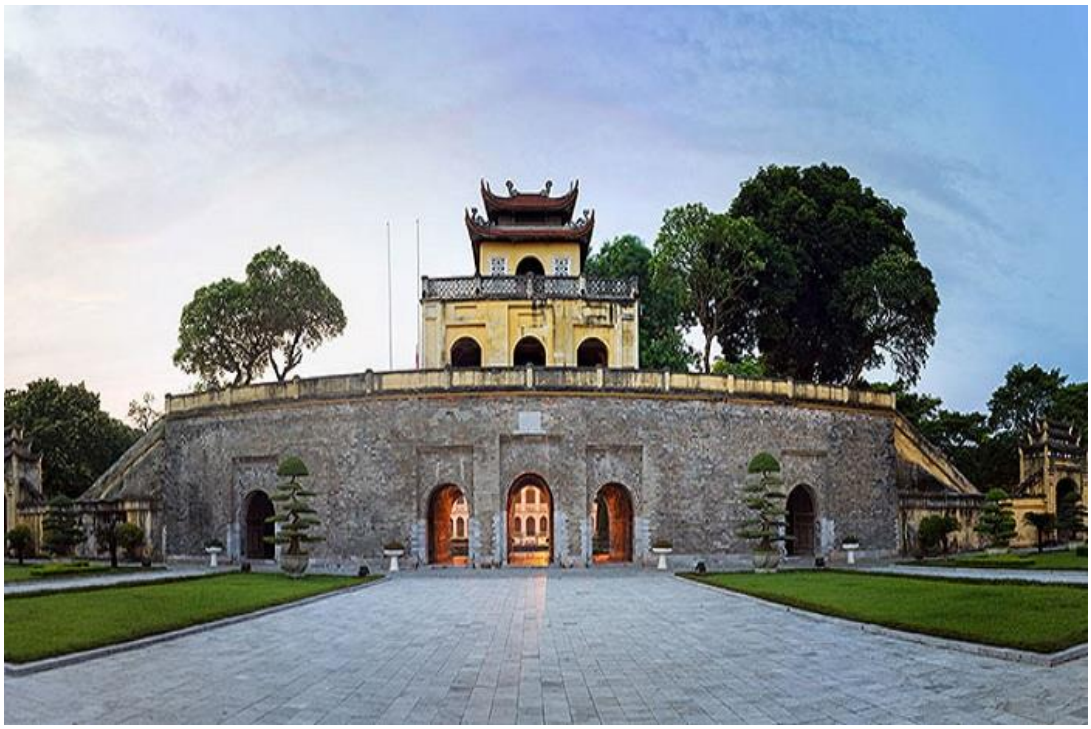
EIER 2022

Hanoi, 13 January 2022

Venue: Online (Zoom link, Meeting ID: 859 3439 1346, Passcode: 265954767)



Contact:

VNU University of Engineering and Technology

Advanced Institute of Engineering and Technology (AVITECH)

Address: Room 707, Building E3, 144, Xuan Thuy, Cau Giay, Hanoi, Vietnam

Email: avitech@vnu.edu.vn

Phone: +84 24 3780 0150

Host & Committee

Host

Advanced Institute of Engineering and Technology (AVITECH),
VNU University of Engineering and Technology

Organizing Committee

- Prof. Dr. Chu Duc Trinh, VNU-UET
- A/Prof. Ha Quang, UTS, Australia
- A/Prof. Dr. Nguyen Linh Trung, VNU-UET

Local Arrangement Committee

- Assoc. Prof. Nguyen Hoai Son, VNU-UET
- Dr. Tran Thi Thuy Quynh, VNU-UET

Program Committee

- Dr. Le Vu Ha, VNU-UET
- Dr. Dinh Tran Hiep, VNU-UET

Secretariat

- Vu Duy Thanh, VNU-UET
- Chu Thi Minh, VNU-UET

Preface

With the rapid growth of population and increased life expectancy, urbanization has emerged as a new trend of living. Along with global warming, urbanization is on one hand the cause of many serious impacts, including energy shortage, infrastructure deterioration, environmental problems and associated health risks. On the other hand, opportunities also arise from major scientific and technological advances, economic changes and ecological protection measures. The evolution of smart cities, enabled by digital technologies, is set to be one of global developments for the future with enormous potential for addressing sustainable needs of civilization and population health.

The translation of advances in digital technologies into real-world, actionable, and personalised services to benefit the general community has become a central focus of many research endeavours in as well as outside Vietnam. For this vision, studies to implement digital intelligence in urban development are being focused on prioritized areas such as energy generation from renewable sources; building management and resilience enhancement of infrastructure; water management, air quality monitoring, and environmental health.

EIER 2022 is the third meeting of an annual workshop series, designed to promote interdisciplinary and international collaboration in such research activities. The first two meetings of this series, EIER 2020 and EIER 2021, drew scholars from Australia, Korea, France, Hong Kong, Germany, Japan, Malaysia, Sweden, Taiwan, India, the Netherlands, United States, and Vietnam. They also provided a forum for young researchers who were eagerly looking for valuable feedback on their work and networking opportunities. We hope to continue building on that success to make EIER 2022 a venue for stimulating discussion and fruitful exchange of ideas, both scientific and practical.

The EIER 2022 workshop's specific objectives are:

- to raise awareness of, and to nourish high quality research in problems of direct relevance to energy, infrastructure and environment;
- to foster collaboration between national and international scholars; and
- to further research engagement with responsible stakeholders towards feasible solutions to the burning issues in energy, infrastructure and environment.

Due to the current Covid-19 situation in Viet Nam, this event will be held online. The organizing committee welcomes participation from academics from different disciplines, as well as government agencies, industries, and the general public.

We trust that you will find this workshop informative, inspiring, and motivating.

Chu Duc Trinh, Prof. Dr.,
Vice-Rector,
VNU University of Engineering and Technology.

Program (Zoom link, Meeting ID: 859 3439 1346, Passcode: 265954767)

07:30 - 08:00	Welcoming Reception
08:00 - 08:10	Welcoming from Prof. Dr. Chu Duc Trinh, Vice Rector of the VNU University of Engineering and Technology
08:10 - 08:20	Introduction about EIER series, Prof. Ha Quang, UTS, Australia
08:20 - 10:00	***Invited Lectures***
08:20 - 08:40	Prof. Dr. Sc. Nguyen Dinh Duc, VNU University of Engineering and Technology, Dr. Pham Tien Thanh, VNU Vietnam Japan University, Vietnam, "Biomass-based Photothermal Composite Material for Sustainable Desalination Solutions"
08:40 - 09:00	Prof. Michael Negnevitsky, University of Tasmania, Australia, "High Renewable Energy Penetration and Power System Security: New Challenges and Opportunities"
09:00 - 09:20	Prof. Koshy Varghese, Indian Institute of Technology Madras, India, "Low Carbon Construction Through Innovation in Materials and Management"
09:20 - 09:40	Prof. Bijan Samali, Western Sydney University, Australia, "Development of Energy Efficient Roof Tiles"
09:40 - 10:00	Prof. Sybil Derrible, University of Illinois Chicago, US, "What do sustainability and resilience mean in the context of urban infrastructure?"
10:00 - 11:40	***Plenary Presentations***
10:00 - 10:10	Hiep Duc Nguyen, John Leys, Matthew Riley, Sean Watts, Merched Azzi, Toan Trieu, David Salter, Huynh Nguyen, Lisa Tzu-Chi Chang, Xavier Barthelemy, "Effects of dust storms and wildfires on phytoplankton growth in the Southern Ocean and Tasman Sea, southeastern Australia"
10:10 - 10:20	Hoang Ngoc Khue Vu, Bang Quoc Ho, "Preliminary results of the causes of air pollution in Hanoi city, Vietnam"
10:20 - 10:30	R.M.T. Raja Ismail "Proton-Exchange Membrane Fuel Cell Energy Conversion and Control"
10:30 - 10:40	Vu Thi Thuy Anh, Pham Dinh Nguyen, Tran Hiep Dinh, "Automatic Simulation for Safety Prediction of Composite Structures under Crack Propagation"
10:40 - 10:50	Vu Ngoc Linh, Nguyen Van Dong, Tran Van Bay, Nguyen Hai Binh, Vu Duy Tung, Nguyen Hong Nam, "Characterization and potential applications of the solid residue from macadamia nutshell gasification"

10:50 - 11:00	Qiuchen Zhu, "Deep Learning for surface inspection with UAV imaging"
11:00 - 11:10	Nguyen Nhut Tien, Vo Tran Thi Bich Chau, "Optimal Planning for Sustainable Hybrid Energy Systems Producing Oxygen Onsite and Considering By-product Hydrogen for Backup Power in Aquaculture"
11:10 - 11:15	Varun Kumar Reja, Koshy Varghese, Quang Phuc Ha, "Existing Challenges in Computer Vision-Based Progress Monitoring of Construction Projects"
11:15 - 11:20	Huynh A.D. Nguyen, Q.P. Ha, H. Duc, M. Azzi, and M. Riley, "Deep learning technique for enhancing the accuracy of air pollution forecast"
11:25 - 11:30	Lanh Van Nguyen, Quang Phuc Ha, "Game Theory for Cooperative Unmanned Aerial Vehicles"
11:30 - 11:35	Bui Van Vu, "Developing Data-driven control algorithms for agricultural mobile robots" (PhD research proposal)
11:40 - 12:00	***Talk and performances***
11:40 - 12:00	Talk and performances, (Dr. Nguyen Le-Tuyen, NSW DET Australia & Prof Salil Sachdev, Bridgewater State University, Massachusetts, USA)
12:00 - 13:20	***Lunch break***
13:30 - 14:00	***Invited Lecture***
13:20 - 13:40	Prof. Nguyen Van Tuan, University of Technology Sydney, Australia, "Population density as a catalyst factor for communicable diseases: the Covid-19 case in Vietnam"
13:40 - 14:40	***For potential postdocs, PhD students: some advice***
13:40 - 14:00	Prof. Ha Quang, "Towards a pleasant PhD candidature"
14:00 - 14:40	Prof. Nguyen Van Tuan, "How to get published in high impact journals"
14:40 - 15:00	***Invited Lecture***
14:40 - 15:00	Prof. Duong Quang Trung, Queen's University Belfast, UK, "Unmanned Aerial Vehicles-assisted Disaster Emergency Communications"
15:00 - 16:00	***Open forum & discussion***
16:00 - 16:10	Workshop Conclusion, Prof. Ha Quang, UTS, Australia

Keynote speakers

1. Prof. Dr. Sci. Nguyen Dinh Duc
Vice-President of Vietnamese Association in Mechanics
Member of the Vietnam Professor Council in Mechanics
Head of Laboratory of Advanced Materials and Structures,
Dean of Department of in Civil Engineering - VNU Hanoi,
University of Engineering and Technology (UET)
Program Director of Infrastructure Engineering Program of Vietnam-Japan University (VJU)
Director of Undergraduate and Postgraduate Academic Affairs Department, Vietnam National University, Hanoi.
Email: ducnd@vnu.edu.vn

2. Dr. Pham Tien Thanh
Lecturer & Program Coordinator of the master's program in Nanotechnology
VNU Vietnam Japan University
Email: pt.thanh@vju.ac.vn

3. Prof. Michael Negnevitsky
Chair in Power Engineering and Computational Intelligence
Director of the Centre for Renewable Energy and Power Systems
School of Engineering, College of Science and Engineering
University of Tasmania, Australia
Email: Michael.Negnevitsky@utas.edu.au

4. Prof. Koshy Varghese
Department of Civil Engineering
Dean of Administration
Indian Institute of Technology Madras, India
Email: koshy@iitm.ac.in

5. Prof. Bijan Samali
Professor of Structural Engineering
Director of the Centre for Infrastructure Engineering
Western Sydney University, Australia
Email: B.Samali@westernsydney.edu.au

6. Prof. Duong Quang Trung
Fellow of IEEE, 2022 Class
Chair Professor of Telecommunications
Queen's University Belfast, U.K.
Research Chair of the Royal Academy of Engineering, U.K.
Email: trung.q.duong@qub.ac.uk

7. Prof. Nguyen Van Tuan
Leadership Fellow of the Australian National Health and Medical Research Council
Director of the Centre for Health Technologies and Professor of the Predictive Medicine
University of Technology Sydney, Australia
Conjoint Professor of Epidemiology
School of Population Health
University of New South Wales, Australia
Email: TuanVan.Nguyen@uts.edu.au

8. Prof. Sybil Derrible
Associate Professor
Department of Civil, Materials, and Environmental Engineering
Department of Computer Science (by courtesy)
Research Associate Professor
Institute for Environmental Science and Policy
Director of the Complex and Sustainable Urban Networks Laboratory
University of Illinois at Chicago, US
Email: derrible@uic.edu

9. Dr. Nguyen Le-Tuyen
New South Wales Department of Education
Teaching Fellow
School of Music
Australian National University, Australia
Email: LE.NGUYEN@det.nsw.edu.au Website: https://nguyenletuyen.wordpress.com/

10. Prof. Salil Sachdev
Bridgewater State University, Massachusetts, USA
Email: salil.sachdev@bridgew.edu
YouTube Channel: https://www.youtube.com/channel/UCI3gHX2Xh4vQQ4ctywRP2BQ

Invited Lectures

Biomass-Based Photothermal Composite Material For Sustainable Desalination Solutions

The scarcity of fresh water sources in coastal areas, which is exacerbated by increasing seawater level rise and salinization, is a key issue for sustainable development in the 21st century. In order to solve this problem, numerous methods for desalination were studied and applied including ion exchange membrane distillation, reverse osmosis, and solar steam generation. Among these, SSG shows many merits, such as renewable energy consumption, zero CO2 emission, simple structure and operation, and affordable price. Therefore, it is expected to be a solution to sustain the fresh water sources for undeveloped countries and remote areas. Agro-waste based photothermal materials attract interest recently because of low cost, simple fabrication, and eco-friendly properties. Plants have appropriate characteristics for fabricating photothermal materials to be utilized in SSG systems. In this study, plant leaves and a common agricultural waste were utilized to fabricate the photothermal material that can be applied in the SSG system. The resulting composite material demonstrated significant advantages such as high light absorption, low thermal conductivity, ultra-fast water transportation, low moisture enthalpy, and self-cleaning properties. The biomass based SSG system possessed high seawater evaporation rate and evaporation efficiency, which are comparable to those in the previous studies on biomass composite material based SSG systems. Especially, the SSG system exhibited excellent structural stability that ensures their long-term performance in the seawater desalination. With simple fabrication process, affordable price, and eco-friendly materials, the biomass-based photothermal composite material proves great potential in seawater desalination application.

Professor Dr. Sci. Nguyen Dinh Duc is one of the leading scientists in mechanical science. He is the Vice-President of Vietnamese Association in Mechanics and a member of the Professor Election Council in Mechanics of Vietnam. Professor Duc is the Head of Laboratory of Advanced Materials and Structures, the Dean of Department of in Civil Engineering - VNU Hanoi, University of Engineering and Technology (UET) and Program Director of Infrastructure Engineering Program of Vietnam Japan University (VJU); Director of Undergraduate and Postgraduate Academic Affairs Department, Vietnam National University, Hanoi.

Prof. Dr. Sci. Nguyen Dinh Duc
VNU University of Engineering and Technology

Professor Duc holds a Ph.D. in mathematics -physics from Moscow State University (1991) and a Doctor of Science degree (Dr. Habilitation) in Engineering from Russian Academy of Sciences (1997). He had been appointed to Associate Professor (2007) and Full Professor (2013) at Vietnam National University, Hanoi. Professor Duc has over 300 publications in which about 200 papers have appeared in numerous ISI (SCI, SCIE) journals. He is the member of Editorial Board of 10 ISI International journal. Last but not least, he has written 5 textbooks and monographs for he undergraduate and graduate programs in Vietnamese, Russian and English.

Professor Nguyen Dinh Duc has been a foreign member of the Russian Academy of Natural Sciences and the member of the International Academy of Scientific Inventions and Patents (since 1999). He was a member of the Central Committee of the Vietnam Fatherland Front (1999-2004), the former Vice-President and Secretary general of Vietnam Science-Technical Association in Russia (1999-2001), former Vice President of Vietnamese Young Scientist Association in Vietnam (2004-2010), Vice President of University of Engineering and Technology, VNU (2008-2012).

Professor Duc has been awarded Silver Medal of Russian Academy of Natural Sciences for the Invention on. The law-behavior of mechanical characteristic for three-phase composite 3Dm reinforced by spherical particles (in Russia, 1999) and the Third Prize of “Talented Vietnamese National Award” (in Vietnam, 2008). Because of outstanding contributions to the national education and training career, professor Duc has received the VNU President's merit of excellence awards in years 2006, 2009, 2011, 2013, 2014, 2015, 2016, 2019, 2020, 2021 and the Prime Minister's merit of excellence award in 2009. He has been selected as one of the most outstanding people in Vietnam education system in 2015, President of Vietnam awarded 3-rd class Labour Medal (2016). Certificate of Merit granted by the Minister of Education of Vietnam, 2019. Professor Nguyen Dinh Duc was announced by the US journal PLoS Biology to be in the list of the top 100,000 most influential scientists in the world in 2019 and the top 10,000 scientists in the world with the greatest influence in 2020,2021 and ranking 96 in the field of Engineering.

In particular, in 2020, 2021, he was one of the two Vietnamese scientists working locally in the country has entered the most prestigious ranking - 100,000 scientists are ranked to influence the world according to lifelong achievements.

Dr. Pham Tien Thanh is currently a lecturer and coordinator in the Nanotechnology program, VNU Vietnam Japan University. He obtained the Bachelor, Master, and Ph.D. degree in Electronics and Applied Physics from the Interdisciplinary Graduate School of Science and Engineering, Tokyo Institute of Technology, Japan. The focuses in his studies include studying optical properties of metallic nanostructures, multilayer nanostructures, bio-inspired materials, metamaterials, and their application to optical devices such as broadband light absorber, plasmonic metamaterial blackbody, biosensors. He is also focusing on the development of nanomaterial and nature-inspired materials to convert the natural, renewable energy into heat energy, which will be used to produce clean water from seawater and wastewater. He has published some papers about the research topic in the high IF journals, for example Desalination, Scientific reports, Advanced sustainable systems etc.

Dr. Pham Tien Thanh
VNU Vietnam Japan University

High Renewable Energy Penetration and Power System Security: New Challenges and Opportunities

The word “security” in the context of a power system implies its security against a complete collapse, or a blackout. An increasing penetration of intermittent renewable energy generation introduces additional uncertainties in power systems. The main challenge facing a power system with high penetration of renewables is the displacement of conventional synchronous generation by non-synchronous generation. Kinetic energy stored in the rotating masses of synchronous generators provides the system rotational inertia. Wind power generators are either partially or completely decoupled from the grid by electronic converters; they do not provide inertia to the system. This reduces the total system inertia, and as a result, the system becomes more vulnerable to contingencies. Traditionally security assessment is based on the worst-case scenario criterion and provides a simple rule in the system design and operation. It has satisfied the needs of the power industry for decades. However, the deterministic approach to security is not adequate in modern power systems with market driven dispatch and high penetration of renewable energy and distributed generation. In this paper, security is defined as the risk in the system's ability to withstand random contingencies without interruption to customer service. In calculating the operational risk, we take into account not just the likelihood of contingencies, but also uncertainties in load variability and renewable energy generation. In risk-based security assessment, we generate contingencies at random, based on their probabilities.

Prof. Michael Negnevitsky

University of Tasmania, Australia

Professor Michael Negnevitsky is Chair in Power Engineering and Computational Intelligence and Director of the Centre for Renewable Energy and Power Systems, University of Tasmania, Australia. The primary focus of his research is smart grids, power system security, demand response, and isolated and remote area power systems with high renewable energy penetration. Professor Negnevitsky authorised more than 400 research publications including 120 journal papers, more than 300 conference papers, 12 chapters in books, 2 books, 9 edited conference proceedings and received 4 patents for inventions. He is Fellow of Engineers Australia. Professor Negnevitsky is Chair of the IEEE PES Working Group on High Renewable Energy Penetration in Remote and Isolated Power Systems, Vice Chair of the IEEE PES Asian and Australasian Infrastructure - Smart Grids with Large Penetration of Renewable Energy, Member of CIGRE AP C4 (System Technical Performance) and CIGRE AP C6 (Distribution Systems and Dispersed Generation), Australian Technical Committee, Member of CIGRE Working Group JWG C1/C2/C6.18 (Coping with Limits for Very High Penetrations of Renewable Energy), International Technical Committee, and Member of CIGRE Working Group C6.30 (The Impact of Battery Energy Storage Systems on Distribution Networks), International Technical Committee.

Development Of Energy Efficient Roof Tiles

Energy efficient tiles refer to those that can improve thermal performance of a building. In this research, phase change materials (PCMs) are incorporated into tiles' mortar that would increase the thermal mass of the object and subsequently strengthen the barrier between the building indoor and outdoor environments. To protect PCMs from leaking, they are mixed with diatomite which would allow them to trap themselves into diatomite pores as a result of capillary action. The composite consisting of PCM and diatomite is called form-stable PCM (FSPCM). A double-jacketed glass reactor was used to prepare FSPCM composite. Regular mortar materials are mixed with FSPCM composite to prepare the tiles. The corresponding energy savings were calculated by empirical formulas. A comparative study on energy savings has been performed. It is found that the cooling energy can be saved by about 35%.

Professor Bijan Samali is Professor of Structural Engineering and the current Director of Centre for Infrastructure Engineering at the Western Sydney University. He received his Doctorate degree from the George Washington University in Washington DC in 1984 in Dynamics of Structures.

He has published nearly 600 technical papers in engineering journals and conference proceedings and to date has supervised over 40 PhD students successfully and has attracted over $5M in research funding as a Chief Investigator. His main research interests and expertise lie in the general area of Structural Engineering (with emphasis on Structural Vibration Control, Structural Health Monitoring, Wind and Earthquake Engineering, as well as Bridge Rehabilitation and Structural Testing) and materials, particularly concrete structures and pavements, including new and innovative, and green materials for engineering applications. He has over 34 years of academic experience in Australia, and engagement with industry as a specialist consultant for over 37 years.

Prof. Bijan Samali

Centre for Infrastructure Engineering,
Western Sydney University

What do sustainability and resilience mean in the context of urban infrastructure?

Planning, designing, and operating sustainable and resilient infrastructure has become a priority for most nations on earth. Yet, by nature, the terms “sustainability” and “resilience” are conceptual, and they do not help much in the design process. In this talk, we will discuss their meaning within the context of urban infrastructure, differentiating between sustainable, tolerable, and unsustainable infrastructure, and discussing the concept of satisficing in resilience. We will also look at specific examples in several infrastructure domains to illustrate how they can be applied. In particular, we will compare the model of water distribution in high-income countries with the one adopted in Vietnam that tends to be both more sustainable and resilient. In the end, while we are a long way from operating truly sustainable and resilient urban infrastructure, we have made much progress that we can learn from and get inspired for the future of urban infrastructure.

Sybil Derrible is an Associate Professor in the Department of Civil, Materials, and Environmental Engineering and the Department of Computer Science (by courtesy), a Research Associate Professor at the Institute for Environmental Science and Policy, and the Director of the Complex and Sustainable Urban Networks (CSUN) Laboratory at the University of Illinois at Chicago. His research is at the nexus of urban metabolism, infrastructure planning, data science, and complexity science to redefine how cities are planned, designed, and operated for smart, sustainable, and resilient urban systems. He is the author of the textbook Urban Engineering for Sustainability (MIT Press, 2019) and he an Associate Editor for the ASCE Journal of Infrastructure Systems and for Cleaner Production Letters.

Assoc. Prof. Sybil Derrible
Institute for Environmental Science and Policy, UIC
Complex and Sustainable Urban Networks Laboratory, UIC

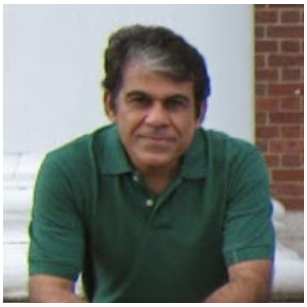
Musical Dialogue, Culture, and Mother Earth

This lecture-recital presents original compositions and arrangements inspired by traditional music and nature in an endeavour to raise awareness of the environment. Starting in 2010, the collaboration between guitarist Le-Tuyen Nguyen (Australia) and percussionist Salil Sachdev (USA) has been an evolving and exciting musical dialogue between two musicians with varied musical backgrounds residing on opposite sides of the world. Discussion will analyse how traditional melodic and rhythmic idioms are weaved with Western music exploring the technical and expressive dimensions of the guitar enhanced with percussion instruments from various parts of the world. Musical excerpts and live demonstrations will explain the instrumental and compositional techniques 1) to recreate the tone color and the sonority of the Vietnamese gong ensembles by the confluence of guitar harmonics and Tibetan gong; 2) to depict the ambience of the landscapes and music of the highlands by using the Hang drum (invented in Switzerland in 2000) and guitar overtone clusters; 3) to capture the aura of traditional dance and festive contexts incorporating guitar scordaturas (different tuning systems) combined with the West African drum (Djembe), rattles and foot jingles.

Dr. Nguyen Le-Tuyen is an Australian composer, researcher, and teacher. He studied music and education at the University of New South Wales and completed his doctorate at the Australian National University. Currently based in Sydney, he has worked in leadership positions within the New South Wales Department of Education and a Teaching Fellowship at the Australian National University School of Music. An active advocate for culture and nature, Dr. Nguyen has collaborated with various academic and traditional musicians, visual artists, dancers, scientists, writers, government and non-government organisations.

Dr. Nguyen Le-Tuyen
University of New South Wales

Prof. Salil Sachdev is on the music faculty at Bridgewater State University (BSU), Massachusetts, USA. He teaches music fundamentals, musics of the world, 20th century music as well as directs Mela (BSU World Music Ensemble). He has composed music for orchestra, percussion, piano, theater, voice, and electronic music. Salil's interest in world music has taken him to India, Ireland, Africa and Cuba. He has studied frame drumming, West African djembe drumming, the bodhran (Irish drum), and Solkattu (the rhythmic system of South India). Salil has made two documentary films, one on the music of the Sidis (an ethnic group of East African ancestry living in India since 800-900 years) and the other on the traditional music of Mali, West Africa.



Prof. Salil Sachdev
Bridgewater State University, Massachusetts, USA

Population density as a catalyst factor for communicable diseases: the Covid-19 case in Vietnam

Despite remarkable advances in public health over the past fifty years, communicable diseases (e.g., HIV/AIDS, malaria, tuberculosis, acute respiratory infections) still pose a major challenge for modern society, and the ongoing outbreak of Covid-19 a case in point. At present, almost one-third of all deaths in the world is attributable to communicable diseases. The Covid-19 pandemic has to date (October 5, 2021) killed 4.85 million people worldwide. Delineation of risk factors that affect the spread of communicable diseases is a critical task to prevent future spread. Research over the past 5 decades have identified three major groups of factors that are associated with the severity of infectious disease outbreaks: education, income, and environmental exposure. One important environmental factor is population density. Indeed, high population density has been hypothesized to be linked to increased risk of communicable diseases, especially covid-19 because its transmission takes place through air. In order to test this hypothesis, I analyzed the covid-19 prevalence data in 63 provinces or cities in Vietnam, and I found that localities with higher population density had a greater chance of covid-19 infection and a greater risk of covid-related mortality. This finding confirms previous observation of a positive correlation between population density and basic reproduction rate (R0), an index of covid-19 transmissibility. These empirical findings are therefore consistent with the hypothesis that regions with a denser population tend to have a higher extent of social interactions, and therefore elevate the probability of transmission between individuals. The findings also have implication for future pandemic resistant urban planning.

Dr. Nguyen Van Tuan is a Leadership Fellow of the Australian National Health and Medical Research Council, Director of the Centre for Health Technologies and Professor of Predictive Medicine at the University of Technology Sydney (Australia), and Conjoint Professor of Epidemiology at the School of Population Health of the University of New South Wales, Autralia. For over 30 years, his research has contributed evidence for better health care policy and clinical guidelines concerning the prevention and treatment of osteoporosis nationally and internationally. Dr. Nguyen has received numerous prestigious awards nationally and internationally for his distinguished contributions to medical research. During the covid-19 pandemic he has applied his epidemiologic skills in the analysis of outbreak data and made recommendations to the leadership of Ho Chi Minh City. For over 20 years, he has contributed to scientific research, medicine and education in Vietnam, and his work has earned multiple awards and recognitions from Vietnamese medical societies, hospitals, universities and governments.

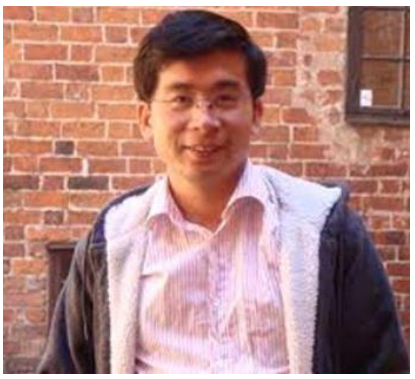
Prof. Nguyen Van Tuan

Centre for Health Technologies,
University of Technology Sydney
School of Population Health,
UNSW Medicine, UNSW Sydney

Unmanned Aerial Vehicles-assisted Disaster Emergency Communications

This talk concentrates on using amateur unmanned aerial vehicles (UAV), aka low-cost drones, to aid in disaster relief under hostile conditions such as congested/destroyed network or lack of power supply. UAVs flying above the affected area (to serve as a backbone to connect the disaster area with central control units) could help first responders in assessing the gravity of disaster recovery and relief scenario, such as aftermath of flooding, hurricanes, and earthquakes. However, the challenge associated with UAVs' use is two-fold. As a device, UAVs' airborne duration is limited by their battery capacity, whereas their intensive assistance is required during the first hours of the disaster. Hence, the resource (including power, bandwidth) allocated to each UAV must be well-optimised. Moreover, optimisation of radio resource for UAVs as a network to provide adequate coverage for the disaster area is critical and not without difficulty, since the disaster environment changes rapidly. Traditional wireless communications methods are expensive and extremely time consuming, failing to address this problem. This remains one of the greatest challenges in communications engineering.

Prof. Duong Quang Trung is a Chair Professor of Telecommunications at Queen's University Belfast, U.K and a Research Chair of the Royal Academy of Engineering, U.K. His current research interests include wireless communications, signal processing, and machine learning. He has published more than 400 papers with 13 100+ citations and h-index 63. He has served as an Editor for the IEEE Transactions on Wireless Communications, IEEE Transaction on Communications, IEEE Transaction on Vehicular Technology, and Executive Editor for the IEEE Communications Letters. He has received the Best Paper Award at the IEEE Vehicular Technology Conference (VTC-Spring) in 2013, IEEE International Conference on Communications (ICC) 2014, IEEE Global Communications Conference (GLOBECOM) 2016, IEEE Digital Signal Processing Conference (DSP) 2017, and GLOBECOM 2019. He is the recipient of prestigious Royal Academy of Engineering Research Fellowship (2015-2020) and has won a prestigious Newton Prize 2017.



Prof. Duong Quang Trung
Queen's University Belfast, U.K
Royal Academy of Engineering, U.K

Low Carbon Construction Through Innovation in Materials and Management

Abstract …

Prof. Koshy Varghese is a faculty with the Building Technology and Construction Management Group at IIT Madras (IITM). He earned his doctorate from the University of Texas at Austin. He has contributed significantly to construction management research and education in India and recognised internationally for his work on construction automation. Prof. Varghese is currently the Dean Administration at IIT Madras and his research group at IIT focuses on Sustainable Lean Project Delivery and Automation.

Prof. Koshy Varghese

Indian Institute of Tech. Madras
Chennai, TN 600036, India.

Plenary Presentations

EIER 2022 The 3rd workshop on
Energy, Infrastructure and Environment Research
Sustainability for resilience, and resilience for sustainability

Effects of dust storms and wildfires on phytoplankton growth in the Southern Ocean and Tasman Sea, South Eastern Australia

Hiep Duc Nguyen *[1][4][5], John Leys [1][6][7], Matthew Riley [1], Sean Watts [1], Merched Azzi [1], Toan Trieu [1], David Salter [1], Huynh Nguyen [3], Lisa Tzu-Chi Chang [1], Xavier Barthelemy [1]

[1] *Department of Planning, Industry and Environment, Australia*

[2] *University Centre of Rural Health, North Coast, University of Sydney, Australia*

[3] *Faculty of Engineering & Information Technology, University of Technology Sydney, Australia*

[4] *Environmental Quality, Atmospheric Science and Climate Change Research Group, Ton Duc Thang University, Vietnam*

[5] *Faculty of Environment and Labour Safety, Ton Duc Thang University, Vietnam*

[6] *The Fenner School of Environment & Society, Australian National University, Australia;*

[7] *Land and Water—Black Mountain, CSIRO, Australia*

[*] Correspondence: hiep.duc@environment.nsw.gov.au, nguyenduchiep@tdtu.edu.vn

Abstract:

Dust storms and wildfires occur frequently in south eastern Australia. Their effects on ecology, environment and population exposure have been the focus of many studies recently. Dust storm do not emit ground-sequestered carbon but wildfires does emit significant carbon into the atmosphere. Both of these natural events, however, promote phytoplankton growth in water bodies when emitted pollutants deposit on surface water. Phytoplankton growth reabsorbed carbon dioxide from the environment via photosynthesis process. The carbon balance of dust storm and wildfires are not well known. Recent studies on the carbon emission of the 2019-2020 summer wildfires in eastern Australia indicated that this megafire event emitted approximately 715 million tonnes of CO_2 (195 Tg C) into the atmosphere from burned forest areas. And with increasing frequency of wildfires in the future due to climate change, the carbon neutral process of reabsorbing emitted carbon by the forest cannot be achieved with the result of net loss of carbon to the atmosphere and hence aggravates the warming climate change. This study focusses on the association of dust storms and wildfires in south eastern Australia with phytoplankton growth in the Southern Ocean and Tasman Sea due to the February 2019 dust storm event and the 2019-2020 black summer wildfires. The results show the similarities and differences in phytoplankton growth patterns and carbon reabsorption amount of each of these events.

Keywords:
February 2019 Dust storm, 2019-2020 summer wildfires, South East Australia, phytoplankton growth, Southern Ocean, Tasman Sea.

EIER 2022 The 3rd workshop on
Energy, Infrastructure and Environment Research
Sustainability for resilience, and resilience for sustainability

Preliminary results of the causes of air pollution in Hanoi city, Vietnam

Hoang Ngoc Khue Vu
Institute for Environment and Resources (IER)
Vietnam National University-Ho Chi Minh City
vhnk1304@gmail.com

Bang Quoc Ho
Institute for Environment and Resources (IER)
Vietnam National University-Ho Chi Minh City
bangquoc@yahoo.com

Abstract:

Along with its rapid urban development, Ha Noi city in recent years has suffered a high concentration of air pollutants, especially fine particulate matters or $PM_{2.5}$. We all know that, the poor ambient air quality remains a significant challenge for Hanoi. Hanoi has a total of 13.874 factories (11.123 consume fuel) that emit air pollutants over the city (and plus producer household in 305 craft villages), 6.091.986 motorcycles and 686.755 automobiles, 8.093.900 inhabitants (2.224.107 housholds), 2012 restaurants, etc which release a big amount of air pollutants into the atmosphere. In fact, for the past few years, the annual concentration of $PM_{2.5}$ in Hanoi up to 59.8 $\mu g/m^3$ in some locations which has always been higher than the WHO recommended value (5 $\mu g/m^3$) and the Vietnamese standard QCVN 05:2013 (25 $\mu g/m^3$). Due to the exposure to PM2.5 in Hanoi, there are a burden of diseases which are fatal and might require hospitalization. The number of pre-mature deaths is approximately 2855 cases per year in Hanoi. To develop a policy for reducing air pollution in Hanoi, we need to understand the causes of air pollution in Hanoi.

Keywords

air emission inventory; air EMISENS model, Hanoi, Vietnam

Objectives and Hypothesis

This research aim: to calculate air emission sources with high emission potential for pollutants such as SO2, CO, NOx, PM10, PM2.5".

Methodology and Techniques

The air emission inventory was conducted in this project by following the top-down and bottom-up approaches (Bang, 2016). EMISENS (Bang et al., 2011) model is applied to calculate air emission for road traffic, SPD model is applied to calculated air emission for ports and ships, emission factor methodology is applied to calculated point and areas sources.

Results and Significance

The estimation of the emission of different types of sources including line, point, area, and the biogenic source was conducted. The results show that A comprehensive EI over Hanoi in 2019 has been calculated in this project by following the top-down and bottom-up approaches. The area sources contributed about 6601 ton PM2.5/year. The point sources contributed about 3497,6 ton PM2.5/year. Air emission inventory is also calculated for NOx, SO2, CO, NMVOC, CH4, PM10…

Key References

1. Bang H. Q, Clappie A (2011) Road traffic emission inventory for air quality modelling and to evaluate the abatement strategies: A case of Ho Chi Minh City, Vietnam. Atmospheric Environment 45 (21): 3584-3593. https://doi.org/10.1016/j.atmosenv.2011.03.073
2. Bang H.Q. 2016. Urban Air Pollution: from theory to practice. 420 pages. VNU HCM Presse, 2016.

EIER 2022 The 3rd workshop on
Energy, Infrastructure and Environment Research
Sustainability for resilience, and resilience for sustainability

Proton-Exchange Membrane Fuel Cell Energy Conversion and Control

R.M.T. Raja Ismail
Instrumentation and Control Engineering (ICE) Research
Faculty of Electrical & Electronics Engineering Technology
Universiti Malaysia Pahang, Pekan, Pahang
rajamohd@ump.edu.my

Abstract:

The harmful impacts of pollutants produced by conventional gasoline cars have prompted scientists to look for alternative energy sources that are less harmful to the environment. Though we have a variety of renewable energy sources, hydrogen is the best option for usage as a vehicle fuel. Hydrogen, like electricity, is an energy carrier capable of delivering massive amounts of energy. Along with the introduction of electric cars, recent advancements in hydrogen fuel cell technology have the potential to revolutionise the future scenario of transportation vehicles. The proton exchange membrane fuel cell (PEMFC) has been a popular alternative for vehicle applications. Under various operating conditions, fuel cells have a nonlinear voltage–current characteristic, with many local maximum power points in the current–power (I–P) characteristic. As a result, a maximum power point tracking (MPPT) algorithm must be developed to increase and maximise the efficiency of the PEMFC system. If fuel cells are used in conjunction with other power conditioning converters in most stationary and mobile applications, a circuit model would be beneficial, especially for power electronics engineers who are often tasked with designing converters associated with the fuel cell for various load applications. Due to its advantages comparatively with the other methods, this project interest was focused on the use of sliding mode controller (SMC) to maximize the power generated from the cell with the guarantee of the system stability in presence of noise and disturbance. SMC consists in the sliding variable system derivations. It maintains the robustness of the system and provides better accuracy than other unconventional approaches. Specially, the SMC is relatively simple to implement, and it gives good robustness to external disturbances.

Keywords:

Proton exchange membrane fuel cell (PEMFC), maximum power point tracking (MPPT), sliding mode control (SMC)

Objectives and Hypothesis

Objective: To propose a sliding mode control algorithm to maximize the power generated from the proton exchange membrane fuel cell.

Hypothesis*:* The SMC maintains the robustness of the system and provides better accuracy than other unconventional approaches. Specially, the SMC is relatively simple to implement, and it gives good robustness to external disturbances.

Methodology and Techniques

A robust control technique based on sliding mode control is developed to attain this goal. The sliding mode control algorithm was used to control the maximum power point tracking.

Results and Significance

A comparison study demonstrates the effectiveness of the maximum power point tracking based on the sliding mode control in terms of convergence time and power extraction.

Key References

[1] Abdelnasir Omran, Alessandro Lucchesi, David Smith, Abed Alaswad, Amirpiran Amiri, Tabbi Wilberforce, José Ricardo Sodré, A.G. Olabi, Mathematical model of a proton-exchange membrane (PEM) fuel cell, International Journal of Thermofluids, Volume 11, 2021, 100110.

[2] Ahmed Souissi, Adaptive sliding mode control of a PEM fuel cell system based on the super twisting algorithm, Energy

EIER 2022 The 3rd workshop on
Energy, Infrastructure and Environment Research
Sustainability for resilience, and resilience for sustainability

Automatic simulation for safety prediction of composite structures under crack propagation

Vu Thi Thuy Anh
Department of Civil Engineering and Transportation
VNU University of Engineering and Technology
anhvutt@vnu.edu.vn

Pham Dinh Nguyen
Department of Civil Engineering and Transportation
VNU University of Engineering and Technology
nguyenpd@vnu.edu.vn

Tran Hiep Dinh
Faculty of Engineering Mechanics and Automation
VNU University of Engineering and Technology
tranhiep.dinh@vnu.edu.vn

Abstract:

Composites have been widely used thanks to their advantages to conventional materials such as strength, weight, as well as thermal and chemical resistance. Current challenges in studying the characteristics of composite materials include but are not limited to: optimal simulation solutions, crack propagation, and application potentials of Artificial Intelligence to related problems. Regarding the crack propagation problem, current simulation methods for composite materials are mainly carried out by converging the materials to homogenous. If the distribution of the reinforcing material composition is functionally graded, this solution is almost not applicable. Besides, current studies only focus on static cracks while dynamic ones are yet to be considered appropriately. Last but not least, data collection is also a pressing concern due to the rarity of new composite materials. The goal of this study is to propose a solution to simulate the crack propagation in composite structures reinforced by graphene. A combination between ABAQUS and MATLAB is developed to automate the data generation process. The generated data can then be employed to predict the safety of structures with cracks.

Keywords: new composite materials, crack propagation, crack dataset, safety.

Objectives and Hypothesis: By simulating crack propagation, the safety of the composite structures reinforced by graphene with cracks can be predicted. In this study, the cracks simulated by the proposed method will be compared with the results obtained in [1].

Methodology and Techniques: (i) ABAQUS software with integrated eXtended Finite Element Method (XFEM) is employed to simulate crack propagation in a composite structures reinforced by graphene beam.

(ii) A linkage between ABAQUS and MATLAB is developed to recursively generate simulations in ABAQUS, based on some pre-defined analyses and level set method.

(iii) A crack propagation length – critical load curve is expected to be obtained, based on which a Machine Learning-based technique to assess and predict the safety of structures with cracks will be developed. This is based on the recent study that there is a high correlation between the simulated and real-world cracks [2].

Results and Significance

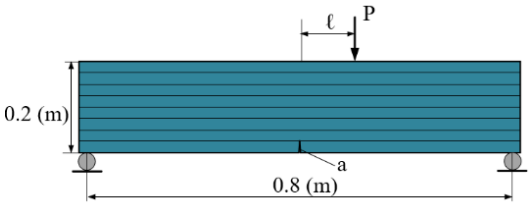


Fig. 1. Geometry of the composite structures reinforced by graphene beam with an initial notch crack at the lower surface and subjected to load at the upper surface

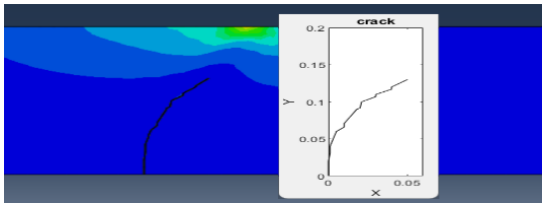


Fig. 2. Crack propagation in beams when the load is placed at $l = 10$. Results in beams using Abaqus and MATLAB.

Key References

[1] M. Tam, Z. Yang, S. Zhao, H. Zhang, Y, Zhang, J. Yang, "Nonlinear bending of elastically restrained functionally graded graphene nanoplatelet reinforced beams with an open edge crack". Thin-Walled Structures, vol. 156, p. 106972, 2020. DOI:10.1016/j.tws.2020.106972.

[2] T.H. Dinh, V.T.T. Anh, N.T Giang, L.C. Hieu, N.L. Trung, N.D. Duc, C.T. Lin, "Towards vision-based concrete crack detection: automatic simulation of real-world cracks", IEEE Transactions on Systems, Man and Cybernetics: Systems (under review).

EIER 2022 The 3rd workshop on
Energy, Infrastructure and Environment Research
Sustainability for resilience, and resilience for sustainability

Characterization and potential applications of the solid residuefrom macadamia nut shell gasification

Vu Ngoc Linh[(1)], Nguyen Van Dong[(1)], Tran Van Bay[(2)], Nguyen Hai Binh[(3)], Vu Duy Tung[(4)], Nguyen Hong Nam[*(5)]
[(1)]*VNU University of Engineering and Technology, Vietnam*
[(2)]*University of Transport and Communications, Vietnam*
[(3)]*Institute of Material Science, Vietnam Academy of Science and Technology*
[(4)] *Faculty of Chemistry, VNU Hanoi University of Science, Vietnam*
[(5)]*University of Science and Technology of Hanoi, Vietnam Academy of Science and Technology*
[*]Corresponding author, Email: nguyen-hong.nam@usth.edu.vn

Abstract:
The sustainability of biomass gasification technology greatly depends on two factors: (1) diversification of the feedstock, and (2) application of the end-of-pipe residual solid. This study aimed to investigate the properties of the solid residue, biochar, generated after gasification of macadamia nut shell and its potential usage. The biochar samples were produced at a conversion rate of 75 % using a macro-thermogravimetric system in a reacting atmosphere of N2 with 20 % H2O, 20 % CO2 at 950 °C. By means of Fourier Transform Infrared (FTIR) and X-Ray Fluoresence (XRF), the composition of functional groups and elements of the char surface were investigated. Nevertheless, the morphology of biochar was studied via SEM-EDS and N2 adsorption/desorption techniques. The yielded data indicated that the structure of biochar was identified to be non-porous with a relatively low specific surface area (73 m2/g). Nevertheless, the surface of solid residue contains a majority of potassium and carboxyl functional groups. Furthermore, the elemental composition of the biochar obtained via XRF showed an astounding amount of potassium (up to 69 wt% of the total inorganics), which highlighted the biochar's potential for application as fertilizer and soil amendment. The results and database established by this study would help elevate the sustainability of macadamia nut shell gasification by offering insights on the solid residue after macadamia nut shell gasification as well as its potential for application.

Keywords:
biochar, macadamia nut shell, morphology, surface composition, functional groups.

EIER 2022 The 3rd workshop on
Energy, Infrastructure and Environment Research
Sustainability for resilience, and resilience for sustainability

Deep Learning for Surface Inspection with UAV Imaging

Qiuchen Zhu
Faculty of Engineering and Information Technology
University of Technology Sydney, Australia
Qiuchen.Zhu@student.uts.edu.au

Abstract:

Drone imagery is increasingly used in automated inspection for infrastructure surface defects, especially in hazardous or unreachable environments. In machine vision, the key to crack detection rests with robust and accurate algorithms for image processing. To this end, this paper proposes a deep learning approach using bidirectional hierarchical convolutional neural networks with feature preservation and an intercontrast iterative thresholding algorithm for image binarization. First, a set of branch networks is proposed, wherein the output of previous convolutional blocks is half-sizedly concatenated to the current ones to reduce the obscuration in the down-sampling/up-sampling stage taking into account the overall information loss. Next, to extract the feature map generated from the enhanced HCNN, a binary contrast-based autotuned thresholding (CBAT) approach is developed at the post-processing step, where patterns of interest are clustered within the probability map of the identified features. The proposed technique is then applied to identify surface cracks on the surface of roads, bridges or pavements.

Keywords:

Crack detection, Computer vision, Automated Monitoring, Deep Learning

Objectives and Hypothesis

Objective: To demonstrate the potential of the deep learning technology in infrastructure health monitoring.

Hypothesis*:* Vision-based techniques have tremendous potential for construction progress monitoring, but their adoption is highly impacted with the existing challenges.

Methodology and Techniques

A bidirectional convolutional network was used to extract image feature on the collected images and generate the crack map based on geometrical inference. The focus was on feature preservation and uncertainty handling in the vision-based crack detection.

Results and Significance

The developed framework can successfully detect surface cracks under different imaging conditions for a road, a pavement, and a bridge subject to various texture levels. Extensive comparisons with the existing state-of-the-art deep learning convolutional neural networks for crack detection has demonstrated the merits of the proposed approach. The key factors that affect the detection accuracy such as light condition, image degradation requires special concern from algorithm designers.

Key References

[1] Q. Zhu, T. H. Dinh, V. T. Hoang, M. D. Phung, and Q. Ha, “Crack Detection Using Enhanced Thresholding on UAV based Collected Images,” in Proc. Australasian. Conf. on Robotics and Automation, pp. 1-7, Dec. 9-11, 2018.
[2] Q. Zhu, M. Duong, and Q. Ha, “Crack detection using enhanced hierarchical convolutional neural networks,” in Proceedings of The Australasian Conference on Robotics and Automation (ACRA). AARA, 2019, pp. 1–8. Best paper award.
[3] Zhu, Q., Dinh, T.H., Phung, M.D. and Ha, Q.P., 2021. Hierarchical Convolutional Neural Network with Feature Preservation and Autotuned Thresholding for Crack Detection. IEEE Access, 9, pp.60201-60214.

EIER 2022 The 3rd workshop on
Energy, Infrastructure and Environment Research
Sustainability for resilience, and resilience for sustainability

Optimalal Planning for Sustainable Hybrid Energy Systems Producing Oxygen Onsite and Considering By-product Hydrogen for Backup Power in Aquaculture

Nguyen Nhut Tien
Can Tho University, Vietnam
nntien@ctu.edu.vn

Vo Tran Thi Bich Chau
Can Tho University, Vietnam
vttbchau@ctu.edu.vn

Abstract:

This paper presents optimal planning for sustainable hybrid energy systems for the aquaculture sector, which inherently requires intensive energy. The designed system is energized by renewable resources to produce pure oxygen in situ through water electrolysis for oxygenation according to the changes of dissolved oxygen (DO) of species under culture. Moreover, the by-product hydrogen from the electrolysis process is used to generate backup power for the eventual power failures. The mathematical models of the system were developed for simulation and optimization to assess the performance of the system regarding technical, economic, and environmental aspects as multi-objective functions in autonomous mode as well as on-grid mode. The merits of the proposed system are demonstrated at a shrimp farm. Furthermore, the optimal results showed that the sustainable hybrid energy system operating in grid-connected mode, which possesses such attractive features as producing onsite pure oxygen for oxygenation and utilizing the by-product hydrogen for generating backup power, could bring significant benefits for farmers thanks to a notable reduction in the annualized cost of the system as well as CO2 emission in comparison with the conventional system, which is powered by the national grid to run common paddlewheel aerators for oxygenation.

Keywords
aeration, onsite pure oxygen, electrolyzer, renewable energy, by-product hydrogen.

EIER 2022 The 3rd workshop on
Energy, Infrastructure and Environment Research
Sustainability for resilience, and resilience for sustainability

Existing Challenges in Computer Vision-Based Progress Monitoring of Construction Projects

Varun Kumar Reja
Department of Civil Engineering
IIT Madras & UTS
varunreja7@gmail.com

Koshy Varghese
Department of Civil Engineering
IIT Madras, India
koshy@iitm.ac.in

Quang Phuc Ha
Faculty of Engineering and Information Technology
University of Technology Sydney, Australia
quang.ha@uts.edu.au

Abstract:

Progress monitoring is the backbone for construction project planning and control. It helps construction managers in keeping a check for timely project completion. There are several ways to monitor a project's progress; however, the widely used are traditional techniques that are manual, time-consuming, requires significant effort, and are prone to errors. Vision-based tools have great potential in progress monitoring but are being used sparsely due to a scarcity of domain knowledge and expertise. Previously, researchers and practitioners have explored pipelines for progress monitoring in automated construction, combining vision-based techniques and systems. These pipelines have appeared in the literature, each with its strength and weakness. Their evaluation is critical to clarify the status quo of the developments applied for a construction site and direct further research for improvements, which is the motivation for this study. This study reviews the existing literature, studies industry practices, and assemble a list of challenges for computer vision-based construction progress monitoring. It is expected that this research will provide implementable solutions to overcome the existing challenges in adopting vision-based progress monitoring for construction projects.

Keywords:
Progress Monitoring, Computer vision, Automated Monitoring, Scan-to-BIM, Challenges

Objectives and Hypothesis

Objective: To highlight the existing challenges for computer vision-based progress monitoring of construction projects.

Hypothesis*:* Vision-based techniques have tremendous potential for construction progress monitoring, but their adoption is highly impacted with the existing challenges.

Methodology and Techniques

Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework was used to select the literature and followed by a detailed review of selected papers. The focus was on deriving the existing challenges for the adoption of computer vision-based techniques.

Results and Significance

Object detection and element recognition through machine learning from 3D point clouds, was recognized as the key technology that can facilitate the progress monitoring of building structures. But several factors were identified that hindered the adoption. The key factors included the issues in data acquisition due to the dynamic nature of construction project sites, changing weather and lighting, data set unavailability for training, specific skill-set requirements, data transmission and storage issues etc. Though few of these factors require technical research and development, others require a collaborative effort from industry and academia.

Key References

[1] S. Paneru, I. Jeelani, Computer vision applications in construction: Current state, opportunities & challenges, Automation in Construction. 132 (2021). https://doi.org/10.1016/j.autcon.2021.103940.
[2] P. Bhadaniya, V.K. Reja, K. Varghese, Mixed Reality-Based Dataset Generation for Learning-Based Scan-to-BIM, Pattern Recognition - Lecture Notes in Computer Science (LNCS). 12667 (2021) 389–403. https://doi.org/10.1007/978-3-030-68787-8.
[3] V.K. Reja, P. Bhadaniya, K. Varghese, Q.P. Ha, Vision-Based Progress Monitoring of Building Structures Using Point-Intensity Approach, in: Proceedings of the 38th International Symposium on Automation and Robotics in Construction (ISARC), 2021: pp. 349–356. https://doi.org/10.22260/ISARC2021/0049.

EIER 2022 The 3rd workshop on
Energy, Infrastructure and Environment Research
Sustainability for resilience, and resilience for sustainability

Deep learning technique for enhancing the accuracy of air pollutant forecast

Huynh A. D. Nguyen
Faculty of Engineering and Information Technology
University of Technology Sydney, Australia
HUYNHANHDUY.NGUYEN@student.uts.edu.au

Q.P. Ha
Faculty of Engineering and Information Technology
University of Technology Sydney, Australia
Quang.Ha@uts.edu.au

H. Duc
Department of Planning, Industry and Environment, Australia

M. Azzi
Department of Planning, Industry and Environment, Australia

M. Riley
Department of Planning, Industry and Environment, Australia

Abstract:

Air pollution forecast is a critical factor in air quality management and control for governments and policymakers towards sustainable development in metropolitan areas. In New South Wales (NSW), the forecast of air pollutants has long been carried out by using numerical models such as Chemical Transport Model (CTM) and Community Multiscale Air Quality Modeling System (CMAQ), in conjunction with data from the Bureau of Meteorology (BOM). However, in face of climate change these models are having high deviations, particularly for prediction of ozone and particulate matter, due to modelling multiple chemical-physical equations with large uncertainties in its initial assumptions of the atmospheric process. This requires a more accurate and efficient model to be developed for air pollution forecast at the NSW Department of Planning, Industry and Environment (DPIE). To this end, data-driven forecasting models applying robust algorithms of deep learning (DL) are promising as they can learn the hidden features of big data aggregated from multiple sources including the numerical forecast models, wireless sensor networks and state-run monitoring systems. This project, built on the ongoing collaboration between UTS and DPIE, aims to develop a novel learning-based forecast model for air pollutants in the state. In this study, a hybrid model is proposed on the core of the Long Short-Term Memory (LSTM), a recurrent neural network, that also incorporates Bayesian inference for addressing DL-related uncertainties and mitigating prediction errors. In addition, as the model inputs comprise both variables, the measured observations and the CTM outputs, the cost of training, processing and forecasting are less than previous studies which involve extraneous meteorological data. The root mean square error (RMSE) is selected as an evaluation metric for performance evaluation over different datasets collected in 2008, 2013 and 2021 for the two pollutants in consideration, ozone and fine particles (PM2.5). The preliminary results of all studied cases indicate the proposed model significantly outperforms the two baseline models, the stacked LSTM deep learning model, and the currently used CTM at DPIE, with up to 72.8% and 40.4% accuracy improvement of the forecast for ozone and PM2.5, respectively.

Keywords:
air pollutant, forecast models, deep learning, LSTM, Bayesian, ozone, PM2.5

EIER 2022 The 3rd workshop on
Energy, Infrastructure and Environment Research
Sustainability for resilience, and resilience for sustainability

Game Theory for Cooperative Unmanned Aerial Vehicles

Lanh Van Nguyen
Faculty of Engineering and Information Technology
University of Technology Sydney, Australia
LanhVan.Nguyen@student.uts.edu.au

Quang Phuc Ha
Faculty of Engineering and Information Technology
University of Technology Sydney, Australia
Quang.Ha@uts.edu.au

Abstract:

Along with high-tech advances, unmanned aerial vehicles (UAVs) or drones have found many interesting applications and are becoming popular in modern life. This technological trend will be expedited with UAVs being smartly applied in numerous human activities owing to the increasing advancement of learning algorithms. In practice, the challenge with UAV systems remains their full autonomy of UAV-based task execution in uncertain conditions due to unavoidable effects of harshness, hazards and unknown environments. In these conditions, there often requires the need of cooperative control of multiple UAVs by selecting the most favourable solution out of all possible schemes from a given setting. This presentation introduces a game theoretic-based approach for cooperative UAV applications. First, a cost function for each UAV in a group of UAVs is defined from task requirements and safe interactions, incorporating multiple objectives and constraints. A game framework is then developed to convert the multi-UAV hierarchical control problem into finding an equilibrium in the solution space. Next, a hierarchical optimization algorithm using PSO is proposed to obtain the game equilibrium representing the global optimal solution. The validity of the developed learning control system is first tested through extensive simulation. Experimental tests on real UAVs further show the advantages of the proposed approach.

Keywords:

Cooperative Unmanned Aerial Vehicles, Game Theory, Particle Swarm Optimization

Figures:

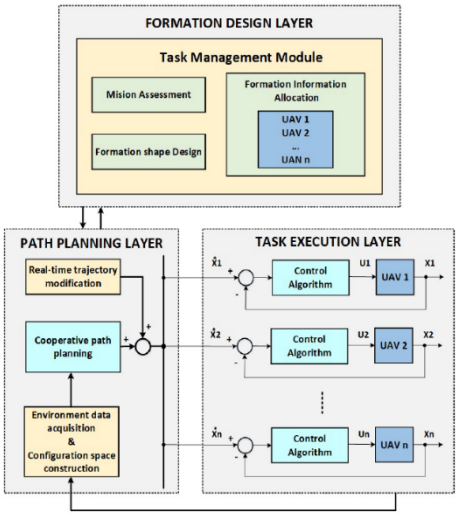


Fig. 1: Hierarchical UAV control structure

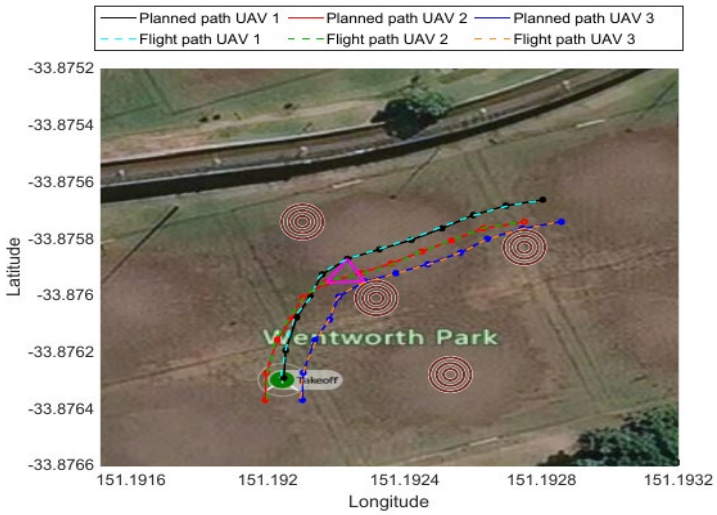


Fig. 2: Experimental result

References

[1] D. Gu, "A differential game approach to formation control," *IEEE Transaction on control systems technology*, Vol. 16, No.1, January 2008.

[2] X. Dong, B. Yu, Z. Shi, and Y. Zhong, "Time-varying formation control for unmanned aerial vehicles: Theories and applications," *IEEE Transactions on Control Systems Technology*, 23(1), 340-348, 2014.

[3] A. Ji, X. Xue, Q.P. Ha, X. Luo, and M. Zhang, "Game theory–based bilevel model for multiplayer pavement maintenance management," *Automation in Construction*, 129, 103763, 2021.

EIER 2022 The 3rd workshop on
Energy, Infrastructure and Environment Research
Sustainability for resilience, and resilience for sustainability

A Ph.D. research proposal: Developing Data-driven control algorithms for agricultural mobile robots

Bui VanVu
Quy Nhon University, Vietnam
buivanvu@qnu.edu.vn

Abstract:

My Ph.D. research proposal would mainly concentrate on the integrated learning and control algorithms for applications to agricultural mobile robots, like drones. Particularly, data-driven control algorithms will be looked at, analyzed and then developed for controlling drones. The validity of the control system will be verified via simulation software Matlab Simulink. Additionally, in order to enhance the verification of the control algorithms, the implementation of the setup and experimental results will be also included in this proposed project.

Keywords:

Agricultural mobile robots, Drones, Data-driven control algorithms

Objectives and Hypothesis

Objective: To demonstrate the potential of the data-driven control algorithms for controlling agricultural mobile robots, like drones.

Hypothesis*:* The theory of data-driven control have tremendous potential for developing control algorithms for agricultural mobile robots

Methodology and Techniques

The theory of data-driven control will be taken into consideration scrupulously and then applied for developing control algorithms for controlling agricultural mobile robots. After being tested via simulations, the proposed algorithms would be applied to practical applications. Experimental data of the real system would be analyzed to compare with other algorithms.

Results and Significance

Key References

[1] Nguyen Van Lanh. Iterative Learning Control Designs For Autonomous Driving Applications. Master thesis, HAN University of Applied Science, the Netherlands; Siemens Industry Software, Belgium 2018.

[2] Hou, Zhong-Sheng, and Zhuo Wang. "From model-based control to data-driven control: Survey, classification and perspective." Information Sciences 235 (2013): 3-35.

[3] Hou, Zhongsheng, Ronghu Chi, and Huijun Gao. "An overview of dynamic-linearization-based data-driven control and applications." IEEE Transactions on Industrial Electronics 64.5 (2016): 4076-4090.

[4] S. Zhao, X. Wang, W. Kong, D. Zhang and L. Shen, "A novel data-driven control for fixed-wing UAV path following," 2015 IEEE International Conference on Information and Automation, 2015, pp. 3051-3056, doi: 10.1109/ICInfA.2015.7279812.

[5] Maupong, Thabiso M., and Paolo Rapisarda. "Data-driven control: A behavioral approach." Systems & Control Letters 101 (2017): 37-43.