, interior design, and assisted by artificial intelligence systems, the elderly can enjoy a simpler, more convenient, happier, and healthier old age.

[TS7-A&TS7-B] Discussion and Feedback

Time: 11:50pm-12:00am, October 24, U.S. Eastern Daylight Time

Session [TS8-A]: Ultrasound Technologies for Biomedical Application

Time: 9:50am-12:10pm, October 23th, U.S. Eastern Daylight Time
Meeting Room (Microsoft Teams): [TS8-A] IEEE UV2022 Session
Chair(s): Viksit Kumar (MGH) and Lin Zhang (MIT)
Assistant(s): Yuan Niu

Meet Our Speakers

Session Overview: Due to its unique benefits, including safety, affordability, and convenience, ultrasound technology is widely used in the field of biomedical engineering for various applications such as diagnostic imaging, stimulation, power transfer, tissue mechanics, and therapies. This session will cover several fascinating topics related to ultrasound technologies for biomedical applications. These topics include the design and manufacture of ultrasound transducers, ultrasound shear wave elastography, acoustic radiation force in tissue engineering, and ultrasound imaging analysis and improvement. Additionally, the session will discuss the challenges and future vision of this topic.

[TS8-A] Session 8A Opening

Speaker(s): Viksit Kumar
Time: 9:50am-10:00 am, October 23th, U.S. Eastern Daylight Time

[TS8-A-1] Novel Ultrasonic Transducers for Applications in Medicine and Biology

Speaker(s): Chang Peng
Time: 10:00-10:30am, October 23th, U.S. Eastern Daylight Time

Abstract: Ultrasonic transducer is one of the most critical components of any ultrasonic systems, which has been widely utilized in biomedical applications for decades, including imaging, therapeutics, blood flow measurement, and cell separation. In recent years, there have been continual advances in ultrasonic transducer technology, which helps prevent diseases and improve quality of life. In this talk, micromachined ultrasonic transducers will first be introduced, including design, microfabrication and experimental tests for imaging and therapy applications. A flexible piezo-composite ultrasonic transducer will then be reported for continuous blood pressure measurement through ultrasonic blood vessel wall motion tracking that eliminates an inflatable cuff. Finally, I will provide an overview of future research directions and a range of applications of flexible ultrasound transducers.

[TS8-A-2] Acoustic Radiation Force-based Ultrasound Elastography

Speaker(s): Piotr Kijanka
Time: 10:30am-11:00am, October 23th, U.S. Eastern Daylight Time

Abstract: Many biomedical applications have been developed that utilize acoustic radiation force (ARF). Among them, ultrasound shear wave elastography (SWE) is emerging as a promising imaging modality for the non-invasive evaluation of tissue mechanical properties. In SWE, focused ultrasound beams are used to generate laterally propagating shear waves that are tracked in the spatiotemporal domains. Most applications of SWE assume that the medium is elastic, homogeneous, isotropic, linear, and infinite. For this type of medium, time-of-flight methods are usually used to estimate the shear wave velocity. However, it has been shown that ignoring tissue viscosity leads to an error in

measuring elasticity. For a viscoelastic medium, the wave velocity varies with frequency, a phenomenon called dispersion. Thus, the tissue viscoelasticity is often examined by examining the shear wave phase velocity dispersion curves in the frequency domain. In this work, recent developments of frequency-domain SWE techniques in biomedical applications are shown and discussed.

[TS8-A-3] Additive Manufacturing in Ultrasonic Transducer Fabrication

Speaker(s): Chi-Tat Chiu (Harry Chiu)
Time: 11:00am-11:30am, October 23th, U.S. Eastern Daylight Time

Abstract: Over the past several decades, the fabrication process of medical ultrasonic transducers has been well-developed. However, this conventional way of making ultrasonic transducers is still relatively labor-intensive and time-consuming. The emergence of additive manufacturing technology has opened up new possibilities for improving the fabrication process. This talk will cover several different aspects of the process, ranging from the fabrication of piezoelectric material to transducer packaging, and discuss how improvements can be made through the application of additive manufacturing technology.

[TS8-A-4] Acoustic Radiation Force: Biomedical Applications from Solid to Liquid

Speaker(s): Hsiao-Chuan Liu
Time: 11:30am-12:00pm, October 23th, U.S. Eastern Daylight Time

Abstract: Acoustic radiation force (ARF) is the time-averaged force exerted on a sample by acoustic waves and has been widely used in many biomedical applications over the past two decades. The momentum transfer in acoustic waves can be used to manipulate microparticles, single cells, and perturb biological tissues and fluids to evaluate their mechanical properties. In this talk, we will start by discussing some interesting works that utilize ARF to explore the mechanical properties of cancer cells associated with chemotherapeutic treatments, aiming to understand the mechanisms of drug resistance. Then, we will move forward to review various applications of ARF in biological tissues, soft condensed matters, and scaffolds in tissue engineering. Lastly, we will extend the topic to biological fluids, exploring their rheological properties using ARF as an acoustic indenter.

[TS8-A] Session Summary

Speaker(s): Lin Zhang
Time: 12:00pm-12:10 pm, October 23th, U.S. Eastern Daylight Time

Session [TS8-B]: Smart Medicine and Smart Healthcare

Time: 8:00am-11:45am, October 25th, U.S. Eastern Daylight Time
Meeting Room (Microsoft Teams): [TS8-B]IEEE UV2022 Session
Chair(s): Shixin Ye
Assistant: Yitong Wang

Meet Our Speakers

Session Overview: We aim to provide an interdisciplinary platform for researchers, students, pharmaceutical industrial scientists to present and discuss the most recent trends, innovations, challenges, and novel solutions adopted in biomedicine. This will be achieved through the utilization of novel computational modeling, machine learning, artificial intelligence, sequence and imaging analysis, bioinformatics tools, and biophysical techniques.

[TS8-B-1] Frontiers of Biomedicine Empowered by Biophysical Principles and Computational Approaches

Speaker: Shixin Ye
Time: 8:00am-8:45am, October 25th, U.S. Eastern Daylight Time

Abstract: We aim to provide an interdisciplinary platform for researchers, students, pharmaceutical industry scientists to present and discuss the most recent trends, innovations, challenges, and novel solutions adopted in biomedicine. This will be achieved through the utilization of novel computational modeling, machine learning, artificial intelligence, sequence and imaging analysis, bioinformatics tools, and biophysical techniques.

[TS8-B-2] Proposal of Robot Recreation Network System

Author(s): Toshimitsu Hamada and Shiroh Itai
Time: 8:45am-9:30am, October 25th, U.S. Eastern Daylight Time

Abstract: This article proposes a robot recreation network system to promote robot recreation. The network system consists of a base center, which has many robots, a robot engineer, and branches such as nursing homes. The members of the base center bring robots to the branch and carry out robot recreation there.

[TS8-B-3] An Efficient Spine Segmentation Method

Author(s): Yuhang Meng, Longfei Zhou, Tianrun Xu, Junrui Wan, Xinyu Zhang and Zhong Wang
Time: 9:30am-10:15am, October 25th, U.S. Eastern Daylight Time

Abstract: The spine is the most complex load-bearing structure in the human body, and herniated discs, spinal stenosis, and degenerative discs are common spinal disorders. MRI is an effective imaging method in medicine, but the identification and quantitative analysis of lesions require physician judgment, which is not only a huge workload but also carries the subjective judgment of physicians, and such drawbacks can be solved by using image segmentation technology. In this paper, we propose an efficient spine segmentation method consisting of selective preprocessing and post-processing and an improved UNET network

structure. In the selective pre-post processing, meaningful parts of the MRI are selected for random input, and the selected parts are effectively restored back to the original size of the segmented image. In the improved UNET network, differing from the traditional UNET structure, the perceptual field of the image input is increased by using inflated convolution, and the attention mechanism is added in the up-sampling and down-sampling end parts for better filtering of features. The experimental results show that our method outperforms the traditional method by substantially reducing the training elapsed time and performing well in terms of the accuracy of the model.

[TS8-B-4] Performance Comparison between U-Net Variant Models in Spine Segmentation

Author(s): Qiyong Zhong, Longfei Zhou, Taoyang Hang, Xiao Yu, Jiantao Wang, Jiasheng Yang, Zijun Zhou, Yukun Quan, Sihan Niu, Yujie Zhu, Zhe Fang and Xinyu Xie
Time: 10:15am-11:00am, October 25th, U.S. Eastern Daylight Time

Abstract: Spine Magnetic resonance imaging (MRI) is a crucial diagnostic technique for illnesses of the spinal cord. The UNET network, the most prominent neural network model for segmenting medical images has opened up new opportunities for spin MRI segmentation as a result of the rapid development of deep-learning algorithms. In this study, we compared the difference between UNet and five other variants (Unet++, Unet+++, Attention-UNet, Dense-UNet, and R2UNet) in performance and efficiency by training and testing them on the same Spine MRI image dataset that contained 200 patients. The results showed that Attention-UNet performed best on the Miou (83.33 percent) and Average dice (89.15 percent) metrics; R2UNet performed best on the Accuracy (97.12 percent) metric. Attention-UNet has the slightest difference between the basic segmentation and the baseline value in terms of segmentation performance. This study could provide a better understanding of different networks on the Spine MRI Segmentation task.

[TS8-B-5] COVID-19 Epidemic Information Disclosure, Personal Information Protection and Precise Governance of Government Data Opening

Author(s): Yifan Yang and Jinji Tian
Time: 11:00am-11:45am, October 25th, U.S. Eastern Daylight Time

Abstract: Open government data is a correct, important, and effective response strategy for the government to deal with public health emergencies. During the prevention and control of the COVID-19 epidemic, personal data information, such as electronic health codes, personal movement trajectories, and relationship maps, played an important role in accurately locating and preventing the spread of the epidemic and promoting the resumption of work and production. However, at the same time, there is also a conflict between the openness of government data and the exposure of sensitive personal information of citizens.

Based on the four stages of epidemic information disclosure, the content of personal information protection, the three-dimensional framework of data availability analysis, and combined with case analysis, this paper identifies the problems existing in the precise governance of government data openness in data collection, storage, utilization, and processing. It provides an analytical basis for the precise governance of government data opening under epidemic prevention and control.

Furthermore, it proposes countermeasures and suggestions to strengthen the "four awareness," optimize the "four processing," and promote the "three perfection" for the precise governance of government data opening, considering the three levels of concept, entity, and procedure.

Session [TS9-A][TS9-B]: Urbanization and Smart Communities & Smart Government and Social Services

Time: 9:00pm-12:00am, October 25th, U.S. Eastern Daylight Time
Meeting Room (Microsoft Teams): [TS9-A,9-B]IEEE UV2022 Session
Chair(s): Zhiyong Lan (Tsinghua University)
Assistant: Haotian Shangguan (UVS)

Meet Our Speakers

[TS9-A&B-1] China's Efforts in Promoting Smart Community Building

Speaker(s): Zhiyong Lan
Time: 9:00pm-9:30pm, October 25th, U.S. Eastern Daylight Time

Abstract: The study is an effort to examine China's smart community initiatives and analyze their current status and future prospects. The paper will first review the significant smart community development policies and principles implemented by both the central and local governments. It will then examine case studies from Beijing, Shanghai, and Hangzhou—cities at the forefront of smart community building—to explore the progress made, achievements attained, challenges faced, and future prospects contemplated.

[TS9-A&B-2] A Comparative Study on Digital Transformation Policies Between Beijing and Shanghai -- A Co-word Analysis

Speaker(s): Xianghong Zhou
Time: 9:30pm-10:00pm, October 25th, U.S. Eastern Daylight Time

Abstract: There is a global consensus that digital transformation can help solve the development problems of giant and complex urban systems. This research selected 144 digital policies from Shanghai and Beijing, spanning from 2011 to 2021. Cluster and co-word analysis were employed to examine high-frequency theme words and policy focuses in their content. The results show that, overall, digital transformation efforts have progressed from simple information projects to data-driven urban development. The policy emphasis has shifted from information gathering to data infrastructure, data-driven approaches, and data empowerment. There has been a transition from information systems to the construction of a digital ecological environment, from fragmentation to integration, and from a single information basis to the integration of information and practice.

The findings also reveal the different policy emphases between Beijing and Shanghai. Shanghai has approached digital transformation through infrastructure improvements, industry and services upgrading, spatial and application scenario enhancements, and mechanism improvements, ultimately leading to digital transformation and revolutionary reinvention. As an international digital harbor, Shanghai's policies have demonstrated the city's unique characteristics in its pursuit of digital transformation. On the other hand, Beijing, being China's political capital, is focused on addressing the complex needs of urban construction, operation, and city security. It emphasizes the establishment of first-class digital infrastructure to enable digital empowerment and data-driven safety. This comparative framework can also be applied to analyze the differences between the cities of New York and London.

[TS9-A&B-3] Conceptual Framework for Collaborative Governance of Urban Smart Senior Services Data Resources - Based on the Case Analysis of the Capital Cities of Three Provinces in Northeast China

Speaker(s): Ruixin Zhang
Author(s): Ruixin Zhang, Yan Jia and Meng Zhang
Time: 10:00pm-10:30pm, October 25th, U.S. Eastern Daylight Time

Abstract: China is rapidly moving into an aging society. The fast aging population and lack of necessary elderly care resources and organizational capacity make it necessary for policymakers to amass information about current elderly care resources, either in the public or private sector, and elderly care service demands, and make informed and intelligent policies to enable collaborative efforts from different social entities to deal with this new challenge. This paper studies elderly care data resources management practices in Northeast China and analyzes how the studied capital cities build platforms, select, gather, manage, and utilize elderly care data for elderly care policy making and service provision. These data come from different sources, have other formats, are normalized differently, and are owned by various social entities. To enable their standardization, compatibility, and efficient use, skills, collaborative methods, principles, and institutions are needed to constitute the conceptual framework for collaborative governance. The study shall extract lessons and experiences from the studied cases in the context of this theoretical guidance and develop policy recommendations for future digital-enabled elderly care practice.

[TS9-A&B-4] Smart Community Building Contribute to the Realization of Inclusive Development: Cases from Jiangbei District, Nanjing, China

Speaker(s): Duanquan Li
Author(s): Zihan Xie, Duanquan Li
Time: 10:30pm-11:00pm, October 25th, U.S. Eastern Daylight Time

Abstract: With the development of the times, information technology is used to build smart communities, which is considered to be the way to improve community governance ability and meet the growing needs of residents for a better life. However, whether the technological revolution can achieve the people-oriented and inclusive development goal emphasized by the new urbanization strategy remains to be tested. This paper reviews the basic concept, functions and technical framework of smart community. The research on the four pilot communities in Jiangbei District shows that the decision-making of community affairs based on the platform has eliminated the dark box operation, enhanced the public trust of residents' voting, stimulated the enthusiasm of residents to participate in community public affairs, and formed a new form of online consultation and autonomy of residents. The authors then discuss the prospects of smart community for inclusive development. This technology not only improves the efficiency of community governance, but also provides a platform for all residents to participate equally in community public affairs, reflecting the advantages of smart community construction in achieving inclusive development.

[TS9-A&B-5] How Private Sector Businesses Promote Smart Safety Regulation for Community Public Facilities?

Speaker(s): Tian Gan
Time: 11:00pm-11:30pm, October 25th, U.S. Eastern Daylight Time

Abstract: As time moves on, public facilities and equipment tend to wear out, and operational safety becomes an issue. Generally, the task of safety regulation enforcement lies with governmental departments. Big data technology now provides a new opportunity for better safety operation monitoring and private sector participation in safety surveillance. This paper studies an elevator safety regulation case in old communities in Beijing. Instead of using a governmental agency to ensure community elevator safety, it explores the use of a private company to lead a smart safety regulation project. The findings show that the complexity of the governance environment, the incompatible institutional logic of the governance subjects, the responsibility avoidance behavior of the regulators, and the pursuit of economic interests of the enterprises together form the causes for engaging private sector participation. The use of big data technology makes such an arrangement traceable and applicable. The company has proven capable of using smart monitoring and management methods to perform "all-weather" monitoring, accident prevention, risk management, and ensure cross-sectoral responses. Further analysis of the case also reveals the limitations of private sector participation in smart safety regulation. These limitations include insufficient government institutional support, which makes the cost of smart safety regulation in the private sector too high, user fee charges that limit safety coverage, and the participating private sector bearing too high a risk and accountability. The study illuminates how, in today's information and big data age, institutional changes are necessary to ensure the proper use of technology.

[TS9-A&B-6] Social Acceptance of Community-based Intelligent Monitoring: A Survey Experiment in China's Covid-19 Pandemic Prevention

Speaker(s): Zhenqing Zheng
Time: 11:30pm-12:00am, October 25th, U.S. Eastern Daylight Time

Abstract: Along with the wide application of intelligent monitoring equipment in urban communities, public authorities are increasingly capable of controlling social dynamics, particularly for the sake of containing the Covid-19 pandemic. However, this often comes at the cost of privacy violations, resulting in a tension between public interests and personal privacy that sharpens and impacts policy compliance during public health crises.

Based on a random sampling questionnaire survey conducted in China in September 2020, this study discusses how people view community-based intelligent monitoring (CBIM) in the midst of the pandemic. The basic findings show that both health concern and political trust are positively associated with people's acceptance of CBIM. Furthermore, by using data from a priming experiment in the survey, we test the causal factors and mechanisms of social acceptance of CBIM. Strong evidence shows that highlighting the purpose of

preventing the spread of the pandemic significantly increases social acceptance of CBIM, regardless of concerns regarding privacy violations. Moreover, the government's promise of safeguarding privacy will result in higher social acceptance of CBIM.

Additionally, these findings are supported by a group interview simultaneously conducted in a Beijing street-level bureaucratic organ, which indicates that more public communication about benign purposes and safeguards will lead to higher social acceptance of CBIM. This study suggests that, although there is inherent concern about technological intervention in social and personal normalcy, public communication and trust play a central role in promoting people's adaptation to an increasingly complicated technocratic governance, particularly after a public health crisis that has deeply impacted people's sense of safety and security.

Session [TS9-C][TS9-D]: Integrated Solutions for Smart Humanity & Smart Design and Design Ethics

Time: 8:30pm-12:00am, October 22nd and 1:00am-3:30am, October 23th U.S. Eastern Daylight Time
Meeting Room (Microsoft Teams): [TS9-C,9-D]IEEE UV2022 Session
Chair(s): Shengsheng Cao
Assistant: Mengxin Zhang and Zhiming Zhao

Meet Our Speakers

[TS9-C&D-1] HCPS empowers new designs and new industries

Speaker(s): Shouqian Sun
Time: 8:50pm-9:40pm, October 22nd, U.S. Eastern Daylight Time

Abstract: Currently, my country is in a critical period of becoming a manufacturing power. The vigorous rise of a new round of scientific and technological revolution and industrial transformation has provided new momentum for the development of innovative design. Digitization, networking, and intelligence are the prominent features of the new round of scientific and technological revolution and the core of the new generation of information technology. With the empowerment of artificial intelligence and other technologies, the traditional "human-physical system" is constantly iterated, and the addition of information systems has transformed the original design domain binary system (HPS) into a new generation of "human-information-physical" system (HCPS). Through the integrated development of the HCPS, the innovative vitality of intelligent manufacturing, digital cultural tourism, and rural revitalization has been further liberated and stimulated, giving birth to a large number of new designs, new business forms, and new models. This will continue to promote innovative design towards more intelligent, green, and sustainable development.

[TS9-C&D-2] Healthy China and Healthy Design

Speaker(s): Chao Zhao
Time: 9:40pm-10:30pm, October 22nd, U.S. Eastern Daylight Time

Abstract: As a new growth point of the design discipline, health design will be based on new diagnosis and treatment technology, as well as narrative evidence-based theory. It will encompass five innovative dimensions: hospital-built environment conversion design, product and service conversion design, public health crisis transformation design, organizational transformation design, and social transformation design. Through humanized innovation practice, it aims to subvert the existing health and medical system, reconstruct people's medical experience, and promote a healthy social lifestyle.

[TS9-C&D-3] Metaverse AI Art and AI Aesthetics

Speaker(s): Jingyan Qin
Time: 10:30pm-11:20pm, October 22nd, U.S. Eastern Daylight Time

Abstract: The Metaverse integrates information and communication technologies, represented by artificial intelligence and other technologies, which have changed the way human beings acquire, perceive, cognize, and express real feelings about real things in the physical world, both subjectively and objectively. Under the triple perspective of the original ontological universe's existence, the telepresence of the digital meta-universe, and the coexistence of the primordial twin universes, the Ego and Alter Ego construct

holographic sympathetic information dimensions of Ego, Id, and Superego. This formation gives rise to a concept of public, private, or shared ownership, which shapes the worldview regarding truth, goodness, and virtue, as well as shared and private value systems, aesthetic values, the three values, empathy for user experience, and individual perceptual qualia. It also establishes a perspective of coexistence between groups and individuals, breeding new aesthetic concepts and aesthetic awareness, and altering the infinite goal of human sustainable development under the guidance of aesthetic awareness. The aesthetic way and aesthetic consciousness, constructed through the virtues of truth, goodness, and virtue, have undergone a comprehensive transformation due to the productivity represented by new technology. Beginning with Metaverse AI art, human intelligence and artificial intelligence integrate their intelligences. Questions such as where beauty comes from, what beauty means, where beauty is headed, and how beauty creates and surpasses human imagination are all worth considering and discussing.

[TS9-C&D-4] Coordination and Evolution of Design

Speaker(s): Wei Ding
Time: 1:00am-1:50am, October 23th, U.S. Eastern Daylight Time

Abstract: From the perspective of design evolution, the design paradigm has shifted from physical logic to information logic, and then to service logic, with the key areas being social innovation and social design. This is because design contributes to building a harmonious society and developing a harmonious city. Against this backdrop, we have promoted exploration in many fields, forming a design-driven industrial innovation perspective with products and industries at the core, a design-driven social innovation perspective with the "Design for Country" plan at the core, and a design-driven cultural innovation perspective with cultural creativity at the core. Simultaneously, the social demand for design talents has also changed. In the past, design was considered a node value - a link in the whole chain, but it has gradually transformed into driving value and system value. This transformation requires designers to have a comprehensive and complete understanding of design.

[TS9-C&D-5] Exploration of Art Creative Mode in the Age of Artificial Intelligence

Speaker(s): Huaqing Shen
Time: 1:50am-2:40am, October 23th, U.S. Eastern Daylight Time

Abstract: The purpose of this lecture is to inspire designers and artists through AI creation practice, teaching them how to keep up with the pace of the times and utilize AI to assist them in their creations. The lecture starts with the artistic practice of style migration, recognizing the abstract features of AI. By transforming a photographic work into a painted art piece using style transfer, this paper explores the selection of abstract artistic styles, develops its own artistic style, and incorporates this experiment into software development. It introduces various forms of image generation based on text descriptions, identifies the

limitations and aesthetic choices of AI-generated art, and considers multiple creative approaches to artistic creation. In an era of increasing communication, art learners should maintain their curiosity. This curiosity should not be limited to their field of expertise; they should expand their areas of interest and enhance their ability to think in interconnected ways. Only by doing so can art learners bring challenges and discoveries to their learning.

[TS9-C&D-6] The effect of English text readability on speech duration of second language learners

Author(s): Tomoko Nariai, Shiroh Itai and Hiroaki Kojima
Time: 2:40am-3:30am, October 23th, U.S. Eastern Daylight Time

Abstract: In order to facilitate active communication among people of various cultural and linguistic backgrounds, it is necessary to learn a second language that is linguistically different from one's native language. The difficulty in learning second language is thought to depend on readability. Most research on the validity of readability assessment has focused on native speakers. Moreover, most of the few studies of readability with second language learners have focused on textual data. This study analyzed actual speech data to determine the effects of word frequencies, syllable structures, and grammatical functions used to estimate the relation with readability on word duration. We compared English word durations in native English speakers and native Japanese speakers. It is hypothesized that highly readable words, i.e., those that are simple and familiar, would be easier for Japanese to utter and shorter in duration, but the opposite was found in the experiment. This suggests that the features adopted for native English speakers as readability indicators are not fully compatible with Japanese speakers.

Session [TS10-A][TS10-B]: Data Management and Algorithm Development

Time: 8:00am-11:05am, October 23th, U.S. Eastern Daylight Time
Meeting Room (Microsoft Teams): [TS10-A,10-B]IEEE UV2022 Session
Chair(s): Yong Xu (Fujian University of Technology)
Assistant: Haotian Shangguan, Fengyang Wang and Xiaohan Hong (UVS)

Meet Our Speakers

[TS10-A&TS10-B] Welcome Speech

Speaker(s): Yong Xu
Time: 8:00am-8:05am, October 23th, U.S. Eastern Daylight Time

Abstract: Learning algorithms play a vital role in Artificial Intelligence and offer efficient solutions to numerous real-world problems. In this era of big data, scientists and engineers are facing the issue of how to use this data more efficiently, both retrospectively and prospectively. To achieve this, new algorithms have to be developed to discover novel methods for the optimized treatment of such data. In this section of the conference, you will find exciting opportunities to explore amazing real-world algorithms for processing various types of data, including text messages, time series data, images, and more.

[TS10-A&B-1] A Transformer-based Unsupervised Clustering Method for Vehicle Re-identification

Author(s): Weifan Wu, Wei Ke and Hao Sheng
Time: 8:05am-8:25am, October 23th, U.S. Eastern Daylight Time

Abstract: Current unsupervised re-identification methods use a clustering-based neural network for training. In the vehicle re-identification field, the feature information between different vehicles is small, and it is not easy to distinguish the detailed features of different vehicles using only the basic clustering algorithm for unsupervised learning. When clustering is performed, the general clustering methods inevitably put different vehicles together due to the high similarity. We propose a new re-identification method to solve these problems. This method is based on clustering and use the unsupervised learning. First, we employ the vision transformer structure as a feature extractor. The vision transformer structure can obtain more discriminative and correlated features than the general convolution. Second, we use a fine-grained clustering method to subdivide the clustered information into different vehicles. We trained our method on two open-source datasets, and finally obtained better test results without additional labeling information.

[TS10-A&B-2] Improved Handwritten Numeral Recognition on MNIST Dataset with YOLO and LSTM

Author(s): Yalin Wen, Wei Ke and Hao Sheng
Time: 8:25am-8:45am, October 23th, U.S. Eastern Daylight Time

Abstract: With the aging population and the advancement of technology, the handwritten numeral recognition system has become sophisticated and widely used. However, the performance of handwritten numeral recognition is limited due to various factors, such as different writing surfaces and postures. In this paper, we propose a new supervised recurrent neural network that combines time and space for target location prediction on handwritten datasets. Our method is based on the YOLO framework and incorporates a

long and short-term memory (LSTM) mechanism. Additionally, our method not only locates handwritten images but also improves classification accuracy. Extensive comparisons with state-of-the-art methods demonstrate that our approach achieves both accuracy and robustness on handwritten datasets. Furthermore, our method is effective and has low computational cost.

[TS10-A&B-3] Targeted Data Extraction and Deepfake Detection with Blockchain Technology Geographic Information

Author(s): Maryam Taeb, Hongmei Chi and Shonda Bernadin
Time: 8:45am -9:05am, October 23th, U.S. Eastern Daylight Time

Abstract: By recording instances of significant forensic relevance, smartphones, which are becoming increasingly crucial for documenting ordinary life events, can produce pieces of evidence in court. Due to privacy or other issues, not everyone is open to having all the data on their phone collected and analyzed. In addition, Law Enforcement Organizations need a lot of memory to keep the information taken from a witness's phone. Deepfakes which are purposefully utilized as a source of disinformation, manipulation, harassment, and persuasion in court, present another significant problem for law enforcement organizations. Recently, the introduction of blockchain has altered the way we conduct business. Decentralized Applications (Dapps) may be a fantastic way to verify the accuracy of the data, stop the spread of false information, extract specific data with precision, and offer a framework for sharing that takes into account privacy and memory issues. This article outlines the creation of a Dapp that provides users with a secure conduit through distributing evidence that has been verified. By utilizing machine learning (ML) classifiers, this platform not only distinguishes between altered and original material before allowing it, but also uses user-uploaded media to retrain its models to increase prediction accuracy and offer complete transparency. The end outcome of this activity can maintain a clear record (timestamp) of the occurrence, submitted proof, and helpful metadata with the aid of the blockchains' consensus notion.

[TS10-A&B-4] MSDT: Masked Language Model Scoring Defense in Text Domain

Author(s): Jaechul Roh, Minhao Cheng, Yajun Fang
Time: 9:05am -9:25am, October 23th, U.S. Eastern Daylight Time

Abstract: Pre-trained language models allowed us to process downstream tasks with the help of fine-tuning, which aids the model to achieve fairly high accuracy in various Natural Language Processing (NLP) tasks. Such easily-downloaded language models from various websites empowered the public users as well as some major institutions to give a momentum to their real-life application. However, it was recently proven that models become extremely vulnerable when they are backdoor attacked with trigger-inserted poisoned datasets by malicious users. The attackers then redistribute the victim models to the public to attract other users to use them, where the models tend to misclassify when

certain triggers are detected within the training sample. In this paper, we will introduce a novel improved textual backdoor defense method, named MSDT, that outperforms the current existing defensive algorithms in specific datasets. The experimental results illustrate that our method can be effective and constructive in terms of defending against backdoor attack in text domain.

[TS10-A&B-5] Generative Cooperative Network for Person Image Generation

Author(s): Yang Liu, Shuai Wang, Yubin Wu, Yubin Wu and Zhang Xiong
Time: 9:25am -9:45am, October 23th, U.S. Eastern Daylight Time

Abstract: Person image generation is to synthesize realistic pedestrian images that follow the same distribution as the given dataset. Previous attempts can be generally categorized into two classes: some methods use human pose information as guidance and others try to generate person images from scratch. The former is to transfer the pose of a source image to a reference pose. The generated person image have the same identity as the source image. The latter takes a random noise from latent space as input, and the real person images are only used as references for the discriminator. While pose-guided person image generation is widely studied, generating-from-scratch methods are also worth exploring because they can synthesize person image with new identity, which is a useful manner of data augmentation. These two types of generating methods have their different advantages and disadvantages, and sometimes they are complementary. In this work, the authors design a Generative Cooperative Network (GCN) to jointly train two types of GANs. The two GANs serve different purposes, and can learn from each other during the cooperative learning procedure. The proposed approach is verified on public datasets, and the results show that our GCN improves the performance of the baseline methods. Comparisons with state-of-the-art methods also prove the effectiveness of the proposed method.

[TS10-A&B-6] Robust Smart Home Face Recognition under Starving Federated Data

Author(s): Jaechul Roh and Yajun Fang
Time: 9:45am -10:05am, October 23th, U.S. Eastern Daylight Time

Abstract: Over the past few years, the field of adversarial attack received numerous attentions from various researchers with the help of successful attack success rate against well-known deep neural networks that were acknowledged to achieve high classification ability in various tasks. However, majority of the experiments were completed under a single model, which we believe it may not be an ideal case in a real-life situation. In this paper, we introduce a novel federated adversarial training method for smart home face recognition, named FLATS, where we observed some interesting findings that may not be easily noticed in a traditional adversarial attack to federated learning experiments. By applying different variations to the hyperparameters, we have spotted that our method can make the global model to be robust given a starving federated environment.

[TS10-A&B-7] Comparison of multiple models of recommendation system

Author(s): Lei Liu and Lin Zhang
Time: 10:05am -10:25am, October 23th, U.S. Eastern Daylight Time

Abstract: In patients' medical service consumption behavior, patients' choice of medical institution is an important link, which determines patients' medical quality and medical cost, and even further affects the distribution of medical resources in the whole health service market. Patients may have problems such as high knowledge barrier and information redundancy in the process of choosing hospitals. Nowadays, with the continuous development of machine learning, the recommendation system using graph neural network has achieved good results in solving this kind of information overload problem. Therefore, we mainly focus on the application of the recommendation system in the process of patients choosing hospitals. Here we complete the construction of the initial data set through data simulation, and then we train and debug the six-graph neural network recommendation system models. In addition, we propose a new comprehensive index to improve the traditional index, which is difficult to better represent the model performance. In the future, we plan to apply this research to our smart medical big data cloud platform. On the one hand, the cloud platform will provide a more solid data basis for our model; on the other hand, we can provide personalized medical recommendation services for platform users by using the recommendation system.

[TS10-A&B-8] Image Caption Enhancement with GRIT, Portable ResNet and BART Context-Tuning

Author(s): Wuyang Zhang and Jianming Ma
Time: 10:25am -10:45am, October 23th, U.S. Eastern Daylight Time

Abstract: This paper aims to create an image captioning novel architecture that infuses Grid and Region-based image caption transformer, ResNet, and BART language model to offer a more detail-oriented image captioning model. Conventional state-of-the-art image captioning models mainly focuses on region-based features. They rely on decent object detector architectures like Faster R-CNN to extract object-level information to describe the image's content. Nevertheless, they cannot remove contextual information, high computational costs, and the ability to introduce in-depth external details of objects presented in the images—the replacement of conventional CNN-based detectors results in faster computation. The experiment can generate image captions comparatively fast with higher accuracy and details with contextual information.

[TS10-A&B-9] Enhanced Video Caption Generation Based on Multimodal Features

Author(s): Xuefei Huang, Wei Ke and Hao Sheng
Time: 10:45am -11:05am, October 23th, U.S. Eastern Daylight Time

Abstract: Video caption is the automatically generated of abstract expressions for the content contained in videos. It involves two important fields — computer vision and natural language processing, and has become a considerable research topic in smart life. Deep learning has successfully contributed to this task with good results. As we know, video contains various modals of information, yet most of the existing solutions start from the visual perspective of video, while ignoring the equally important audio modal information. Therefore, how to benefit from additional forms of cues other than visual information is a huge challenge. In this work, we propose a video caption generation method that fuses multimodal features in videos, and adds attention mechanism to improve the quality of generated description sentences. The experimental results demonstrate that the method is well validated on the MSR-VTT dataset.

Session [TS11-A][PE]: Education Systems in the Universal Village City of the Future

Time: 8:00Pm-9:00Pm, October 23th, U.S. Eastern Daylight Time
Meeting Room (Microsoft Teams): [TS11-A][PE]IEEE UV2022 Session
Chair(s): John Galinato and Jing Yu (Build-it-Yourself)
Assistant: Sofia Arana, Rodrigo Kai and Andy Nguyen (UVS)

Meet Our Speakers

Session Overview: The post-pandemic world is not only different in terms of work and life but also in the realm of education, which is being redefined and reformed. In the city of today/UV concept, we must find a way to make education more efficient—meaning cheaper, more accessible, and more effective by providing the necessary skills for the next generation of leaders. As we all agree, "art and technology education is the long-term solution to many of the world's problems." How can such education be achieved? This session will discuss how education can embrace art and technology, as well as how it can be accessible to all city families. Furthermore, we will delve into how a global education community positively nurtures kids' learning and growth by bringing them together to solve problems collaboratively.

[TS11-A-1] The importance of education in a prosperous world

Speaker(s): Herman Korsgaard
Time: 3 min

[TS11-A-2] The skills MIT and Mujin are looking for

Speaker(s): Huan Liu
Time: 3 min

[TS11-A-3] The value of art education

Speaker(s): Wen Yu
Time: 3 min

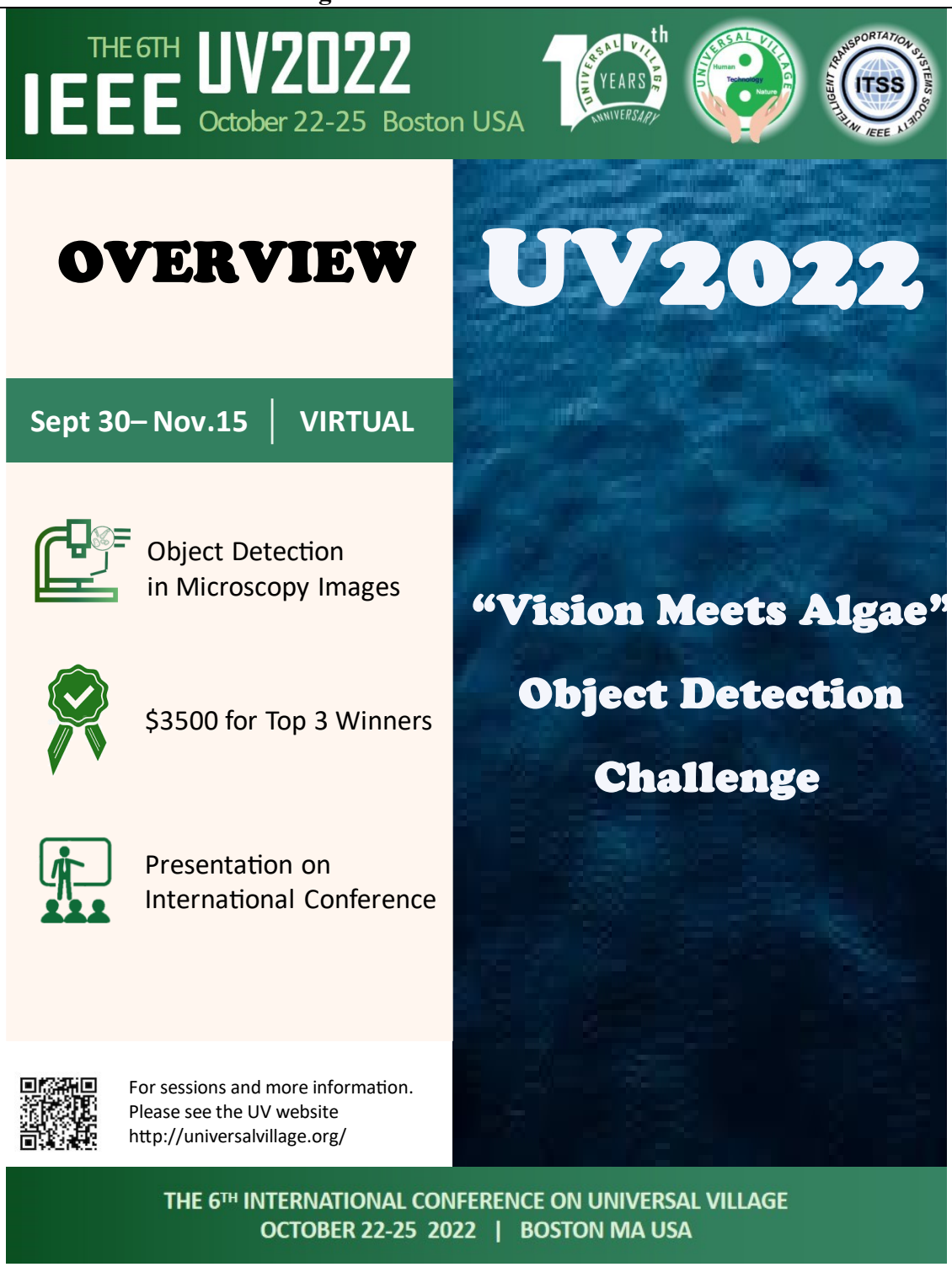
[TS11-A] Discussion and feedback

Time: 8:09pm -9:00pm, October 23th, U.S. Eastern Daylight Time

Session [TS11-B]: UV Data Science Competition: Algorithm Report Session

Chair(s): Juntao Jiang

PS: Session 11-B will be merged into Session TS6-A&TS6-B



[TS11-B-6] Bag of Strategies Set New State-of-The-Art for Algae Object Detectors

Author(s): Zhiqiang Yang, Haiming Wen, Zihan Wei, and Zehan Zhang
Time: 8:00pm-8:15pm, November 15th, U.S. Eastern Daylight Time

Abstract: Deep learning-based detection of marine microalgae in natural waters can meet the need for rapid monitoring, facilitating researchers in marine and environmental sciences, while also paving the way for downstream cellular analysis tasks. We use a new training scheme for marine microalgae detection that consists of two phases: a teacher benchmark model phase and a student model learning phase. Using teacher model supervision to get better student model training results. Through a simple and fast image fusion method, we can obtain more realistic algae-generated images to extend the training set and eventually improve the convergence speed and performance of the model. Based on the algorithms of YOLOv5 and YOLOv6, we use the DHLC backbone network fusion method to fuse features from different levels of C3 modules and BepC3 modules together as the input of the PANet middle layer. We also use the module in BoTNet network to obtain stronger feature extraction capability by introducing self-attention mechanism in the yolo model. Since there are many small targets in marine microalgae images, we also extend the YOLOv6l model to the more powerful YOLOv6l-P6 model, which can get better detection results in the input image size of 1280. In addition, we also use time-test augmentation (TTA), weighted boxes fusion (WBF) and Singleclass wighted boxes fusion (SinWBF) techniques to optimize the performance of each class. These strategies greatly improve the model detection performance and robustness under the conditions of small amounts of marine microalgae microscopic image data. Finally, our solution won the first place on the "Vision Meets Algae" Object Detection Challenge, and got 58.25 MAP.

[TS11-B-7] RAD: A Robust Algae Detection Solution to IEEE UV 2022 "Vision Meets Alage" Object Detection Challenge

Author(s): Ye Zheng and Bo Wang
Time: 8:15pm-8:30pm, November 15th, U.S. Eastern Daylight Time

Abstract: This article introduces the solutions of the "MicroalgaeDetector" team for the IEEE UV 2022 Vision Meets Algae Object Detection Challenge. This challenge focus on developing computer vision detection algorithm to automatically detect marine microalgae from microscopy images. Automatic localization and identification of microalgae are anticipated to be accomplished concurrently during image analysis, which will simplify downstream cell analysis and lay the groundwork for algae identification using image data in conjunction with biomorphological traits. In this competition, we observe that the training dataset has a serious class imbalance problem, and some classes are in a state of few samples, which greatly limits the performance of both single stage detectors and multistage detectors. There are also issues with tiny objects in high resolution images and serious bounding box annotation inconsistencies. To address the aforementioned competition challenges of few samples, unbalanced categories, noisy annotations and small objects in this competition, we propose a robust and high-performance algae detection

method (RAD), which can precisely localize and identify marine microalgae in microscopy images. In the proposed RAD, we develop a class-specific copy-paste strategy to achieve instance-level re-sampling, which resolves the problem of the data imbalance. We also introduce several training/inference strategies and a bag of tricks that brings more or less performance boost. In order to increase robustness, we also train multiple expert models to ensemble them. Our RAD wins the competition after achieving 58.192% mAP in the test dataset.

[TS11-B-8] SimpleCopy: A Strong Data Augmentation for Microalgae Detection

Author(s): Shaojin Wu, Junjie Zhang, Bingrong Xu, and Zhigang Zeng
Time: 8:30pm-8:45pm, November 15th, U.S. Eastern Daylight Time

Abstract: Marine microalgae detection is of great importance to the environment and ecosystem. In this paper, we consider microalgae detection as a computer vision task and use a twostage object detection network, Cascade R-CNN, to build our detector and deal with the dataset which contains a variety of small targets. Firstly, We proposed a novel data augmentation strategy called SimpleCopy for microscopic images, which typically have more small targets and sparse target distributions. Secondly, we leverage the strengths of different backbone and employ model ensemble techniques to enhance the performance of our detector. Finally, with carefully designed post-processing methods, the recall and precision of our detector can be further improved. Extensive experiments conducted on the marine dataset show the superiority of our model. We verified the effectiveness of our method by achieving 58.18 mAP and ranked 3/347 on the official leadboard.

[TS11-B-9] Multi-Model Fusion Solution for IEEE UV 2022 "Vision Meets Algae" Object Detection Challenge

Author(s): Peng Xiaoxiao, Tian Yuchen, Chen Dayu, Zheng Jianfeng, Wang Yueyi, and Huang Keyu
Time: 8:45pm-9:00pm, November 15th, U.S. Eastern Daylight Time

Abstract: This report summarizes the fourth-place solution of the "Vision Meets Algae" object detection challenge held on IEEE UV'2022 focuses on object detection in marine biology images obtained through the microscope. First, we experimented with a large number of backbones and necks to improve mAP by enhancing the model structure. Then, we designed and tested a variety of data augmentation schemes based on algal characteristics from a data perspective. Finally, with multiple models ensembled adopted, our methods achieve 57.579% mAP on the test set.

[TS11-B-10] Towards Effective Microalgae Object Detection Solutions to IEEE UV 2022 "Vision Meets Alage" Object Detection Challenge

Author(s): Yunchen Zhang, Wei Zeng, and Fan Yang
Time: 9:00pm-9:15pm, November 15th, U.S. Eastern Daylight Time

Abstract: This technical report introduces our solution for microalgae object detection in IEEE UV 2022 Vision Meets Alage Object Detection Challenge. The purpose of this challenge is to employ computer vision to more effectively analyze population change in ocean microalgae species. Therefore, we performed a comprehensive analysis of the distribution of the microalgae dataset and designed a customized training strategy for the task. In order to better identify the categories and coordinates of microalgae in microscopic images, we propose CBSwin-Cascade RCNN++ as a strong baseline for microalgae detection. Our final submission the results, which achieves 56.13 in mAP 0.5:0.95 on a single model, and obtains 57.09 in mAP 0.5:0.95 with the ensembled models.

[TS11-B-11] Bag of Tricks for "Vision Meet Alage" Object Detection Challenge

Author(s): Xiaode Fu, Fei Shen, Xiaoyu Du, and Zechao Li
Time: 9:15pm-9:30pm, November 15th, U.S. Eastern Daylight Time

Abstract: In this paper, we introduce our solution to the "Vision Meets Algae" Workshop and Challenge (VisAlgae) in details. Since a large number of small objects and similar categories, the location and classification of algae are challenging. For that, we propose a bag of tricks for VisAlgae, including data augmentation, model architecture, and pipeline. For data augmentation, we introduce bounding-box jitter, mix-up, multiscale, albu, and test time augmentation to increase sample diversity and randomness. We learn a better region of interest (RoI) features by adding global semantic information to RoI features. Especially a novelty double head is devised to enhance final features via reserving spatial and channel information. For the pipeline, We introduce the detector framework, backbone, stochastic weights averaging, pseudo labels, and weighted boxes fusion. Experimental results demonstrate that our approach can achieve an excellent mean average precision (mAP) performance of object detection.

[TS11-B-12] Deep Learning Based Algae Detection Method

Author(s): Ziye Fang, Shu Jiang, Xiaoyu Du, and Zechao Li
Time: 9:30pm-9:45pm, November 15th, U.S. Eastern Daylight Time

Abstract: The ocean is an important part of the ecosystem and is closely related to our lives. Detecting the status of algae in the ocean contributes to the protection of the marine environment. With the continuous development of target detection technology, small target detection tasks are gradually applied to the task of monitoring marine organisms. We use two-stage cascade RCNN with Res2Net, ResNeSt, CBNet, ConvNeXt and DetectoRS backbone. Secondly, data pre-processing was used with blur, motion blur, MixUp, random rotation and other data enhancements. Then the pseudo label training model is used as a

pre-training model. And model ensemble is used to improve the inference results. Finally Post-processing is performed using reduced bbox. We conduct extensive experiments on the dataset and achieve the performance of 0.562.

[TS11-B-13] Microalgae Detection Based on Cascade R-CNN Object Detection Model

Author(s): Guoyu Yang, Siyu Cheng, and Jie Lei
Time: 9:45pm-10:00pm, November 15th, U.S. Eastern Daylight Time

Abstract: Marine microalgae are one of the significant biological resources in marine ecosystems and a part of the "blue carbon sink." Artificial identification of marine microalgae usually takes a lot of time, so using the object detection method to detect microalgae automatically can save a lot of artificial resources. The official website provides an algae dataset in the IEEE UV 2022 "Vision Meets Algae" object detection challenge. However, this dataset contains many small objects, which is unfavorable for the object detection model to identify algae. We use Cascade R-CNN with the backbone ConvNeXt-B as our main object detection model in this challenge. To make the model recognize small objects well, we increase the input image size and add global context to the model. During training, we used data augmentation and multi-scale training strategies that improved the performance of the model. Finally, to improve the detection performance, we integrate Cascade R-CNN, TOOD, and GFL. We evaluated our method on the test set. The mAP of Cascade R-CNN reached 54.69, while the mAP of model
integration reached 56.22.

[TS11-B-14] When Computer Vision Meets Algae

Author(s): Fusheng Yu
Time: 10:00pm-10:15pm, November 15th, U.S. Eastern Daylight Time

Abstract: Universal Village (UV) is a new concept proposed by MIT's Universal Village Program, which envisions an ideal future society that prioritizes environmental and ecosystem preservation while fulfilling human needs, thereby ensuring sustainable well-being for society's residents. Marine ecological conservation is an integral part of the Global Village plan, and algae are essential marine biological resources. The organic matter and accumulated energy they produce serve as the foundation for the survival and development of the entire marine biological community. With the rapid development of computer vision technology, there is now the possibility of combining advanced object detection algorithms with traditional algae detection methods. In this work, we leveraged Swin Transformer and Covnext as feature extractors and Cascade RCNN as the main network to detect and classify eight types of microalgae in microscope images. We also employed Weighted Boxes Fusion in post-processing to improve detection accuracy and model generalization.

[TS11-B-15] EfficientNet-YOLOv5: Improved YOLOv5 Based on EfficientNet Backbone for Object Detection on Marine Microalgae

Author(s): Rongsheng Wang, Yukun Li, Yaofei Duan, and Tao Tan
Time: 10:15pm-10:30pm, November 15th, U.S. Eastern Daylight Time

Abstract: Object detection has been a popular task in deep learning. In marine microalgae detection, the dimension of the image in the marine microalgae is too large, but the object is too small compared with the images. Additionally, the number of images in each category differs greatly, which brings a great challenge to object detection. We propose EfficientNet-YOLOv5 to solve the two problems mentioned above. Based on YOLOv5, we improved the Backbone of YOLOv5 with EfficientNet. To further strengthen our proposed EfficientNet-YOLOv5, we offer a variety of useful tricks, such as offline and online data augmentation, multi-scale testing, multi-model ensembled, and LabelSmooling. Extensive experiments on marine microalgae have shown that EfficientNet-YOLOv5 has good performance. It also has very strong interpretability in the marine microalgae scenario. On the marine microalgae detection in microscopy dataset, we used only the EfficientNet-YOLOv5 model and obtained an online score of 44.73 percent. Compared with the baseline model (scored 42.38 percent), EfficientNet-YOLOv5 improved by 2.35 percent. In model ensembled, we received an online score of 50.683 percent using the ensembled model of EfficientNet-YOLOv5 and YOLOv5s for detection. Overall, our model obtained a considerable improvement in detection accuracy. Moreover, it also has excellent performance in inference speed and model size.

[TS11-B-16] Self-attention and Online Hard Example Mining Based Network for Marine Microalgae Detection

Author(s): Qizhi Zhang, Xiaohai He, Wangming Zeng, Zhengyong Wang, and Honggang Chen
Time: 10:30pm-10:455pm, November 15th, U.S. Eastern Daylight Time

Abstract: With the utilization and exploitation of marine resources, the consciousness of protecting the environment is rising, and the classification and localization of marine microalgae is a good solution. In this regard, we propose self-attention and online hard example mining based network for marine microalgae detection, which is based on Cascade-RCNN network. First, the Mixup method is introduced to enhance and augment data. In the backbone network, Transformer self-attention and feature pyramid network (FPN) are introduced to make the model getting stronger feature extraction ability and can adapt to objects of multi-scale. By introducing online hard example mining (OHEM) method, the training can be completed under the condition of imbalanced data distribution. We also use multiscale training and multi-scale testing methods to improve the training performance of the model. Through experiments on the marine microalgae

dataset provided by IEEE UV 2022 “Vision Meets Algae” Object Detection Challenge, compared with the baseline network, our proposed method improves by 3.97%.

Session [TS11-C]: Advance in Distributed Energy System: Design, Simulation and Operation

Time: 9:00pm-11:00pm, October 22nd, U.S. Eastern Daylight Time
Meeting Room (Microsoft Teams): [TS11-B]IEEE UV2022 Session
Chair(s): Ting He (Jinan University)
Assistant: Lan Lan and Zhenyao Liu (UVS)

Meet Our Speakers

Session Overview: The distributed energy system brings together the user load center and small-scale power generation and conversion technology through distributed grid-connected/stand-alone devices, instead of transmitting the energy from a large-scale centralized facility. The distributed energy system not only integrates local green energy resources such as solar, wind, hydrogen, and biomass but also utilizes fossil fuel technologies such as micro gas turbines to provide heat, cold, and electricity. To enhance system efficiency, waste heat generation and cascade energy utilization technologies are commonly employed. Additionally, energy storage is essential for coordinating energy supply and user energy needs.

[TS11-C-1] Research on the Regulation Mechanism of Active Energy Storage in Distributed Energy System

Speaker(s): Lejun Feng
Time: 9:00pm-9:30pm, October 22nd, U.S. Eastern Daylight Time

Abstract: As a cutting-edge technology in the energy field, distributed energy systems have greater advantages over traditional energy supply models in terms of energy conservation, economy and carbon emissions. In the face of multi-type, multi- climate region and hourly fluctuating load demands, reasonable system integration design and variable working condition regulation are the keys to improving system performance. In this paper, the medium temperature heat storage unit is used as the main control method of the system, the system configuration after the system is coupled with the ORC unit is constructed, the essential difference between active energy storage and traditional passive energy storage control is explained, and the two different supply and demand of power generation excess and shortage are quantitatively analyzed. Energy storage active decoupling mechanism and active regulation method in matching scenarios.

[TS11-C-2] Feedforward and Desired Dynamic Equation Control for Solid Oxide Fuel Cell Power Generation System

Author(s): Zhenlong Wu, Yanhong Liu, Donghai Li and Yangquan Chen
Time: 9:30pm-9:45pm, October 22nd, U.S. Eastern Daylight Time

Abstract: The solid oxide fuel cell (SOFC) system, with almost no pollution, low noise and high efficiency, is playing a more and more significant role in power supply. However, the regulation of output voltage and desired range of the fuel utilization, caused by its strong nonlinearity, system uncertainty and ever-changing external current load, are challengeable. To relieve these challenges, this paper proposes a hybrid control scheme combing the physical feedforward and desired dynamic equation (DDE) control. By analyzing these control challenges theoretically, a physical feedforward is applied to accelerate the system response and keep the fuel utilization in the desired range, and DDE control is proposed to handle system nonlinearity, uncertainty and external disturbances. Then a practical and effective tuning method for the DDE parameters is provided. Finally,

the proposed and comparative control strategies are applied to the SOFC system. Simulation results show that the proposed control scheme has the strongest ability to reject the external current load and handle system uncertainties. Besides, it can guarantee that fuel utilization always locates in a reasonable range.

[TS11-C-3] An improved operation strategy to balance the design and operation for a solar-based distributed energy system
Author(s): Yixian Yan, Ting He and Chang Huang
Time: 9:45pm-10:00pm, October 22nd, U.S. Eastern Daylight Time

***[TS11-C-4] Dynamic simulation study of hybrid solar-fossil fuel thermochemical* storage and electricity, heat and cold generation system**
Author(s): Ting He, Yufan Wen and Mingen Huo
Time: 10:00pm-10:15pm, October 22nd, U.S. Eastern Daylight Time

[TS11-C-5] Application of Complementary Multi-energy Distributed Energy System in Oil Transfer Station

Author(s): Feng Zhang, Feng Liu, Xin Liu, Xiangyu Chen and Kai Zhou
Time: 10:15pm-10:30pm, October 22nd, U.S. Eastern Daylight Time

Abstract: Oil companies with oil and gas as their main products are not only large energy producers but also significant energy consumers and carbon emitters. The extensive adoption of efficient, clean, and low-carbon energy represents an effective approach for oil companies to achieve carbon peaks and, ultimately, carbon neutrality goals. The oil and gas gathering and transportation system serve as the primary infrastructure for oilfield ground engineering. The oil transfer station plays a crucial role within this system, primarily responsible for heating and pressurizing crude oil during transportation. Currently, the energy supply system relies on grid electricity and natural gas boilers to meet respective electrical load and low-temperature heat load requirements. To address this, the implementation of a complementary multi-energy distributed energy system is proposed for the oil transfer station. This system integrates solar energy, geothermal energy, natural gas, and other energy sources, utilizing cascade utilization technology to provide stable power supply and low-temperature heat to the transfer station. By replacing the existing energy supply system, the oil transfer station can significantly enhance energy utilization rates, leading to reduced carbon emissions and contributing to energy conservation and carbon reduction efforts in oil fields.

[TS11-C-6] Density functional theory study of ionic liquid-ammonia-water systems

Author(s): Zhibin Wu, Yun Li, Weijia Huang and Ping Cheng
Time: 10:30pm-10:45pm, October 22nd, U.S. Eastern Daylight Time

Abstract: Ammonia-water is a commonly used working fluid in absorption refrigeration cycles, and high energy consumption occurs during the working process due to the incomplete separation of ammonia and water. To address this problem, several cations ([Dmim]+, [P1111]+) and anions ([BF4]-, [DMP]-, Cl-, [Tf2N]-) are selected in this paper to form ionic liquids (ILs). These substances are then added to the ammonia-water system to create ternary systems. Energy analysis between different particles of the new systems is carried out using the density flooding theory (DFT). The results indicate that [Dmim][DMP] has a high affinity for water and demonstrates a more obvious potential to promote the separation of ammonia from water in the energy calculation. The theoretically predicted results are also consistent with the experimental data in the literature.

[TS11-C-7] Research on the regulation mechanism of active energy storage in distributed energy system

Author(s): Lejun Feng, Hong Bai and Wenhui Shi
Time: 10:45pm-11:00pm, October 22nd, U.S. Eastern Daylight Time

Abstract: As a cutting-edge technology in the energy field, distributed energy systems have greater advantages over traditional energy supply models in terms of energy conservation, economy, and carbon emissions. In the face of multi-type, multi-climate regions, and hourly fluctuating load demands, reasonable system integration design and variable working condition regulation are key to improving system performance. This paper utilizes the medium temperature heat storage unit as the primary control method of the system, constructs the system configuration after coupling it with the ORC unit, explains the essential difference between active energy storage and traditional passive energy storage control, and quantitatively analyzes the two different power generation scenarios: excess and shortage. Furthermore, the energy storage active decoupling mechanism and active regulation method in matching scenarios are discussed.

Session [TS11-D]: Modeling Competition

Time: 8:00pm-11:00pm, November 22nd, U.S. Eastern Daylight Time
Chair(s): Juntao Jiang

[TS11-D-Vac-1] A New Mindset about the Vaccination Allocation

Author(s): Guangli Luo, Jiaqi Yan and Yixuan Guo
Time: 8:00pm-8:15pm, November 22nd, U.S. Eastern Daylight Time

Abstract: These days, the epidemic has evolved from a huge disaster to a protracted war. And as a precious and indispensable protecting resource, vaccine is definitely deserved our reminding because of its lack to some extents. In this paper, we develop mathematical models to predict the daily vaccination numbers in a short phase and more crucially, analysis a number of factors to figure out a more efficient plan to allocate the vaccine among the central hospitals, community hospitals and health centers. And based on the conclusion, we give a brief note to the medical institutions.

[TS11-D-Vac-3] Predict the Number of Vaccinated People and Formulate Vaccine Distribution Strategy of COVID-19 Based on LSTM and Particle Swarm Optimization

Author(s): Yiqiao Zhang, Ping Cui, and Guijin Xie
Time: 8:15pm-8:30pm, November 22nd, U.S. Eastern Daylight Time

Abstract: This paper uses the LSTM network to predict the number of vaccinations in China from December 2022 to February 2023. In addition, according to the number of residents in different regions, the number of medical staff and other factors, the vaccine allocation optimization model is built. The model is solved by particle swarm optimization. The distribution strategy is applied to the analog data of Gongshu District of Hangzhou City and Daoli District of Harbin City. Finally, we give some implementable suggestions for the vaccination

[TS11-D-Vac-4] Vaccine Prediction and Distribution Model under the New Situation in China Based on Informer

Author(s): Yupeng Niu, Jiaqi Xu, and Jingxuan Tan
Time: 8:30pm-8:45pm, November 22nd, U.S. Eastern Daylight Time

Abstract: In this paper, a comprehensive prediction model of daily vaccination in China was established by using Informer long sequence prediction model. For the first time, we established a comprehensive prediction model considering the number of nearby residents, transportation convenience, number of medical personnel, vaccine storage and transportation costs.

[TS11-D-Vac-5] Dynamic Information Mining Based Vaccine Distribution Strategy

Author(s): Junjie Liang, Huilin Yao, Jiayi Wang, and Ya-Hui Jia
Time: 8:45pm-9:00pm, November 22nd, U.S. Eastern Daylight Time

Abstract: Vaccination is essential for preventing epidemics likes COVID-19. Rational vaccine distribution can greatly improve vaccination efficiency and reduce costs. In this paper, to predict the number of future vaccinations, we utilize ARIMA model on the total number of new coronavirus vaccinations in China for a period. Based on the model, we propose a vaccine distribution method that is composed of two distribution strategies with different characteristics, namely "proximity-based vaccine distribution" and "transfer based vaccine distribution." Specifically, we propose a hierarchical vaccination serving communities model to obtain the serving pressures, and construct a first order Marcov chain to explore the importance of different vaccination sites to decide the dynamic distribution with consideration of the rules based on some practical factors. Extensive experiments including two cities in China show that the proposed model can

flexibly and effectively adapt to cities with different conditions.

[TS11-D-Vac-6] A COVID-19 Vaccine Allocation Scheme Based on Queuing Model

Author(s): Boxuan Lai and Hongjun Chen
Time: 9:00pm-9:15pm, November 22nd, U.S. Eastern Daylight Time

Abstract: As the global pandemic becomes inevitable, it is necessary to promote large-scale vaccination as quickly as possible. This paper studies the allocation of COVID-19 vaccine in urban areas. First, the Wave-net method is used to predict the trend of future vaccination, and then the prediction results are fitted to obtain a mathematical model of vaccination in the next 90 days. Then, according to the queuing model, taking Daoli District and Gongshu District as examples, the policies of vaccine distribution in cities with different levels of development are analyzed. Finally, some practical suggestions on vaccine allocation in different cities are given.

[TS11-D-Vac-7] Vaccine Rational Distribution Program

Author(s): Yiran Niu, Zhenyang Zhang, and Qianling Shui
Time: 9:15pm-9:30pm, November 22nd, U.S. Eastern Daylight Time

Abstract: In the post-epidemic era, vaccination has become an important measure to protect the general public. In this paper, we use an ARIMA model to predict the daily number of vaccinations nationwide for the next three months by analyzing data on vaccination rates as well as the number of inhabitants, taking into account a variety of practical factors, in conjunction with the current state of the times. Indicators are rationally established, and the distribution problem is transformed into a problem of evaluating the importance of each indicator, using a simulated annealing algorithm to solve for vaccine distribution ratios for cities, neighborhoods, and towns, and to provide a reasonable vaccine distribution plan, as detailed in the model description.

[TS11-D-Vac-8] Wise in Vaccine Allocation

Author(s): Baiqiao Yin, Jiaqing Yuan, and Weichen Lv, Guian Fang, Jiehui Huang
Time: 9:30pm-9:45pm, November 22nd, U.S. Eastern Daylight Time

Abstract: In this paper, the machine learning method and mathematical model are used to predict the number of future vaccinations, and the problem of how to distribute vaccines to central hospitals, community hospitals and health centers is solved. In the context of the growing importance of vaccination, we need to rationalize the distribution of vaccines to central hospitals, community hospitals and health centers, taking into account the need and cost of vaccination. First, in order to predict the national daily vaccination figures for the next three months, we consulted relevant website data to obtain the vaccination figures for each day since the vaccination began in March 2021, and made the forecast for the next three months through the time series prediction method LSTM. Combined with the increment of the number of daily vaccinations as the label value, the final prediction results were obtained. Second, we first collected data and analyzed and processed the characteristics. Through collinearity analysis, we found that the number of residents and the number of medical personnel had strong collinearity, and the logarithm of the number of residents was calculated with log10. Then AHP was used to analyze the impact of the number of nearby residents, convenient transportation, number of medical personnel, vaccine storage and transportation costs on vaccine distribution, and CR index was used to evaluate our model. The third question is to substitute the collected data of the two regions into the model of the previous question, and we subtract 10% number of nearby residents from the index of central hospitals as a penalty for crowd gathering. Got central hospitals, community hospitals, and health centers vaccine distribution ratio: Hangzhou Gongshu District 4.8:3.3:1.9; Harbin Daoli District 3.6:4.7:1.7. Fourth, in combination with our model and conclusions, we provide an adequate explanation for vaccine distribution.

[TS11-D-Index-2] Smart City Development Index

Author(s): Ya Gao, Zhoulai Li
Time: 9:45pm-10:00pm, November 22nd, U.S. Eastern Daylight Time

Abstract: Smart city is a new stage of development after industrial city, and a product of human science and society. Task 1: Based on the development of smart city, it selects 26 indicators of 7 main factors and draws the hierarchical structure chart by holding the scientific selection principle. When determining the weight of factors at each layer, it uses the consistent matrix method to compare the pair and pair factors, judges the consistency ratio of the obtained matrix, and finally determines the weight of each indicator. The smart city development index is the value of the second-level index multiplied by their respective weights and then summed, and the development level of the city is divided with 0.5 as the standard. Task 2: Firstly, compared with China's GDP, it is found that Hangzhou's growth rate is always higher than that of China, while Harbin's GDP is lower than Hangzhou's and its development is slower. According to the development index proposed in the first question, the scores of Hangzhou and Harbin are calculated and the trend chart is drawn. It is found that before 2017, the development of Harbin was higher than that of Hangzhou, but after that, the growth rate of Hangzhou was faster and Hangzhou surpassed Harbin. After 2017, the scores of Hangzhou both exceeded 50, that is, both were above the average development level. Task 4: Based on the system dynamics theory, the smart city system dynamic model is constructed based on the data of Hangzhou City. The model includes seven parts: smart economy, intelligent humanity, intelligent energy management, intelligent medical treatment, intelligent urban infrastructure, intelligent environmental protection, and urban planning and crowd management. Vensim was used to simulate the model, and the results showed that the future construction level of Hangzhou would be stable but rising, and all subsystems would play an important role in urban development, among which the smart economy was the most obvious. Finally, according to the conclusions of the research, some suggestions and plans are provided for Hangzhou and Harbin from the aspects of green development, science and technology, government leadership and so on.

Session [CF]: Digital City Forum

Time: 8:30pm-12:30am, October 22nd, U.S. Eastern Daylight Time
Meeting Room (Microsoft Teams): [CF]IEEE UV2022 Digital City Forum
Chair(s): Li Ji (Chinese Artificial Intelligence Society)
Assistant: Yongfang Tian and Haihan Wang (UVS)

Meet Our Speakers

[CF-1] Cultural Tourism Experience Scene, Consumer Products and Tourism Service Reform Based on Digital Technology

Speaker(s): Ji Li
Time: 8:30pm-9:00pm, October 22nd, U.S. Eastern Daylight Time

Abstract: In the context of COVID-19, digital cultural tourism has become an important part of promoting the recovery of the cultural tourism industry and enhancing the expansion and quality of cultural tourism consumption. The establishment of virtual venues and other experiential settings using digital technology, the creation of new consumer products like digital collections, and the intelligent enhancement of tourism services have emerged as primary avenues for the advancement of digital culture and tourism. These developments have brought about profound changes in tourism methods, tourism products, and tourism services.

[CF-2] Evaluation Criteria and Methods for Smart Cities

Speaker(s): Zengliang Liu
Time: 9:00pm-9:30pm, October 22nd, U.S. Eastern Daylight Time

Abstract: The digital city is the foundation of a smart city. A smart city is the development goal of the digital city. How to build a smart city from the perspective of the digital city? How to establish the evaluation criteria and methods of smart cities from the perspective of urban big data is one of the important research topics of digital city and smart cities.

[CF-3] The Logic of China's Digital City Growth

Speaker(s): Erxiang Dou
Time: 9:30pm-10:00pm, October 22nd, U.S. Eastern Daylight Time

Abstract: Driven by information technology, cities have evolved from substantiation to informatization, and then to digitalization. This evolution can be described in three stages: the feeling city, the perception city, and the smart city. These stages aim to address the problems of urban information asymmetry, urban integrity, and the emergence of urban value. Their purpose is to promote the evolution of cities along the beacon of IFR. IFR assumes solving the problem of resource scarcity as a premise, with the FRIT pattern and RIFT effect as hypotheses. It divides the columns and beams of the digital city into four parts, transforming the physical city into a city with abundant educational resources, active innovation, a craftsmanship spirit, livability, and happiness.

[CF-4] Governance and the Universal Village

Speaker(s): Bogeng Zhang
Time: 10:00pm-10:30pm, October 22nd, U.S. Eastern Daylight Time

[CF-5] Digital Twins and Smarter City

Speaker(s): Zong Ling
Time: 10:30pm-11:00pm, October 22nd, U.S. Eastern Daylight Time

Abstract: This report relies on the design concepts and practices of digital twin application development and deployment for global customers. It will focus on the origin, implementation architecture, business scenarios, and application cases of digital twins. Its purpose is to help audiences accurately understand the technical challenges brought by digital twins, lay a solid foundation for efficiently promoting the application and innovation of digital twin technology in smart cities, and embrace the potential of a virtual world for urban transformation.

[CF-6] Digital Economy and Smart City

Speaker(s): Xiaohua Chen
Time: 11:00pm-11:30pm, October 22nd, U.S. Eastern Daylight Time

Abstract: In the past decade, China has implemented the development strategy of the digital economy deeply, and it has become the most innovative, fastest-growing, and influential field in China's economic development. The digital economy is not only the key field of a new round of industrial reform but also an important starting point for China to build a digital power and a modern industrial system.

[CF-7] Beijing Metacosmic System and the Mode of Urban Digital Consumption Festival

Speaker(s): Peng Ren
Time: 11:30pm-12:00am, October 22nd, U.S. Eastern Daylight Time

[CF-8] Typical Application of Orderly Charging by Installing Charging Piles Based on the Parking Space (Full Coverage) in the Community [Typical Application of Smart City and Smart Community

Speaker(s): Xiaohua Wang
Time: 12:00am-0:30am, October 23th, U.S. Eastern Daylight Time

Abstract: When planning and constructing parking lots in most residential areas in China, the design of electric load for installing charging stations in the parking lots is not considered 100%. Therefore, we propose a solution for orderly charging by combining mature, complete sets of charging station equipment to successfully resolve the contradiction between the increasing number of new energy vehicles and the construction of charging stations in residential areas.

[SF]UV Student Forum

[SF-WS] UV Introduction & Workshop

Time: 7:00pm-11:00am, October 21st, U.S. Eastern Daylight Time
Meeting Room (Microsoft Teams): [SF] IEEE UV2022 Student Forum
Student Chair(s): Juntao Jiang, Hanxia Li and Zhenyao Liu

[SF-WS] Student Forum Opening
Speaker: Juntao Jiang
Time: 7:00pm-7:05pm, October 21st, U.S. Eastern Daylight Time

[SF-WS] Student Forum Agenda Introduction
Speaker: Zhenyao Liu
Time: 7:05pm-7:10pm, October 21st, U.S. Eastern Daylight Time

[SF-WS-1] Preliminary Study on Evaluation of Smart-Cities Technologies and Proposed UV Lifestyles
Speaker: Hanxia Li
Time: 7:10pm-7:30pm, October 21st, U.S. Eastern Daylight Time

[SF-WS-2] Evaluation of Smart Environmental Protection Systems and Novel UV-Oriented Solution for Integration, Resilience, Inclusiveness and Sustainability
Speaker: Ruiyang Gao and Cheuk Wang Su
Time: 7:35pm-7:55pm, October 21st, U.S. Eastern Daylight Time

[SF-WS-3] Evaluation of Smart Healthcare Systems and Novel UV-Oriented Solution for Integration, Resilience, Inclusiveness, and Sustainability
Speaker: Kelly Zhang
Time: 8:00pm-8:20pm, October 21st, U.S. Eastern Daylight Time

[SF-WS-4] Evaluation of Smart Humanity Systems and Novel UV-Oriented Solution for Integration, Resilience, Inclusiveness and Sustainability
Speaker: Yitong Wang
Time: 8:25pm-8:45pm, October 21st, U.S. Eastern Daylight Time

[SF-WS-5] Smart Home and Community
Speaker: Hanxia Li
Time: 8:50pm-9:10pm, October 21st, U.S. Eastern Daylight Time

[SF-WS-6] Evaluation of Smart Energy Management Systems and Novel UV-Oriented Solution for Integration, Resilience, Inclusiveness and Sustainability
Speaker: Roh Jaechul
Time: 9:15pm-9:35pm, October 21st, U.S. Eastern Daylight Time

[SF-WS-7] Evaluation of Smart Response Systems for City Emergencies and Novel UV-Oriented Solution for Integration, Resilience, Inclusiveness and Sustainability
Speaker: Sophia Chin
Time: 10:05pm-10:25pm, October 21st, U.S. Eastern Daylight Time

[SF-WS-8] Evaluation of Transportation Systems and Novel UV-Oriented Solution for Integration, Resilience, Inclusiveness and Sustainability
Speaker: Tianshu Li
Time: 10:30pm-10:50pm, October 21st, U.S. Eastern Daylight Time

[SF] Student Forum - Research Presentation

Time: 9:00am-12:00pm, October 23rd, U.S. Eastern Daylight Time
Meeting Room (Microsoft Teams): [SF] IEEE UV2022 Student Forum
Chair(s): Hanxia Li, Zhenyao Liu and Ziliang Lan,

[SF] Student Forum - Research Presentation - Afternoon
Host: Hanxia Li
Time: 2:00pm-8:00pm, October 23rd, U.S. Eastern Daylight Time

[SF] Student Forum - Research Presentation - Night
Host: Zhenyao Liu and Ziliang Lan
Time: 8:00pm-12:00pm, October 23rd, U.S. Eastern Daylight Time

[SF-TS1-A][SF-TS1-B]: Vision for Universal Village and UV Indices

[SF-TS1-A&B-1] Innovative Application and Improvement of Panoramic Digital Technology in Indoor Display Scenes

Author(s): Fenglei Huang, Xingshi Luo, Hao Lin, Yingxi Chen, Zhiling Xu, Keyu Wan, Mengchen Zhang, Pengyi Peng, Xinyu Wen, Longfei Zhou, Zimo Li and Yihan Wang
Time: 11:10am -11:35am, October 23th, U.S. Eastern Daylight Time

Abstract: Ever since the birth of panoramic technology, it has been a hot topic in the digital media field, especially in the digital display field. Against the background of epidemic prevention and control on a regular basis, the government has presented more and more support for the development of online culture, entertainment and service industries. Nevertheless, in the panoramic field, Baidu, Google and other companies valued their products very much and conducted a monopoly of techniques, hindering the development of the industry. The panoramic roaming technology now faces many problems, including a lack of data acquisition criteria, nonstandard scene construction and unsmooth scene switching. To break the technical monopoly, promote industrial development and improve user experience, the design provided a grid spherical panoramic scene modeling technique that can be switched smoothly. In the premise of the reproduction of the industrial grade panoramic technology, its application in the indoor panoramic scene has experienced improvement and innovation. Major contributions of this design include: It broke the monopoly of commercial panoramic

technologies and optimized the image effect and the interactive mode, providing more functions; and it formulated reference standards for panoramic data acquisition and indoor scene modeling; and it designed and realized the smooth switching among spherical panoramas.

[SF-TS1-A&B-2] A New Convolutional Neural Network for Identification of Damaged Electronic Components

Speaker(s): Fei Teng, Longfei Zhou, Haoliang Liu, Qingyang Zhao, Zehang Li, Pengfei Liu, Yonggen Dai, Lu Gao, Zhichao Gou, Jiazheng Chen, Jiasheng Yang
Time: 11:35am -12:00pm, October 23th, U.S. Eastern Daylight Time

Abstract: The development of image recognition technology has made lots of opportunities to the manufacturing industry, speed up the intelligentization of manufacturing systems such as product quality assurance, automated assembly, and industrial robot control. In IC industry, manual inspection of industrial products for flaws is costly and inaccurate. Therefore, technicians have researched and developed computer vision technology and applied it to defect detection. However, most of the existing CNN models are only aimed at a certain dataset, and the effect is not good for the mixed data set. In the paper, we use machine vision to identify different classes of defects and imperfections. Specifically, an improved model based on UNet and SegNet is proposed for flaw detection of cables and transistors. This paper starts with the traditional SegNet model, integrates skip connection and Atrous Spatial Pyramid Pooling (ASPP) to improve the performance of the model, and integrates a 13-layer convolutional neural network (ECON) in the experiment for classification to improve the model's performance. Accuracy. A dataset of electronic component images from industrial production is used to compare the improved model, SegNet and UNet, and consider the performance of the combined classification model. The results show that the combined ECON and improved models have higher accuracy in the confounding of the two datasets compared to other networks.

[SF-TS1-A&B-3] A Playful World- establishing a mindset for Metaverse!

Speaker: Jing Yu, Andy Nguyen, Rodrigo Kai and Sofia Arana

Abstract: A-STEM education.
We live in a world where Metaverse is not just a fantasy as 30 years ago, when the word first invented, but toward realization "by combining several technologies, such as AI, blockchain, VR, and AR". (arrow.com, 2022). How do we educate our kids and help them establish a constructive mindset as this world evolves so rapidly?

1. Technology is playful. We use our originally created storylines, apply colorful and interesting artistic visual designs to engage our kids.

2. Hands-on skills equally important. Virtual reality is based on reality, and it only will make sense when it has a connection with reality. And we stress hands-on skills as much as computer skills.
3. Community is essential. A stable and sustained community nurtures children's growth in a way no other factors can provide. We keep supporting our students through their youth and all the way through universities and beyond.

[RTD][SF-TS2-A] Systematic and Integrated Frameworks for UV Subsystems and Contributing Factors

[SF-TS2-A-1] Preliminary Study of Automated System Issues Based on IoT Networks

Speaker: William Wang

[SF-TS3-A-2] UV Coordination for Robust Management of Future Smart Homes

Speaker: Xuan Liu

Abstract: While the smart home industry is in the midst of rapid development, with fresh products and solutions emerging in recent years, the overall stability of smart homes and the ability to handle unexpected events are still lacking. This presentation summarizes some of the most recent findings about smart home robustness since 2022 and included some significant improvements with some smart home solutions for vulnerable groups and some overviews of future smart homes.

[SF-TS3-A-3] A Review of Human Activity Recognition Methods in Different stages of Dataflow

Speaker: Zhenyao Liu

[SF-TS3-A-4] Preliminary Study on UV Operating System for Coordinated and Robust

Speaker: Ziliang Lan

[SF-TS2-B]: Smart Medicine and Smart Healthcare

[SF-TS2-B-1] Sensitive and reproducible cell-free methylome quantification with synthetic spike-in controls

Speaker: Rebecca Xu

[SF-TS3-A]: Intelligent Transportation, Urban Planning, and Smart City Infrastructure

[SF-TS3-A-1] Compatibility of State-of-the-art Machine Learning Solutions to Road Anomaly Detection System in Universal Village Intelligent Transportation System

Speaker: Tianshu Li

Abstract: Transportation systems have revolutionized the form of society. Being an integral part of the Intelligent Transportation System (ITS) defined by Universal Village (UV), the Road Anomaly Detection System (RADS) is crucial to increasing road safety, transportation efficiency, and associated cost-efficiency. However, the RADS nowadays are also facing great challenges, especially a lack of robustness that significantly affects detection accuracy.

The limited transportation budget, resources, and labor cannot meet the safety standards of transportation, the expensive modern lifestyle puts the environment we rely on in jeopardy, the exhaustion of traditional transportation tools damages the health of all living creatures, and the current transportation system even brings about many safety and efficiency issues.

Although the ITS has been proposed to address these issues in the last century, many connectivity problems are still not considered with respect to the RADS without an overview study.

In this paper, we evaluate, from the UV perspective, the current status and challenges of the RADS based on a framework of a closed feedback control loop: data acquisition, communication, decision-making, and action. We propose that an effective RADS should take into consideration the interaction between the RADS and other seven smart city subsystems: smart home and community, smart medicine and healthcare, smart energy management, smart city infrastructure, smart environmental protection, smart response system for city emergency, and smart humanity, and also study how the RADS in ITS would be affected by four major impacting factors of smart cities: information flow, material cycle, lifestyle, and community.

This systematic study will help us explore in-depth the complicated dynamic relationship between multiple impacting factors and propose a UV-oriented, integrated, resilient, inclusive, and sustainable development framework design to address current imminent challenges and to improve our modern intelligent transportation system through our innovative methods of accurate static and dynamic information matching based on the redundancy in data acquisition, novel communication mechanism based on multi-dimensional layers of information that ensures the information effectiveness, robustness and self-adaptive methods, and demand-response management.

[SF-TS3-A-2] SSTCU: A Spatial Temporal Correlation Unit based Short Term Traffic Flow Prediction Approach

Author(s): Yao Liu, Xiyu Chen, Zhongfu Jin, Yujie Zhang and Jiandang Yang

Abstract: Traffic flow prediction is a crucial application in intelligent transportation systems. Existing approaches rarely consider the dynamically correlated spatial-temporal features between multiple road segments. In order to effectively capture the dynamic spatial-temporal features between multiple road segments, we propose a novel approach called as Spatial-Temporal Correlation Unit (STCU). STCU utilizes a fast Fourier transform-based autocorrelation mechanism to extract the correlations between temporal sequences, a graph attention mechanism to extract the correlations between spatial traffic monitors, and a feed-forward neural network to fuse the interacting spatial-temporal correlations. We construct a traffic flow prediction model with stacked STCU module, called as Sequential STCU (SSTCU). We conduct extensive experiments to validate the efficiency of SSTCU, compared with several baselines. The experimental results show that our approach outperforms the baselines and achieves state-of-the-art performance. We also conduct ablation experiments to validate the effectiveness of the STCU module. Moreover, we change the layer depth of the model to find the most efficient setting for a computation efficiency consideration.

[SF-TS6-A] Smart Ecological and Environmental Systems

[SF-TS6-A-1] Evaluation of Smart E-waste management and Novel UV-Oriented Solution for Integration, Resilience, Inclusiveness and Sustainability

Speaker: Ruiyang Gao

Abstract: At present, technological advancements are transforming every aspect of life, delivering unparalleled convenience and escalating productivity in our daily routines. However, the escalating global demand corresponds with a surge in the production of electronic devices. This massive production results in the generation of enormous volumes of electronic waste (E-waste), posing an imminent challenge. Hazardous materials pose a dual threat: they jeopardize human health and deliver detrimental effects on the environment. As the United Nations mentioned in the Global E-waste Monitor 2020, the amount of e-waste generated in 2022 is 59.4 Mt, and 7.3kg per capita, which is equivalent to the weight of 52 mobile phones. The report also predicts global e-waste will reach 74 Mt by 2030 and 9kg per capita. More importantly, this makes e-waste the world's fastest-growing waste issue, particularly in terms of sustainability as it is fuelled mainly by higher consumption rates of electric and electronic equipment, short life cycles, and few options for repair. Nevertheless, only 17.4 percent of 2019's e-waste was collected and recycled. Under this circumstance the problems of dealing with the E-waste arise, in this paper, we evaluate, from the UV perspective, firstly the challenges of the E-waste, including E-waste management, technical limitation, ethical

consideration and the challenges with respect to the changes in people's lifestyle, and secondly the current status of E-waste processing aspects based on the framework of closed feedback control loop: data acquisition, communication, decision-making and action.

[SF-TS6-A-2] Evaluation of Plastic recycling and Novel UV-Oriented Solution for Integration, Resilience, Inclusiveness and Sustainability Preliminary Study of Plastic Cycling System

Speaker: Cheuk Wang Su
Author(s): Cheuk Wang Su, Ruiyang Gao, Mingyuan Hu, Yajun Fang
Time: 11:30am-12:00pm, October 23th, U.S. Eastern Daylight Time

Abstract: At present, rapid urbanization has resulted in increased production of commodities, thereby enhancing the convenience of human lives. However, these products generate a lot of waste, which leads to severe environmental challenges damaging mother earth.

Plastic has been an essential part of the world as society continues to develop. Bottles, toys, cars, and electronic products all have plastic components. With plastic becoming an increasingly ubiquitous presence in our daily lives, the production of plastic has also soared. A study estimated that 8.3 billion metric tons of plastic have been produced from the early 1950s to 2017. As production increases, disposal methods also need to improve. However, according to UNEP, less than 10% are recycled.

If plastic is not properly processed, it would remain in the world forever and create mass destruction to our environment. The oceans serve as a pertinent example, wherein a significant influx of plastic finds its way through waterways and beaches. As time moves on, plastic will start to degrade and become microplastic. According to the data, there is 51 trillion microplastic litter in the ocean. They then affect our health entering the food chain, since a lot of sea animals see them as food.

Overwhelmed plastics also affect human health. A research found that an apple has around 195,500 plastic particles per gram, ranking the highest among items they tested. A report estimates that a person could eat a credit-card-size of plastics per week. Out of all types of plastics, including PET, HDPE, PVC, LDPE, PP, PS, and others. PVC is estimated to be the most toxic to the human body. It contains a lot of phthalates, which can damage the liver, kidneys, lungs, and reproductive system.

In this paper, we evaluate plastic pollution based on the framework of a closed feedback control loop: data acquisition, communication, decision-making, and action. Currently, there are multiple ways to collect data. For example, researchers can capture images from unmanned aerial vehicles and self-designed trucks. There are existing operational technologies that are actively engaged in the collection of plastics, particularly within the marine environment, such as 4ocean’s skimmer and Mr. Trash Wheel in Baltimore.

There are also innovations such as turning used plastics into bricks. In addition, We propose that effective smart plastic recycling should ideally interact with the other seven smart city subsystems proposed by UV: Smart Home, Smart Medicine and Healthcare, Smart ITS, Urban planning and Crowd management, Smart Energy Management, Smart City Infrastructure, Smart Response System for City Emergencies, and Smart Humanity.

[SF-TS6-A-3] The Relationship Between Annual Household Income and Quality Greenspace Access in the City of Seattle

Speaker: Qianchao Zhao

[RTD][SF-TS7-A][SF-TS7-B] Lifestyle Innovations to achieve mobility, connectivity, efficiency, and happiness
[SF-TS7-A] Smart Homes and Community, Virtual Living
[SF-TS7-B] Mobility, Connectivity, and Innovative Lifestyles

[K12-Research-10] [Social Issues Discussion Article] [SF-TS7-A&B-1] Preliminary Exploration and Evaluation of Smart Support for Homeless Community

Speaker: Yitong Wang
Author: Yitong Wang, Yajun Fang

Abstract: Nowadays, the homeless situation is getting worse especially under the pandemic. The rates of homelessness in the United States have expanded by over 130 percent in just the past two years. Our society has been highly changed and our life quality has significantly improved thanks to technologies like Artificial Intelligence in nearly a decade. However, for people experiencing homelessness, and other such vulnerable groups are under social circumstances lacking humanistic consideration and facing moral issues. Over the past few years, many policies, technologies and approaches have been developed in directions like developing information-collecting platforms, building and classifying emergency shelters and creating robots dedicated to solving comprehensive problems to help people overcome the influences of poverty, illness and unaffordable housing that lead to homelessness, but the actions are never enough because of the partial absence of their focus on user experience, insufficient scope of application and the difficulty of promotion. Under this comprehensive circumstance of the crisis of homelessness, in this paper, we explore homeless status, difficulties and both internal and external challenges with their actual need and various technical solutions. More importantly, we are trying to analyze reasons for not being able to help homeless solve problems and breakthroughs in application and promotion, summarizing existing technologies and future innovations, proposing possible direction of improvement with a perspective of promoting sustainable development, universal design, and communicative action to help the homeless in various situations.

[K12-Research-3] [SF-TS7-A&B-2] Depression Detection for Suicide Prevention

Speaker: Houjun Ji

Abstract: Depression is a common illness worldwide, affecting an estimated 3.8% of the population. In 2021, 13.84% of youth (aged 12-17) reported suffering from at least one major depressive episode in the past year. People with depression have a three times higher risk of suicide compared to those without the condition. Many individuals who die by suicide exhibit few signs during their lives that reveal their thoughts. Therefore, detecting their depressive mood is crucial. In this presentation, I will introduce the general situation of depression and suicide worldwide. Additionally, I will discuss two major areas of depression detection: home monitoring and social media detection. Finally, I will present an ideal proposed model that can improve detection time, speed, and accuracy. Moreover, the proposed ideal model could be personalized for individuals who prefer not to be monitored.

[SF-TS7-A&B-3] Preliminary Review on The Sanitation for Elderly and The Disabled

Speaker: Xiaohan Hong

Abstract: The number of the elderly will keep increasing in the future because of the improvement of living standards. Data from World Statistics Pocketbook 2019 shows that by 2050, 1 in 6 people in the world will be over the age of 65 (16%), up from 11 in 2019 (9%); by 2050, 1 in 4 people in Europe and North America will be 65 years or older. In addition, the population aged 80 or older is expected to triple from 143 million in 2019 to 426 million in 2050. Moreover, according to the World Health Organization report, 15% of the world's population lives with some sort of disability. For the elderly and disabled, one critical problem is how to bathe securely, comfortably, and with dignity. According to the website caregiver.com, 30% of people aged sixty-five and over who were injured in bathrooms sustained a fracture. In addition, 38% aged eighty-five and over needed hospitalization as a result of the injury that they sustained. Moreover, the CDC has found that 235000 people over the age of fifteen visit the emergency room each year over bathroom injuries. This paper will discuss the assistive devices for the elderly and disabled to bathe safely, comfortably, and with dignity.

[SF-TS7-A&B-4] *Evaluation of How Technology Facilitate Chronic Disease Prevention and Enables Better Lifestyles for Chronic Patients*

Speaker: Haihan Wang

Abstract: As the population ages, the chronic disease becomes a major concern for the senior population. How to prevent chronic diseases effectively as well as how to enable chronic patients to live better are the core obstacles most medical scientists encounter with. With the technology revolution, such as artificial intelligence, scientists have developed new methods to help with Chronic Disease Prevention and to enable better lifestyles for Chronic Patients.

This paper talks about the connection between Smart technology and Chronic Disease Prevention as well as between technology and chronic patients' lifestyles, particularly under the environment of Smart Home.

The first part presents current challenges people have about chronic diseases and the impacts of chronic diseases. The second part discusses the traditional methods people have for preventing chronic diseases and the connection between them and current technology. The third part points out how new technology empowers different kinds of chronic disease patients to better and healthy lifestyles. Moreover, the content includes how to deal with emergency situations for established patients and also for more vulnerable groups. In the fourth part, the paper evaluates the robustness of designed systems and the weaknesses of our current systems.

The whole paper is based on Universal Village's concepts: inclusive, safe, resilient, and sustainable. Using artificial intelligence, big data, and other technology, Universal Village aims to develop a better community for everyone. This paper mainly discusses the interaction between chronic disease and Smart Home, a concept proposed by Universal Village.

[SF-TS7-A&B-5] How Technology can Bring Negative Effect on Youth's Development

Speaker: Haotian Shangguan

[SF-TS7-A&B-6] Evaluation of Smart Support for Vulnerable Groups and Their Acceptance for AI Technologies

Speaker: Hanxia Li

Abstract: At present time, vulnerable groups are receiving more and more attention as the numbers of these vulnerable populations are increasing. These populations are facing challenges including diminished physical and mental capacity; lack of socio-economic status and equal access to medical resources; and dependency within the family. Furthermore, vulnerable groups are also having a hard time to accept the AI technologies that support them due to the technological uncertainties, service intangibility and private information concerns.

In this paper, we evaluate, from the UV perspective, the challenges of the Vulnerable groups facing and the current smart support for vulnerable groups based on the framework of closed feedback control loop: data acquisition, communication, decision making and action. Also, we study how vulnerable groups embrace new technologies and how their lives would be affected by four major impacting factors of smart cities: information flow, material cycle, lifestyle and community. This systematic study will help us explore in depth the complicated dynamic relationship between multiple impacting factors and propose a UV-oriented, integrated, resilient, inclusive and sustainable development framework design to address current imminent challenges, their hesitation to use new technologies to improve their quality of life through multi-source real-time smart monitoring, hierarchical and context-based data fusion, directed information disclosure within families and communities, smart appliances integration for subject-oriented, event-triggered and coordinated action.

[SF-TS7-A&B-7] Research on Home Interface Interaction Design based on SAT Model

Speaker: Xiaojing Li

[SF-TS7-A&B-8] Model Based Smart Communication System Design

Speaker: Mingyuan Hu

Abstract: The development of natural language processing (NLP) has revealed its huge potential power and wide implementation. However, in the current status of natural language processing and smart communication design, there are some problems and limitations. First, most of the NLP and smart communication research mainly focus on the direction of the algorithm but lacks communication and relationship model design. The second, algorithm and memory implementations of models seldom separate for different tasks and situations. The third, wide use of unsupervised learning makes the model difficult to interpret, uncontrollable, and inflexible. To solve those problems, we designed memory-relationship classification categories to classify and guide the implementation of NLP and smart communication. With the implementation of model basing learning concept and communication model, we designed a sequential controllable semantic dimension and relationship dimension system to classify smart communication.

[SF-TS7-A&B-9] Preliminary Study on the Long Term Objective and Current Status about How Smart Home Technologies Should Empower People with Different Lifestyles

Speaker: Yifan Wei

Abstract: In the modern days, family structures are experiencing rapid changes, the family size is decreasing, as the number of people who live independently have increased prominently. The fast-paced working environment has triggered problems like the lack of time for having healthy routines in daily lives, the loneliness feeling, and so on, which destroy the original lifestyle that people are having, making it harder for people to maintain their healthy living habits. Up to this point, people are forced to alter their living habits to adapt to the overall environment, and their quality of life, health conditions, or even life span have been compromised.

In this context, the situation for vulnerable groups also becomes more severe. More and more elders live independently, leading to numerous underlying dangers for them, both physically and mentally. Considering the compact life that most people have, people who have disabilities are not able to receive as much assistance from people around them.

While it is well known that smart homes have made prominent progress recently, the current smart home technologies still have not addressed the challenges triggered, and people are still suffering.Moreover, as smart homes are developing, it is facing problems about safety and privacy like cyber attacks. The current smart home technology is far below the expectation and could not meet the special need for residents who live in various lifestyles.

In this paper,
1) We thoroughly studied the new challenges and special needs for smart home technologies for people living at different lifestyles and explored the possible solutions. To improve the quality of life for these people, the development of smart home technologies should be human-centric and take in consideration of other subsystems in Universal village.
2) We also examine how current smart home technologies have been transforming the lifestyles for different people, including smart furniture.

This systematic study will help us explore in depth the complicated dynamic relationship between multiple impacting factors and propose a UV-oriented, integrated, resilient, inclusive, and sustainable development framework design which will improve quality of life, and reduce the care burden for formal and informal caregivers.

[SF-TS7-A&B-10] Evaluation of Smart Home Systems and Novel UV-Oriented Solution for Integration, Resilience, Inclusiveness & Sustainability

Speaker: Longling Geng, Xinzhang Xiong, Zhenyao Liu
Author: Longling Geng, Xinzhang Xiong, Zhenyao Liu, Yifan Wei, Ziliang Lan, Mingyuan Hu, Mengxi Guo, Rebecca Xu, Hao Yuan, Zhiyuan Yang, Hanxia Li, Yifan Zhou, Huchong Jin, Chenyi Wang, Liuxuan Jiao, Qiuhang Huang, Fengyang Wang, Katrina Sung, Charles Zhang, Mingyang Sun, Xiaojing Li, Nanbo Zhang, Xuan Liu,

Ruiyang Gao, Haihan Wang, Juntao Jiang, Yi Tao, Lifeng Zhang, Shengsheng Cao, Longfei Zhou, Xiaoman Duan and Yajun Fang

Abstract: At present, smart Homes are receiving more attention as they are becoming the predominant space that houses people's activities. Even though intelligent home appliances are capable of ameliorating residents' quality of life and decreasing their household workload, current Smart Homes are still limited to providing support and services to satisfy the needs of the aging society, small families, and busy lifestyles.

In addition to their limited capability, current Smart Homes lack robustness and resilience and introduce some unexpected new challenges, including waste of energy and resource, safety and security concerns, compatibility, discontinued service due to technology obsolescence, and financial challenges which are further aggravated by the imbalanced development of different regions and communities.

In this paper, we first discuss the new trend in people's lifestyles, the major needs of the current society, and the special requirements for their future homes. We further elaborate on the significance and contribution of existing Smart Home systems, the challenges of Smart Home applications, the importance of human involvement, and future development.

We then propose the concept of the UV Smart Home and its general framework and evaluate, from the UV perspective, the current status of the Smart Home system based on the framework of a closed feedback control loop: data acquisition, communication, decision-making, and action, as well as the available technologies relevant to each element of the systems.

After that, we explore the information flow and material cycle associated with UV Smart Home systems and study how Smart Homes would be affected by these two major impacting factors: information flow and material cycle.

The need for information flow and the current absence of centralized management and disorganized information-sharing practices are discussed. We also propose the concept of hierarchical information fusion, addressing the lack of fusion between data content, temporal and spatial information, data from different sources, and the lack of fusion between different informational layers, such as human know-how and system data.

The paper also points out that the material cycle is a key element in Smart Homes as it connects all UV components through the exchange of physical products, energy, and natural resources. We investigate and highlight several issues within the current Smart Home material cycle, ranging from improper handling of hazardous materials and exposed electrical wires to unauthorized access to firearms and improper mixing of cleaning substances. This part also emphasizes the risk of cascading failures in interconnected systems and processes. It underscores the need for improved information management, fusion, and coordination, as well as proper handling of materials and resources to ensure the safety and functionality of the UV Smart Home system.

In addition, we propose that an effective Smart Home should take into consideration the interaction between Smart Home subsystems and the other seven smart city subsystems: smart medicine and healthcare, intelligent transportation, urban planning and crowd management, smart energy management, smart city infrastructure, smart environmental protection, smart response system for city emergency, and smart humanity. We identify the categories of information exchanges required for the interactions between UV Smart Home systems and other smart subsystems and how such information would support each other and enhance the performance of other smart subsystems.

Moreover, we will be examining how human lifestyle and community dynamics could potentially shape the UV Smart Home concept, with a particular focus on their potential to enhance unique and diverse lifestyles, such as those of vulnerable groups. We will delve into how these smart homes can provide tailored support, catering to specific needs, and creating a more inclusive and supportive living environment. Whether it's aiding the elderly with health monitoring or assisting people with disabilities through enhanced accessibility features, we'll explore how smart homes can be a beneficial tool for a wide spectrum of lifestyles. In addition to individual lifestyles, we'll explore how UV Smart Homes can integrate with and benefit diverse communities. We'll delve into how these smart homes can provide specialized functions to cater to unique community needs, such as communal healthcare monitoring for elderly communities, or enhanced security features for urban neighborhoods. Furthermore, we'll discuss how the collective strength of a community can compensate for certain limitations of smart homes, like addressing the digital divide or reinforcing community-wide data security, ultimately working towards a better, more sustainable living experience for all.

Lastly, based on the in-depth exploration of the complicated dynamic relationship between multiple impacting factors, we propose a UV-oriented, integrated, resilient, inclusive, and sustainable UV Smart Home framework design to address current imminent challenges and to improve residents' quality of life through multi-source real-time smart monitoring, hierarchical and context-based data fusion, directed information disclosure within families and communities, "home operating system" featuring life-long learning of users' dynamic preferences, and smart appliances integration for subject-oriented, event-triggered and coordinated home services and actions.

The proposed UV Smart Home system offers a comprehensive solution to the challenges identified in this paper. It addresses the diversity of human needs and lifestyles by structuring an integrated, personalized, and dynamic information package that captures various aspects of residents' lives. The system incorporates a Multiple-Input-Multiple-Output (MIMO) package of coordinated processes, consisting of seven core functions and six system objectives, to provide personalized services and functionalities for different living groups and communities. By adopting a closed feedback loop, dynamic adaptiveness, and interactive human involvement, the UV Smart Home system aims to be a highly automated, intelligent, and human-controllable system. It leverages machine learning techniques and user feedback to continually update its knowledge base and adapt to changing lifestyles. The system's coordination and automation capabilities

ensure efficient information flow and seamless coordination across sensing, communication, decision-making, and action stages.

[SF-TS7-A&B-11] Integrating Chat GPT: Enabling Intelligent Interactions in Smart Homes

Speaker: *Yuchao Wan*

Abstract:
With the rapid growth of artificial intelligence, smart homes have become more prevalent, offering a convenient and efficient living experience. In this paper, we explore the application of Chat GPT in the context of smart homes.

Chat GPT, developed by OpenAI, is a state-of-the-art language model that excels in generating human-like text responses. GPT-4.0 is the latest iteration of this model, benefiting from enhanced performance and improved language understanding capabilities.

In the realm of smart homes, Chat GPT can be integrated into various aspects, including voice assistants, home automation, and personalized customer support. By leveraging its conversational abilities, GPT can facilitate seamless interaction between users and their smart home devices, making the user experience more intuitive and efficient.

In terms of voice assistants, Chat GPT can understand and respond to user commands, allowing for hands-free control of smart home devices. Its natural language processing capabilities enable users to communicate with their smart home systems in a conversational manner, enhancing the overall user experience.

Furthermore, GPT can be employed in home automation systems, where it can interpret and execute complex instructions for controlling multiple devices simultaneously. This enables users to create personalized scenarios, such as “movie mode” or “goodnight mode,” through simple conversational prompts.

Additionally, Chat GPT can play a vital role in providing personalized customer support for smart home users. By understanding user queries and providing accurate responses, GPT can assist in troubleshooting common issues, guiding users through device setup processes, and offering suggestions for optimizing device usage.

However, it is important to acknowledge the limitations of Chat GPT, including potential biases and ethical considerations. Ensuring user privacy and addressing biases in the training data are crucial steps in its implementation within smart homes.

Furthermore, the integration of Chat GPT in smart homes also poses certain challenges, such as privacy concerns, system robustness, and user acceptance. Further research and development are needed to address these challenges and optimize the performance of Chat GPT in smart home applications.

Overall, the integration of Chat GPT in smart homes opens up new possibilities for intuitive user-device interactions, enhanced automation, and personalized customer support. As technology continues to advance, we anticipate further advancements in language models' capabilities, leading to more efficient and intelligent smart homes. And, the integration of Chat GPT in smart homes offers promising opportunities for transforming ordinary houses into intelligent living spaces. The natural language processing capabilities of Chat GPT enable seamless interaction with smart devices, personalized assistance, and improved user experience. However, addressing the associated challenges is crucial to ensure the successful adoption and widespread implementation of Chat GPT in smart homes.

[SF-TS8-B]: Home/Healthcare - Vulnerable Group

[SF-TS8-B-1] Evaluation of Smart Agitation Prediction and Management for Dementia Care and Novel Universal Village Oriented Solution for Integration, Resilience, Inclusiveness and Sustainability

Speaker: Kelly Zhang
Author: Kelly Zhang, Hao Yuan, Yajun Fang

Abstract: At present, the world is being faced with the challenge of an aging population, correlated with a growing number of seniors with dementia. With this uptick in persons with dementia (PWD), treating dementia-induced agitation, a behavior presents in 90% of PWD characterized by physical aggression, verbal outburst, or other troubling behavior, is a pressing issue.

Use of AI technology, big data, and integrated networks of wearable and ambient sensors has enabled continuous monitoring of dementia care. However, most methods focus on data collection at the early stages of dementia. More research is needed on how novel technologies can empower PWD and their caregivers to take action to manage agitation and support them in the long term as symptoms progress. Moreover, current methods have not taken full advantage of the information obtained and do not provide personalized care.

In this paper, we use the Universal Village (UV) perspective to evaluate the current status of smart technologies with the potential for use in preventing and mitigating agitation while providing support to the caregiver. We conduct evaluations based on the framework of a closed feedback control loop: data acquisition, communication, decision making, and action.

We propose that a robust PWD agitation management system should take into consideration the interaction between the smart healthcare system and other seven smart city subsystems: smart home, intelligent transportation, urban planning and crowd management, smart energy management, smart city infrastructure, smart response

system for city emergency, smart environmental protection and smart humanity, and also study how managing agitation would be affected by four major impacting factors of smart cities: information flow, material cycle, lifestyle, and community.

This systematic study will help us explore in depth the complicated dynamic relationship between multiple impacting factors and propose a UV-oriented, integrated, resilient, inclusive, and sustainable development framework design. As such, the novel framework will improve PWD quality of life and reduce the care burden for formal and informal caregivers through continuous, unobtrusive monitoring, life-long agitation management throughout different stages of dementia, PWD-caregiver dyad-specific guidance, preventive healthcare, and timely treatment.

[SF-TS8-B-2] Primary Hyperhidrosis: A Systematic Review of Current Status and Potential Interventions

Speaker: Wenjie Lin

Abstract: Primary hyperhidrosis (PH) is a rare inherited disorder characterized by excessive sweating. It can affect any part of the body, but most commonly affects the axilla, palms of the hands, groin, chest, and soles of the feet. This paper comprehensively overviews current and potential diagnosis and management methods of PH from both medical and engineering perspectives. We also investigate how patients and society can live better with PH by non-invasive medical treatments and proposepotential engineering and social interventions.

[SF-TS10-A][SF-TS10-B]
[SF-TS10-A]: Responsible and Ethical Data Management and Processing
[SF-TS10-B]: Learning Algorithm Development, Analysis and Interpretability

[SF-TS10-A&B-1] Understanding the Difficulty of Introducing Secure Coding in Small-Scale Projects

Speaker: Nicholas Chang

Abstract: The importance of cybersecurity is growing, and constant reports of data leaks and popular sites being hacked underscore the need for more secure code. However, knowledge of secure coding practices is inaccessible, especially for junior developers or new programmers, as security knowledge is not often taught in computer science curriculum, and even when it is, formal instruction is not easily accessible. This study analyzes the accessibility of resources for new programmers looking to implement security into their applications. Such programmers utilize web searches to locate resources to learn from, so this study analyzes web search terms and results to understand the accessibility of resources for developers to learn from. This is done through a

cognitive walkthrough in which the study mimics the experience of a new developer looking at web sources. The results show that web search results are often low in quality, lacking key learning tools like code examples or external links for a developer to learn more. Search terms with specific security-related keywords were necessary to find more useful results.

[SF-TS10-A&B-2] A Novel Dynamical Weight Hegselmann–Krause Model based on Spiral of Silence

Author: Jiawei Ruan

Abstract: Opinion dynamics, which utilizes mathematical and physical models to investigate the spreading of opinions in social networks, has drawn the attention of researchers in related fields these years, on its excellent performance in evaluating and predicting the public mind on various general issues.
In this paper, inspired by the Spiral of Silence (SOS) theory that shows people tend to alter their opinion to be confirmed by the dominant one considering the fear to be isolated, a novel Dynamical Weight Hegselmann-Krause (DWHK) model is proposed.
Specifically, the variation of interpersonal influence as opinion spread in the community is considered, represented by dynamic weight in networks according to the SOS theory. Proof of the convergence of the proposed model is then given.
Extensive experiments in different types of networks show the effectiveness and efficiency of the proposed model, considering the crowds corresponding to specific kinds of spiral of silence.

[SF-TS10-A&B-3] Carpet Defect Detection by Transfer Learning Combing Classification and Semantic Segmentation

Author: Tianqing Ren, Longfei Zhou, Ke Xu, Yifan Wang, Siyu Wu, Yuliang Gai, Jiazheng Chen, Zhichao Gou

Abstract: Nowadays, with the development of industrial production technology, defect detection has become an indispensable part of industrial production. However, due to various types of products and defects, it can be extremely difficult to identify and locate those defects precisely and accurately. The current major trend in defect detection is using convolutional neural networks and semantic segmentation techniques to better minimize the error rate of human eye recognition and highly improve efficiency. Our work is based on semantic segmentation method and combines it with transfer learning technique enabling our model to train on a relatively small dataset without compromising the performance, and use CNN to firstly classify input images in order to further reduce the number of images to improve computational efficiency and accuracy. Then through incorporating state-of-the-art semantic segmentation model U- Net++, our model achieves the best performance compared to U- Net under transfer learning scenario. We compare our model with the state-of-the-art U-Net. Then we use mIOU

and pixel accuracy to measure the models' performance under two scenarios. Results illustrated that through transfer learning scenario, our model achieves the highest scores over other methods.

[RTD][PD] UV Round Table Discussion & Panel Discussion

Time: 7:30am-12:30pm, October 22nd, U.S. Eastern Daylight Time
Meeting Room (Microsoft Teams): [SF] IEEE UV2022 Student Forum
Chair(s): Juntao Jiang, Hanxia Li, Ziliang Lan and Zhenyao Liu

[RDT][PD2] New Opportunities and Technical, Legal, Social, and Ethical Challenges Posed by Applications of AI
Moderator: Zhenyao Liu and Ziliang Lan
Time: 7:30am-9:00am, October 22nd, U.S. Eastern Daylight Time

Theme 1: Evaluation of Smart Applications: The Most Favorite Applications and The Least Favorite Applications
Panelist: Roh Jaechul, Ruiyang Ji, Sophia Chin, Zhang Charles, Shiqi Zhang, Yuheng Zhang

Theme 2: Future Lifestyle
[SF-TS7-A&B-6] How Technology can Bring Negative Effect on Youth's Development
Speaker: Haotian Shangguan

[SF-TS7-A&B-7] Feature controllable expression and translation based on natural language processing

Speaker: Mingyuan Hu

Abstract: In the model of communication, diverse meaning in one word and bias influence language understanding and expression. Bias is the perception and noise influence how we express our content idea and how we understand others' meanings. Based on the model of communication and psychology, we use the dictionary to frame the diverse meaning of words and build six dimensions variables to adjust the result of how natural language processing understands and extracts the meaning with a special dimension feature in documents and conversations.

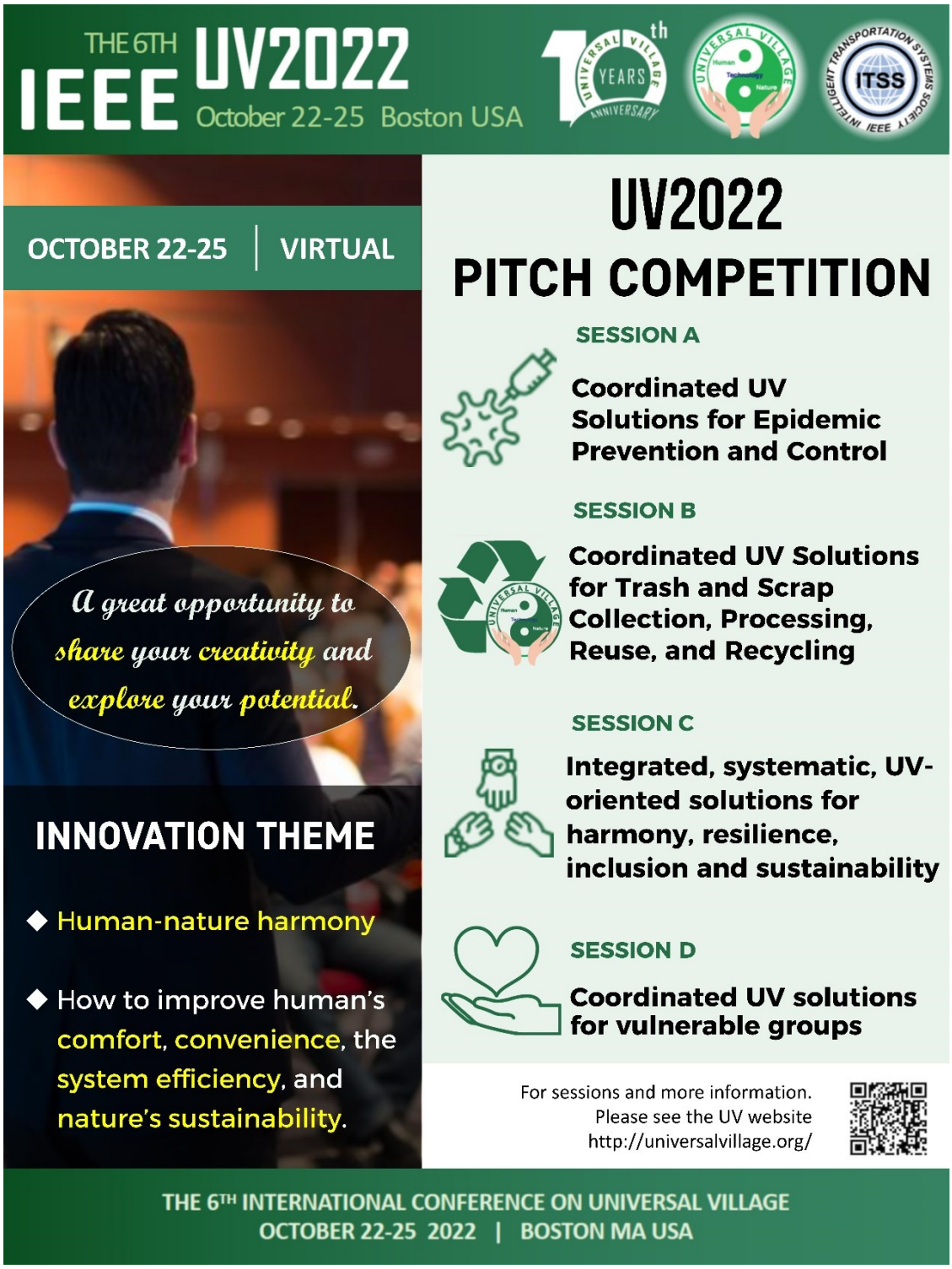
[SF-TS7-A&B-8] Preliminary study on the long term objective and current status about how smart home technologies should empower people with different lifestyles
Speaker: Yifan Wei

[RDT][PD1] Empowering vulnerable groups through the power of education and technology - Develop the capability of reflective, proactive and transformational learning and improve their quality of life
Moderator: Dominic Mentor (Columbia University), Hanxia Li, Junyi Yu
Time: 9:00am-11:00am, October 22nd, U.S. Eastern Daylight Time
Panelists: Brian Ahn (Columbia University), DJ Jeffries (Columbia University) and Yipu Zheng (Columbia University)

[RTD-1] Energy Crisis, Global Warming, Environmental Protection, and Future Lifestyles
Moderator: Gene Fry
Time: 11:30am-9:00am, October 22nd, U.S. Eastern Daylight Time
Panelists: Xinyu Tan, Yasha Yi and Xiaoman Duan

Session [PC]: UV Pitch Competition

Time: Ongoing
Chair(s): Hanxia Li



Session [K12C]: K-12 Challenge

Time: 10:30-15:00, October 22,23, U.S. Eastern Daylight Time
Meeting Room (Microsoft Teams): [K12C] IEEE UV2022 K-12 Competition
Chair(s): Klley Zhang

Time Table:

US EDT Time	10/21/2022	10/22/2022	10/23/2022	10/24/2022	10/25/2022
8:00am		UV Round table discussion			
10:00 ~ 10:30am		1.Kahoot	1. Research Presentation		
10:30 ~ 12:00pm		2.Current News			
12:00 ~ 1:00pm		Break	Break		
1:00 ~ 2:00pm		3. Spotlight Talks	2.Innovation Competition		
2:00 ~ 2:30pm			3.Talent Show		
3:00pm		Wrap Up	Wrap Up		
8:00pm ~ 12:00am	UV workshop	Innovation Competition (2) - 8-10pm Pitch Competition - Student Forum 10-12am			

[K12C] Session 1A: Kahoot Quiz Game

Time: 10:00am-10:30, October 22, U.S. Eastern Daylight Time
Team Channel: [K12C] IEEE UV2022 K-12 Competition
Chair(s): Kelly Zhang

All are welcome, ice breaker activity, no scheduled presentations at this time

[K12C] Session 2A: Current News Table Talk

Time: 10:30am-12:00pm, October 22, U.S. Eastern Daylight Time
Team Channel: [K12C] IEEE UV2022 K-12 Competition
Chair(s): Kelly Zhang

[K12-News1] Smart robot pet for seniors living with dementia

Speaker(s): Kelly Zhang
Time: 10:30am-10:40am, October 22th, U.S. Eastern Daylight Time

Abstract: Senior dementia patients often experience agitation, rejection of care, and loneliness. Recently, smart robot pets have been effectively used to reduce agitation and provide companionship. The most remarkable abilities of smart pets are that they can provide coaching for daily tasks, give reminders, detect when the patient is sick or in pain, and connect emotionally. Thus, smart pets can reduce caregiver burden and increase the patient's quality of life.

[K12-News2] Death of the Queen, Trump Trial, Ukraine War

Speaker(s): Charlie Cao
Time: 10:40am-10:50am, October 22th, U.S. Eastern Daylight Time

[K12-News3] AI Crime prediction and Solar Geoengineering

Speaker(s): Houjun Ji
Time: 10:50am-11:00am, October 22th, U.S. Eastern Daylight Time

Abstract: A presentation that discuss new global topic. The focus is on AI Crime prediction and Solar Geoengineering

[K12-News4] Human cortical organoids in a rat

Speaker(s): Weiguo Zeng
Time: 11:00am-11:10am, October 22th, U.S. Eastern Daylight Time

Abstract: The research team from Stanford successfully transplanted human cortical organoids into a rat's brain. Researchers observed that the human organoids occupied one-third of the rat's brain and functioned similarly to a healthy rat's brain. This experiment can assist scientists in understanding the mechanisms behind certain brain diseases and offer a conducive environment for organoid development. However, there are certain concerns.

[K12-News5] Restriction to Science

Speaker(s): Weiguo Zeng
Time: 11:10am-11:20am, October 22th, U.S. Eastern Daylight Time

[K12-News6] Currents: Technology News

Speaker(s): Jerry Ji
Time: 11:20am-11:30am, October 22th, U.S. Eastern Daylight Time

Abstract: international, national, diplomatic, normal life

[K12-News7] Password-free Future

Speaker(s): Chenghao Mo
Time: 11:30am-11:40am, October 22th, U.S. Eastern Daylight Time

Abstract: The FIDO Alliance, established by Google, Apple, Microsoft, and several other tech giants, is creating a password-free future. This technique allows users to log into apps and websites without using a password. Currently, an increasing number of companies are adopting FIDO standards to provide users with a password-free login option.

[K12-News8]

Speaker(s): Yitong Wang
Time: 11:40am-11:50am, October 22th, U.S. Eastern Daylight Time

[K12-News9]

Speaker(s): Haotian Shangguan
Time: 11:50am-12:00pm, October 22th, U.S. Eastern Daylight Time

[K12-News10]

Speaker(s): Haihan Wang
Time: 12:00pm-12:10pm, October 22th, U.S. Eastern Daylight Time

[K12C] Session 3A: Spotlight Talks

Time: 1:00pm-2:30pm, October 22, U.S. Eastern Daylight Time
Team Channel: [K12C] IEEE UV2022 K-12 Competition
Chair(s): Kelly Zhang

[K12-Spotlight-1] Introduction

Speaker(s): Kelly Zhang
Time: 1:00pm-1:10pm, October 22th, U.S. Eastern Daylight Time

[K12-Spotlight-2] Building My own Computer

Speaker(s): Mukun Zhou
Time: 1:10pm-1:30pm, October 22th, U.S. Eastern Daylight Time

[K12-Spotlight-3] UV Coordination for Robust Management of Future Smart Homes

Speaker(s): Liu Xuan
Time: 1:30pm-1:50pm, October 22th, U.S. Eastern Daylight Time

[K12-Spotlight-4] Why my high school failed to do paperless?

Speaker(s): Zheng Weiguo
Time: 1:50pm-2:10pm, October 22th, U.S. Eastern Daylight Time

Abstract: It was a confusing experience I felt this year. Similar things happened repeatedly, and we couldn't permanently solve them. I hope anyone who listens to this can come up with an idea and address this problem one day.

[K12-Spotlight-5] About Bullying

Speaker(s): Ailun Liu
Time: 2:10pm-2:30pm, October 22th, U.S. Eastern Daylight Time

Abstract: Bullying is hard to define due to its vague bound- aries and subjective nature, and often causes misunderstood issues of school bullying. Bullying can lead to both physical and mental devastating outcomes, and thereby managing and addressing bullying effectively become very important. A more accurate and comprehensive definition of bullying, increased awareness and training for teachers, and collaborative efforts between schools and education authorities will undoubtedly help effectively combat this pervasive problem.

[K12-Spotlight-6] The line of God

Speaker(s): Vivian Li
Time: 2:30pm-2:50pm, October 22th, U.S. Eastern Daylight Time

Abstract: Scoliosis – experience and expectation

[K12-Spotlight-7] Favorite and Least Favorite Subsystem

Speaker(s): Charles

[K12C] Session 1B: Research Presentation

Time: 10:00am-12:00pm, October 23, U.S. Eastern Daylight Time
Team Channel: [K12C] IEEE UV2022 K-12 Competition
Chair(s): Kelly Zhang

[K12-Research-1] Evaluation of Smart Agitation Prediction and Management for Dementia Care and Novel Universal Village Oriented Solution for Integration, Resilience, Inclusiveness and Sustainability

Speaker(s): Kelly Zhang
Time: 10:00am-10:30am, October 23th, U.S. Eastern Daylight Time

[K12-Research-2] Barnacle's negative impact on marine transportation

Speaker(s): Weiguo Zeng
Time: 10:30am-11:00am, October 23th, U.S. Eastern Daylight Time

Abstract: Barnacles have become a severe problem for marine facilities and transportation. Every year, individuals and companies lose more than 10 billion dollars due to the need to clean off accumulated barnacle clusters. I want to encourage more people to consider solutions based on my observations of several beaches in Guangxi, discussions with nearby ship owners, and other research. Let's motivate more individuals to tackle these issues.

[K12-Research-3] Depression Detection for Suicide Prevention

Speaker(s): Houjun Ji
Time: 11:00am-11:30am, October 23th, U.S. Eastern Daylight Time

[K12-Research-4] Preliminary Study of Plastic Cycling System

Speaker(s): Cheuk Wang Su
Time: 11:30am-12:00pm, October 23th, U.S. Eastern Daylight Time

Abstract: At present, rapid urbanization brings convenience and high efficiency to our daily lives. However, the increase in GDP comes at the cost of high metabolic rates, high waste per capita, a severe lack of resources, heavy pollution, and waste siege. This expensive lifestyle leads to severe environmental degradation and soaring resource consumption.

Plastic has become involved in every part of our world. Bottles, toys, cars, and electronic products all have plastic components. As plastic becomes a very familiar presence in our lives, plastic production is also high. Studies estimate that 8.3 billion metric tonnes of plastic have been produced since the early 1950s to 2017. Continuing this trend, it is estimated that total plastic manufacturing will reach 34 billion metric tons by 2050. As production increases, disposal methods also need to improve. However, according to studies, only 9% is recycled.

If plastic is not properly processed, it will remain in the world forever and create mass destruction in our environment. For example, the ocean contains a significant amount of plastic that enters from waterways and beaches. Over time, plastic degrades and becomes microplastic. According to data, there are 51 trillion microplastic particles in the ocean. These particles then enter the food chain, affecting our health as many sea animals mistake them for food.

Overwhelming amounts of plastic also affect human health. Research has found that an apple contains around 195,500 plastic particles per gram. As plastic enters our bodies, it exposes us to health impacts. Reports estimate that a person could consume the equivalent of a credit card's size of plastics per week. Among all types of plastics, including #1 PET, #2 HDPE, #3 PVC, #4 LDPE, #5 PP, #6 PS, and #7 others, PVC is estimated to be the most toxic to the human body. It contains a significant amount of phthalates, which can damage the liver, kidneys, lungs, and reproductive system.

In this paper, we evaluate plastic pollution based on the framework of a closed feedback control loop: data acquisition, communication, decision-making, and action. For sensing, most technologies focus on plastic classification. Many current technologies have achieved high performance in dataset experiences but still lack stability and performance in real-time scenarios. For action, there are already technologies working in the real world to help collect plastics, specifically in the ocean. These technologies include 4Ocean's skimmer, Mr. Trash Wheel in Baltimore, Maryland, and Cleantec Infra. There are also innovations such as turning used plastics into bricks.

We propose that effective smart environmental protection should consider the interaction between environmental protection subsystems and the other seven smart city subsystems: smart home, smart medicine and healthcare, intelligent transportation, urban planning and

crowd management, smart energy management, smart city infrastructure, smart response system for city emergencies, and smart humanity.

This systematic study will help us explore in-depth the complicated dynamic relationship between multiple impacting factors and propose a UV-oriented, integrated, resilient, inclusive, and sustainable development framework design to address current imminent challenges. It aims to improve our living environment through real-time monitoring of pollution, crowd-sourcing based on hazard reports, identification of pollution sources, preventive waste and pollution control based on comprehensive management of material cycles, and personalized lifestyle guidance and suggestions.

[K12-Research-5] CRISPR gene editing technology: Introduction, problems and solutions

Speaker(s): Pengjun Guo
Time: 12:00pm-12:30pm, October 23th, U.S. Eastern Daylight Time

Abstract: CRISPR technology is a gene-editing technology discovered in 2012. This technology has had a revolutionary impact on molecular biology research due to its affordability, convenience, and speed. Today, scientists have discovered a variety of CAS enzymes that can be used for gene editing. However, despite these advancements, CRISPR still poses several problems, which can disrupt the harmony between humankind and nature. The presentation will describe the basic principles, some issues, and the solutions of CRISPR technology.

[K12-Research-6]

Speaker(s): Charles Zhang

[K12-Research-7]

Speaker(s): Tristan Li

[K12-Research-8] Preliminary Study on Unmanned Aerial Vehicles: In the Lens of Universal Village

Speaker(s): Jerry Ji

[K12-Research-9]

Speaker(s): Sophia Chin

[K12-Research-10] [Social Issues Discussion Article] Preliminary Exploration and Evaluation of Smart Support for Homeless Community

Speaker: Yitong Wang

[K12C] Session 2B: Innovation Competition

Time: 1:00pm-2:00pm, October 23, U.S. Eastern Daylight Time
Team Channel: [K12C] IEEE UV2022 K-12 Competition
Chair(s): Kelly Zhang

[K12-Innovation-1] Non-Newtonian Fluid for Speed Bumps

Speaker(s): Kelly Zhang
Time: 1:00pm-1:20pm, October 23, U.S. Eastern Daylight Time

Abstract: New innovation for speed bumps: Currently, speed bumps are made of hard materials, which can create an uncomfortable experience for vehicle occupants, even when they are following the speed limit. Additionally, some bumps may scrape the bottom of a car. The new innovation proposes the use of non-Newtonian fluids in speed bumps. This way, the bump can differentiate between fast and slow cars. If a vehicle is traveling at a high speed, the fluid will solidify and function like a typical speed bump. However, if a vehicle is adhering to the speed limit, the fluid will transform into a liquid state, providing a sensation as if the speed bump doesn't exist.

[K12-Innovation-2] [Popular Science Knowledge Article] Introduction and Comparison of Different Renewable Energy Sources

Speaker(s): Richard Liao
Time: 1:20pm-1:40pm, October 23, U.S. Eastern Daylight Time

Abstract: This paper introduces different resources of renewable energy including biomass, hydroelectricity, tidal, solar, wind and geothermal. The advantages and disadvantages of each renewal energy resource in relation to the environment are compared.

[K12-Innovation-3] Auto driving evolution

Speaker(s): Mingyuan Hu
Time: 1:40pm-2:00pm, October 23, U.S. Eastern Daylight Time

Abstract: The history of how auto driving developed.

[K12-Innovation-4]

Speaker(s): Jerry Ji
Time: 2:00pm-2:20pm, October 23, U.S. Eastern Daylight Time

[K12-Innovation-5]

Speaker(s): Yitong Wang
Time: 2:20pm-2:40pm, October 23, U.S. Eastern Daylight Time

[K12C] Session 3B: Talent Show

Time: 2:00pm-2:30pm, October 23, U.S. Eastern Daylight Time
Team Channel: [K12C] IEEE UV2022 K-12 Competition
Chair(s): Kelly Zhang

[K12-Talent-1]

Speaker(s): Kelly Zhang
Time: 2:00pm-2:10pm, October 23, U.S. Eastern Daylight Time

[K12-Talent-2]

Speaker(s): Mingyuan Hu
Time: 2:10pm-2:20pm, October 23, U.S. Eastern Daylight Time

[K12-Talent-3]

Speaker(s): Sophia Chin
Time: 2:20pm-2:30pm, October 23, U.S. Eastern Daylight Time

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