

THE 4th INTERNATIONAL CONF. ON UNIVERSAL VILLAGE

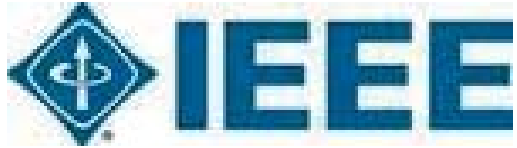
IEEE UV2018

October 21st-24th, 2018, MIT, BOSTON, USA



UV2018, BOSTON, USA

***HUMANKIND IN HARMONY WITH NATURE
THROUGH WISE USE OF TECHNOLOGY***



UV 2018

IEEE International Conference on Universal Village 2018

October 21st-24th, 2018
Boston, USA

Program Book

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Previous Theme



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GREETINGS FROM CONFERENCE CHAIRS

General Chair, Professor Berthold K. P. Horn



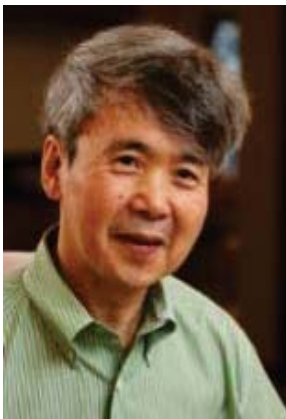
It is great to see all of you here at the International Conference on Universal Village.

We live at a unique time in history where, on the one hand, marvelous new technology is available, and on the other hand, great societal needs have arisen. The new technology comes in part from the maturation of computer hardware and software and in part from better understanding and modeling of the physical processes underlying systems interactions particularly those of a living community.

In some cases, we even have the unique opportunity to “start from scratch” in that, with rapid growth in some of the developing world, it is possible to actually design communities and the underlying infrastructure to better suit the modern world.

At MIT, we have a diverse set of efforts addressing different aspects relevant here today, including intelligent traffic research and work on machine vision, my own specialty. But there is much more to this topic and we will hear about that in the next two days. But I won’t take any more of your time since I am sure you are eager to hear the technical presentations, as I am, since that, after all, is why we are all here.

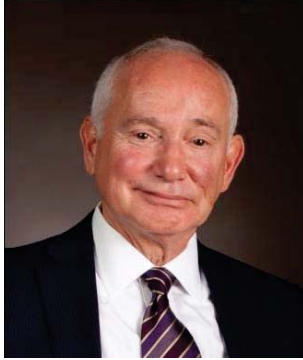
General Chair, Dr. Ichiro Masaki



Welcome to the International Conference on Universal Village. Universal Village (UV) is a desired future society which provides their residents with sustainable happiness. In order to develop UV, we take a top-down or, in other words, system-oriented approach instead of a bottom-up or element-oriented approach. In the development process, a higher-level objective such as sustainable happiness of the residents defines lower-level objectives including environment protection, energy management, communication, healthcare, transportation, and other related systems. Feedback from the bottom to the top is also important in this integration and collaboration. I hope this conference stimulates various kinds of collaborations.

At the end of my greeting, I would like to say “Congratulations!” to everyone who contributed to starting up this conference. Please enjoy the conference. Thank you very much!

General Chair, Professor Lionel C. Kimerling



We meet to envision the future of our life on this planet. It is clear to each of us that our common ecosystem, as it exists today, cannot support the global security and economic parity that embodies that vision. Our envisioned world is a system built on the unity of our existence and comprised of a variety of solutions that are organically linked and constantly adapting to new realities. We can differ in the political will that sets regional priorities, but as the chief engineers with the responsibility to construct that world, we must recognize that UV 2018 is a critical feedback element that enables our common vision to be achieved and to be sustained.

General Chair, Professor Kazuya Takeda



It is a great pleasure and an honor to welcome you to the fourth Conference of Universal Village, UV2018 and to MIT! On behalf of the organizing committee, I would like to extend my appreciation to all participants of the conference.

Thanks to the hard work of the organizing committee, I am proud of attractive events as well as technical sessions hosted by the UV2018.

I hope all participants will enjoy technical presentations and joining discussions throughout the conference.

Again, thank you very much for your participation in the UV2018.

General Chair, Professor Zhang Xiong



It is our greatest pleasure to welcome you to the 4th International Conference on Universal Village (UV2018) at MIT, Boston, United States. As one of the collaborations, Beihang University has been working on the creating “smart city” in China for a long time, in which we pay more attention to the technical level and the city part. Here, in the UV conference, we would like to pursue human-nature harmony through wise application of technologies for a higher-level objective.

When I attended the UV conference in Beijing in 2013, I found that UV conference is unique and special. Since its first edition, UV has attracted rich diversity of authors and speakers from universities, industries, government and public sectors, etc., around the

world to share their ideas and advances in overcoming the challenges during the urban development. I am also pleased to note that the UV conference has grown gradually in scale, depth and also influence.

A lot of information from multi-disciplinary fields will be presented in the three-day conference, so that researchers with different background can collaborate beyond the traditional boundaries of their individual research fields. I hope you can find a systematic, coordinated, long-term solution for the future of human kind and nature at the end of this conference. As the theme for UV2018, we would like to expand our horizon: UV for regions at different developing phases, and for people of different ages, with various technology & culture backgrounds.

Finally, I want to extend my thanks to those who are truly responsible for making UV 2018 a successful event by devoting their time and energy.

Thank you very much for attending UV2018!

CONFERENCE COMMITTEE

General Chairs

- **Berthold K.P. Horn (MIT, USA)**
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- **Chenchen Gong (MIT, USA)**
- **Qinghe Kong (Jiyuan, China)**

Industry & Entrepreneurship Forum Chairs

- **Graham G. Rong (MIT, USA)**
- **Rongduo Liu (China Academy of Information and Communications Technology, China)**
- **Lijuan Su (Tencent, China)**

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- **Bin Huang (MIT, USA)**

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- **Gang Zhao (Universal Village Society, USA)**

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- **Sio Kei Marcus Im (Macao Polytechnic Institute, Macao S.A.R., China)**

Volunteers

- **Lan Lan (Universal Village Society, USA)**
- **Wenqin Wu (Universal Village Society, USA)**
- **Qikai Su (Universal Village Society, USA)**
- **Jie Zheng (Universal Village Society, USA)**
- **Shuqing Li (University of California, Santa Cruz, USA)**
- **Shijun Lun (Universal Village Society, USA)**
- **Tianyi Zhang (Trinity College School, Canada)**

- **Zhonghe Wang (Universal Village Society, USA)**
- **Ziyan He (Universal Village Society, USA)**
- **Edgar Fu (Universal Village Society, USA)**

GENERAL INFORMATION

After great success in China (Beijing, UV2013), United States (Boston, UV2014) and Japan (Nagoya, UV2016), the Fourth International Conference on Universal Village (UV2018) will be held again in Boston, United States. UV2018 will extensively exemplify a desired future society pursuing human-nature harmony through wise application of advanced technologies. The concept is an expanded/advanced version of Smart Cities and signifies that we follow the law of universe to protect the environment and ecosystems while innovating new lifestyles to provide sustainable happiness for humanity's future.

UV2018 will call for the collective efforts across multi-disciplinary fields to develop a platform where researchers with different backgrounds can collaborate beyond the traditional filed boundaries, and to find a systematic, coordinated, long-term solution for the future of human kind and mother nature.

Subjects for UV2018 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 UV2018 is "Diversity, Mobility and Connectivity for Emergence of Harmony in Universal Village".

UV 2018 Website

<https://uv2018.universal-village.org>

Contact Information

Please Contact us whenever you have any question at this email:

uv2018.committee@universal-village.org

HOTEL AND VICINITY

A Cambridge House at Porter

<http://www.acambridgehouse.com/>

Andrea

617-491-6300

innach@comcast.net

The Kendall Hotels

<https://www.kendallhotel.com/>

Alex/Ryan

617-577-1300

Residence Inn

<https://www.marriott.com/boscm>

discount code: MT2

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TRAVEL INFORMATION

Welcome! We hope you have a wonderful day to spend in MIT campus and Boston because there is a lot to see.

1. Boston Travel Guide:

<https://www.bostonusa.com/>

2. Cambridge Visitor Information:

<https://www.cambridgeusa.org/>

PROGRAM AT A GLANCE

Oct. 21st: 2018 UV Day, [Location] Little Theatre (Open to the public)

[Theme] Breaking boundaries, we belong to one family—Universal Village!

[Topics] Universal Village: What? Why? How?

Promote the UV basics & concept, including: UV History, UV Exploration, UV Future

- ◆ Fantastic exhibition: Promoting the vision and the many aspects of the Universal Village to all generations of visitors.
- ◆ Great design: The team of Ph.D. students and young scholars helps the enthusiastic visitors understand the what's, why's, where's and how's of UV.
- ◆ Fun games for the young children: Parents are also given the chance to team up with their children to play. The computer games would prove an instructive way for the family to learn.
- ◆ Interesting experiments: Giving budding scientists a chance to test their skills, to learn the process and to see some real results.

Oct. 22nd: 2018 UV Workshops, [Location] W20-491

[Topics] Fundamental subjects & knowledge relevant to UV research

Oct. 23rd: Academic Conference, [Location] Main Kresge and Little Theatre

- ◆ Opening Ceremony - MIT Kresge Auditorium
- ◆ Keynote Speech

Oct. 24th: Academic Conference (Multiple Sessions), [Location] Little Theatre/W20/CSAIL(Bldg.32)

[Topics] Research Reports

Session 1: Intelligent Transportation and Urban Planning

Session 2: Healthcare and Well-being

Session 3: Intelligent Communities & New Lifestyles Enabled by Big Data & AI

Session 4: Data Management

Session 5: Green Energy and Materials

Session 8a: Intelligent Modeling and Simulation

Session 8b: Future Intelligent Manufacturing

Session 8c: Effective Microorganisms Technology

Session 9a: UV City Forum & UV City Evaluation

Session 9b: UV Student Forum

Session 9c: UV Industry & Entrepreneurship Forum

UV DAY

Time: 1:00pm-5:00pm, October 21st

Location: Little Theatre

Fantastic exhibition

- promoting the vision and the various aspects of Universal Village to visitors of all ages

Great Design

- showcasing the essentials of the UV aspiration: why, when, where, who, how

Fun games

- encouraging young children to learn through family-friendly, instructive computer games

Interesting experiments

- giving prospective scientists a chance to apply their skills in real-life scenarios

UV WORKSHOPS

Time: 10:00am-5:00pm, October 22nd

Location: W20-491

Host: Tingying Zeng & Ruitao Wen

Democratizing Intelligent Vehicle Technologies

Kazuya Takeda

Nagoya Univ., Japan, Professor, Presidential Adviser

Time: 10:00am-10:45am

Bioconversion of Solar Energy for UV Sustainable Enhancement

Pengcheng Fu

Hainan Univ.

Time: 10:45am-11:15am

Design Culture on Healthy Life under the View of Ecological Civilization

Shengsheng Cao

Tsinghua Univ.

Time: 11:15am-12:00pm

Lunch Break

Time: 12:00pm-2:00pm

Innovative Sustainable Technologies

Anumakonda Jagadeesh

Time: 2:00pm-2:45pm

Smart City: An Evaluation of Blue Energy

Edgar S. Fu

University of Pittsburgh

Time: 2:45pm-3:15pm

Panel Discussion: New Energy

Tingying Zeng, Ruitao Wen, Xiaoman Duan

MIT

Time: 3:15pm-4:15pm

A New Generation Multi-media Artist Living in Boston

Wen Yu

Art Director, Build-It-Yourself

Time: 4:15pm-4:45pm

KEYNOTES

October 23rd: Opening Session

Host: Lin Zhang

Location: W16 Kresge Auditorium

Greetings

Xiaoman Duan and Yajun Fang

Ichiro Masaki

Berthold K. P. Horn

Professor, MIT, General Chair of UV2018

Title: Bilateral cruise control: smooth traffic from simple local interactions

Time: 8:00am-8:45am

Location: Main Kresge

Abstract: The average urban commuter in the USA spends 38 hours per annum stuck in traffic, as the result of traffic congestion and as wastes 72 liters (19 gallons) of fuel, which adds an extra 172 kgs (380 lbs) of CO₂ to the atmosphere. Overall, in the USA alone, the costs of congestion are estimated to be around \$121 billion per annum (\$820 per commuter), with 11 billion liters (2.9 billion gallons) of fuel wasted, and 25.4 billion kgs (56 billion lbs) of extra CO₂ emitted (as of 2012).

Much of this problem is the result of traffic flow instabilities such as so-called phantom traffic jams and stop-and-go traffic. Bilateral cruise control (BCC) suppresses traffic flow instabilities. Bilateral cruise control does not require fully autonomous cars, and does not require vehicle-to-vehicle communication or vehicle-to-infrastructure communication. BCC can be implemented by adding rear-facing sensors to adaptive cruise control (ACC) and replacing the ACC control algorithm.

We have demonstrated this using mathematical methods, as well as simulation, and more recently using small robot cars.

Anant Agarwal

Professor, MIT, Former Director of CSAIL, Founder and CEO of edX

Title: The Future of Work and Education

Time: 8:45am-9:30am

Location: Main Kresge

Abstract: EdX, a nonprofit, open-source, online learning destination and MOOC (massive open online course) platform, aspires to reinvent education through technology. Founded by Harvard and MIT, edX's mission is to increase access to high-quality education for everyone, everywhere, and to enhance the quality of teaching and learning both online and on campus.

Anant will discuss how today's workplace is evolving and how both employers and employees are facing the need for a major skills transformation. He will also discuss how education must evolve to meet the needs of this future workplace. Some of the important trends in education include modular credentials and unbundling of degrees, lifelong learning, and omnichannel distribution of education.

Lin Zhang

Professor, Beihang University, Conference Chair of UV2018

Title: Cloud manufacturing: a new paradigm of intelligent manufacturing

Time: 9:30am-10:15am

Location: Main Kresge

Abstract: As a service-oriented, networked and intelligent manufacturing paradigm, cloud manufacturing maps manufacturing resources and capabilities to the cloud by virtue of technologies such as cloud computing, Internet of Things, service computing and Artificial Intelligence. This forms a cyber-physical-human system with interactions between virtual worlds and reality, which enables cloud-based sharing, collaboration and on-demand use of manufacturing resources and capabilities, and provides intelligent, efficient on-demand services over the full lifecycle of manufacturing. As a novel manufacturing paradigm, cloud manufacturing represents a development trend of manufacturing and it is considered an effective approach to achieving service-oriented, green, intelligent, socialized and agile manufacturing. In the new era of Industry 4.0, the Internet of Things and smart manufacturing, cloud manufacturing has a unique role to play.

- **Tea Break**

Time: 10:15am-10:30am

October 23rd: Session II

Host: Lin Zhang

Location: W16 Kresge Auditorium

Gang Luo

Associate Professor, Ophthalmology, Harvard Medical School

Title: Driving assisted by low resolution vision

Time: 10:30am-11:00am

Location: Main Kresge

Abstract: This talk is about the visual mechanisms involved in driving by visually impaired drivers, and also the implications of our findings to intelligent vehicle.

Hirofumi Aoki

Vice Research Leader, Nagoya COI, Institute of Innovation for Future Society, Nagoya University

Title: Driver's mental workload estimation from eye and brain

Time: 11:00am-11:30am

Location: Main Kresge

Haibo Wang

Senior Scientist & Project Leader, Philips Research North America

Title: Contactless Patient Monitoring in Hospitals

Time: 11:30am-12:00pm

Location: Main Kresge

Abstract: Monitoring patients with a camera would allow us provide health cares in a non-obtrusive, scalable and low-cost way. Over the years, Philips Healthcare has been developing advanced technologies to enable touchlessly measure one's vital signs such as pulse rate, breathing rate, Spo2 and certain diseases with a camera. When deployed in a hospital environment, contactless monitoring faces

many challenges including crowdedness, patient motion, lighting change, privacy, etc. To tackle the challenges, our group have been conducting some basic vision research such as patient detection, tracking and recognition. In this talk, I will elaborate on some of these researches and show how critical they are in deploying contactless monitoring in hospitals.

Graham G. Rong

Director of MIT Corporate Relations

Title: MIT's Innovation and Entrepreneurship Ecosystem

Time: 12:00pm-12:30pm

Location: Main Kresge

● **Lunch Break**

Time: 12:30pm-1:30pm

October 23rd: Session III

Host: Hirofumi Aoki

Location: W16 Kresge Auditorium

Jesus Maria Sousa

Professor, University of Madeira, Portugal

Title: (Re)thinking Education out of the box

Time: 1:30pm-2:00pm

Location: Main Kresge

Abstract: Despite the accelerating change at all levels of life, demanding a plethora of new intelligent systems, formal education continues to resemble a box, created during Industrial Revolution and only modestly changed since. The technician curriculum and the public school remain a modernist project, boxing in students and constraining their imaginations.

It is not worth investing in intelligent technologies if education is not taken into account, creating new flexibilities for people's behaviours and attitudes. A

paradigm shift in the area of education and teacher education will advance the fruition of the Universal Village more than any specific invention or system.

The aim of this presentation is to share my concern about the inadequacy of the “black-and-white” mental organisation caused by the knowledge boundaries of various disciplines in hierarchical order, characteristic of the modernist curriculum implemented at schools, and the real need for a global and interdisciplinary methodological approach focused on the greatest problems of humanity.

Rita Tse

Director of School of Public Administration, Macao Polytechnic Institute

Title: Environmental Sensing – can people be trusted as sensors in the domain for air pollution quality?

Time: 2:00pm-2:30pm

Location: Main Kresge

Abstract: In recent years, the growing prevalence of social networks makes it possible to utilize human users as sensors to inspect city environment and human activities. When a post telling how a person feels about pollution at a given time at a given location, can we trust people as sensors in the domain for air pollution quality? A number of works have addressed the question of assessing the status and the air quality of the environment through the lens of Online Social Networks (OSNs). These contributions fall in the area of human-centric sensing, area specialized in using what people spontaneously say on social media to detect the occurrence of given events. Research in this area has exhibited interesting results, regardless of the accuracy of sensing operations. OSNs may help shed light on the sensitivity of human beings to a wide variety of environmental phenomena. Consequently, valuable insights can be gained by applying data mining techniques to the data generated through the OSNs, enabling us to have a better understanding of the complex relationship between human beings and the natural environment.

Qingyang Du and Juejun Hu

Department of Materials Science and Engineering, MIT

Title: Optics and Photonics: Manipulating Light for the Future

Time: 2:30pm-3:00pm

Location: Main Kresge

Abstract: Photons are electromagnetic waves that radiate in a large range of frequencies. In the high energy spectrum range, we have used the Gamma ray and X-rays for material micro-crack detection and medical imaging. Visible light are currently readily harvested as solar energy by either photo-thermal or photo-voltaic devices to power up our daily life. In the meantime, IR light and RF electromagnetic waves are the major carrier of information in current high speed communication systems. In this talk, we will introduce current light wave technologies and photonic devices to demonstrate the advantages we can acquire by manipulating light.

- **Tea Break**

Time: 3:00pm-3:15pm

October 23rd: Session IV

Host: Tingying Zeng

Location: Little Theatre

Ming Ching Chang

Assistant Professor, University at Albany

Title: AI Visual Intelligence Technologies for Building a Smarter World

Time: 3:15pm-3:45pm

Location: Little Theatre

Abstract: Emerging AI technologies are transforming our world in making everything more convenient, secure, and innovative. Smart mobility devices, automotive, IoT, cloud infrastructures all are pushing the boundary of technology that impacts our daily life. How such technology-life transformation can be continuously improved, and how technology can be wisely applied, to ensure the sustainability and quality of life in the long run, is the key issue that the Universal

Village is pursuing. In this talk, I will introduce how computer vision and AI technologies are making our world smarter in several aspects. Among many changing fronts, I will focus on four topics: (1) smart transportation, which represents the core of smart city with strong technical readiness and impact, (2) video scenario understanding based on human pose estimation, facial analysis, action recognition, and group behavior analysis, (3) industrial video analytics including manufacturing inspection, and (4) image/video forensics in fighting fake medias. The talk will conclude with technology development trends and future directions.

Patrick Shen-Pei Wang

Professor(emeritus), Northeastern University

Title: Science, Technology and Humanity - Some concerns

Time: 3:45pm-4:15pm

Location: Little Theatre

Abstract: Motivation and goals, left and right brain balance, knowledge in general, "humanistic literacy", general education can help modern people; Drinking water to remember the source; Tall tree is not leave the roots; Science cannot be separated from fantasy(imagination), and art cannot be separated from reality (truth). To learn as a pyramid, we must be able to be high. Music has a deeper inspiration than all wisdom philosophies-Music Saint Beethoven; IQ, EQ, AQ, SQ, FQ, PQ, learning methods, more encouragement, more examples, more thinking, motivating positive energy, learning is endless: the beauty of Chinese characters and the power of literature; The ten major suggestions of Wang Enge, president of Peking University; To have magnificent ambitions, broad minds, noble character and "love" heart: love others as oneself (Bible), care for family, parents, brothers and sisters, neighbors, society, country, nation, world.

Zhishun Wang

Associate Professor, Columbia University

Title: Brain Networks, Brain Imaging and Deep Learning: Background and Applications

Time: 4:15pm-4:45pm

Location: Little Theatre

Abstract: Human brain is the most complex organ in the living nature and human cognitive process is governed solely by human brain, which is most mysterious phenomenon in the universe. It is composed of 100 billion of neurons in the gray matter. Every neuron is a computational unit or a computer. These neurons are interconnected together, either wired through fibers in the white matter, or wireless through information coupling, or being modulated by neurotransmitter, which thus constitute vast multi-modal, multi-state, multi-level, multi-scale neural networks, or super networks, that are self-organized and perform distributional computations and evolve dynamically along temporal and spatial directions, supporting human cognitive process. State-of-the-art study of such networks may uncover how the brain works, which is of great theoretical and applicational values and thus of profound significance. Such a study is multidisciplinary and multilevel one, presenting a positive feedback manner. On one hand, in order to study human brain accurately, we have to master the most advanced multidisciplinary theories and algorithms (such as neuroscience, brain imaging and computational algorithms, machine learning as well as their combination) and also improve them constantly and thus develop a series of revolutionary new theories and algorithms; on the other hand, we can learn from our study of human brain and apply what we have learnt to the development of human-made networks such as deep learning networks such that these networks or AI-based techniques become more self-developed and smarter. This talk will introduce the background of this 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 process and mental disorders.

Gene R. H. Fry

Ph.D., Consultant of Energy Efficiency & Global Warming

Title: The Path to 5°C Warmer, When Earth Last Had This Much CO₂ in the Air

Time: 4:45pm-5:15pm

Location: Little Theatre

Qiang Wang

Professor, Worcester Polytechnic Institute

Title: Chemical Sources of Electric Power: Current Status and Future Perspective

Time: 5:15pm-5:45pm

Location: Little Theatre

Sunny Wang

CEO, BROAD USA

Title: What Changes can UM bring to UV? (Ultimate Material & Universal Village)

Time: 5:45pm-6:00pm

Location: Little Theatre

Y. Fang

Research Scientist, MIT CSAIL

Title: Universal Village and Innovative Life Styles

Time: 6:00pm-6:15pm

Location: Little Theatre

Highlight from Category Chairs

Time: 6:15pm-6:30pm

Location: Little Theatre

TECHNICAL PROGRAM

Session 1: Intelligent Transportation and Urban Planning

Time: 8:00am-12:25pm, October 24th

Location: 32-D463

Chair(s): Hao Sheng

Why Do We Need Bilateral Control? - In View Of Energy Consumption

Author(s): Taiyi Wang, Yajun Fang, Berthold K.P. Horn,

Abstract: Bilateral control is a kind of new control system proposed by Berthold K.P. Horn, MIT, in 2013. Using information from both sources which allows the gain of feedback to be reduced below one, the new control system effectively eliminate the instability characteristic of "car following." model. In addition to its intrinsic characteristics, suppressing the traffic flow faster, people are more concerned about how much energy consumption or fuel consumption can be reduced by such a new mechanism. Taking various factors into account, including platooning effect, the article presents a general calculation method here.

A Bottom-Up Design Model for Improving Efficiency of Transit System

Author(s): Jiayang Li, Ruzhang Zhao, Yanfeng Ouyang, Meng Li

Abstract: This paper presents a model to design high- performance public transit system, where the optimal solution is directly selected from routes built up on real road structure. The objective function is the travel time for all travelers and the infrastructure cost can also be under consideration. The optimization procedure consists of four components, including a method to simulate downtown travel demand using open- source data on the Internet, a method to narrow down the decision variable space with the help of reasonable restriction and map api, an efficient algorithm to compute average travel time using block representation of the urban area and an improved evolutionary algorithm to search the optimal solution. Eventually, this method is applied to design the transit system for Changzhi, China. The optimal solution is compared to the original transit system of Changzhi to test both the effect and reasonability of the algorithm.

Analysis of Sparse Roadway Trajectories

Author(s): Sudarshan S. Chawathe

Abstract: Recent technological advances enable the gathering of extensive data on vehicular trajectories of large numbers of travelers at an unprecedented level of detail. Such trajectory datasets provide a wealth of information for purposes such as urban planning, carpool formation, and public-transportation design. This paper describes methods for analyzing and visualizing such data with an emphasis on sparse-traffic environments. It outlines the needs of applications in this domain and presents methods for clustering trajectories and for visualizing the results. The methods are evaluated by an experimental study on a publicly available dataset from real travelers.

An object tracking algorithm for static camera

Author(s): Lianfeng Shil, Guanghua Chen, Yang Liu, Yajun Fang, Berthold K. P. Horn

Abstract: Mainstream surveillance system takes a huge investment both in terms of workforce and time. As people are pursuing a smarter way of managing cities, the current methods of surveillance limits the efficiency and smartness of the city. Abnormal activity detection of video is an algorithm that devotes to finding unusual activities in a certain clip of video. This can filter out the normal scenes and let the human monitors focus on scenes that may contain accidents. Previous works either doesn't use object tracking at all, or they can only track moving objects, which will lost a lot of useful information. This research project proposes an improved approach to track objects in the scene, with a unique combination of feature point tracking and optical flow. Feature points keep tracking objects, and optical flows decide which feature points that are valuable to be tracked. Further more, this algorithm can control the density of feature points to reduce computation. This algorithm is able to track every object of interests, no matter it is moving or not. This algorithm can be integrated into smart city system, can be used to statistically analyze the traffic condition of the city automatically.

Adaptive Spatio-temporal Model Based Multiple Object Tracking in Video Sequences Considering a Moving Camera

Author(s): Yi Tao, Jiahui Chen, Yajun Fang, Ichiro Masaki, Berthold K.P. Horn

Abstract: Tracking multiple objects in a moving camera is challenging. Due to the irregular movements of the camera, the displacement, scale, and appearance of the objects can be difficult to predict and track. To cope with these problems, we propose an Adaptive Apatio-temporal (AST) model, which explicitly estimate the movement and scale of targets in the view of the moving camera. Moreover, the interactions among objects are also considered to increase the robustness. We introduce our model to the multiple hypothesis tracking and achieve a competitive result on the public benchmark, which includes video of both moving and statistic camera.

A Method to Extract Overall Trajectory Information from Frame Sequence of Fixed Background without Object Tracking

Author(s): Hongkai Chen, Yang Liu, Yajun Fang, Guanghua Cheng, Tianhong Shen, Berthold K.P. Horn

Abstract: We present a novel method for overall trajectory information extraction from RGB frame sequence of fixed background. In contrast to existing methods using object detection and tracking, which focus on individuals' trajectories, our method extract overall trajectory information without needs for object tracking, which brings about considerable reduction on computation cost. Rather than tracking every object, we detect objects of each frame, recording their central positions. These positions are then joint to form a 2D trajectory point cloud. A clustering algorithm is then performed on the 2D point cloud to extract overall trajectory information. Our method shows a significant potential on real-time traffic analysis for the feature of low computation cost and the extraction of overall information.

Real-time Vehicle Status Perception Without Frame-based Segmentation for Smart Camera Network

Author(s): Jiahui Chen, Yajun Fang, Hao Sheng, Ichiro Masaki, Berthold Horn, Zhang Xiong

Abstract: Nowadays camera network plays an important role in the Intelligent Transportation System (ITS), and due to the weak computing ability of smart devices in the camera network, collecting traffic status in real time is one of the critical tasks in this field. A common strategy for traffic status collecting is first to form the trajectories of vehicles and then to measure interested indicators. To address this problem, we present a real-time vehicle status perception approach, which directly extracts vehicle status from our proposed novel video feature, temporal component-weight. Specifically, temporal component-weight is calculated based on a sampling of the whole frame. Also, a hybrid model is proposed to handle crowded situations. We test our approaches in surveillance sequences, and the results show that the proposed approach can effectively collect the vehicle status, including number, relative location, and relative speed.

Autonomous Mobility and Energy Service Management in Future Smart Cities: An Overview

Author(s): Xiaoqi Tan, Alberto Leon-Garcia

Abstract: With the rise of transportation electrification, autonomous driving and shared mobility in urban mobility systems, and increasing penetrations of distributed energy resources and autonomous demand-side management techniques in energy systems, tremendous opportunities, as well as challenges, are emerging in the forging of a sustainable and converged urban mobility and energy future. This paper is motivated by these disruptive transformations and gives an overview of managing autonomous mobility and energy services in future smart cities. First, we propose a three-layer architecture for the convergence of future mobility and energy systems. For each layer, we give a brief overview of the disruptive transformations that directly contribute to the rise of autonomous mobility-on-demand (AMoD) systems. Second, we propose the concept of autonomous flexibility-on-demand (AFoD), as an energy service platform built directly on existing infrastructures of AMoD systems. In the vision of AFoD, autonomous electric vehicles provide charging flexibilities as a service on demand in energy systems. Third, we identify four key decisions that, if appropriately coordinated, will create a synergy between AMoD and AFoD. Finally, we discuss key challenges regarding the system-wide coordination between AMoD and AFoD.

Designing Intelligent Spaces as if They Were Human: A “Space Agent” Framework

Author(s): Yixiao Wang, Keith Evan Green, Rod Grupen, Johnell Brooks, Ian D. Walker

Abstract: The literature of communication theory suggests that people tend to interact with interactive artifacts as if these were human. For decades, this understanding has been applied to designing computer embedded devices at small physical scale (i.e. objects). In this paper, the authors extend this same

understanding to the dimension of space—to designing intelligent, physical environments. The conceptual ground for this design intention is found in a “pattern language” developed by Alexander, et al. for designing static physical environments based on the “best guesses” of architects. Upon this foundation of a pattern language, the authors offer a design framework based on our novel concept of “space agency” whereby observed human-human interaction is translated into human-machine Interaction for spatial artifacts by way of two mapping techniques. Our intention is to strive for more human-human-like interactions between human beings and intelligent spaces whereby intelligent spaces become friendly, helpful, and welcoming. In this paper, the design of an interior space within a fully autonomous vehicle provides a case study. The framework presented here has significance for designing intelligent artifacts and interactions with them as these extend, inevitably, to the dimension of space, entertaining, serving, and augmenting our increasingly digital and human-centered society.

A Study on Correlation Analysis and Application of Communication Network Service

Author(s): Bingqing Liu, Hongyan Cui, Xue Qiu, Tao Yu, Haiyong Xu, Yan Huang, Meng Xu

Abstract: Research on mobile network user behavior is of vital importance for mobile communications services. However, in most cases, large amounts of data are collected in a dispersed way and irregularly, impeding operators from offering reasonable business recommendations for users, hence business managers can hardly satisfy customers' needs. Therefore, we conduct a correlation analysis of mobile data, including a correlation analysis between a user's mobile network business and district, between business and time, and between business and business. In the process of analyzing, based on the Hadoop distributed computing platform, we apply the FP-Growth correlation algorithm to analyze real communication data from operators, obtaining the business type transition law of the network service types of users. Then, by applying the K-means algorithm, we cluster the data of base stations in the city, classify and count the network traffic flow used by users in each area and acquire their preference of network access. Furthermore, through the visualization of base station data of network businesses, mobile data could be better applied and analyzed. The study is useful for achieving the optimization of resource allocation and communication network service provided by operators, contributing to the better guidance of urban planning.

Emergency Preparedness System- Environment Warning of Waterlog

Author(s): Yuchao Wan, Yajun Fang

Abstract: Beijing suffered the strongest rainstorm and flood disaster in 61 years on July 21, 2012. 79 people have died in heavy rain. The number of houses collapsed to 10,660, and more than 1.602 million people were affected by heavy rains, with an economic loss of 11.64 billion yuan. Therefore, the paper would discuss more about the current situation of the Emergency preparedness system of Waterlog in China.

Session 2: Healthcare and Well-being

Time: 8:00am-11:10am, October 24th

Location: 32-G449

Chair(s): Hongyan Cui

A Survey on the Status of Smart Healthcare from the Universal Village Perspective

Author(s): Guoxin Huang, Yajun Fang, Xiushi Wang, Yu Pei, Berthold K.P. Horn

Abstract: This survey paper discusses the condition of smart healthcare implementation. It discusses the current healthcare problems and how smart healthcare technologies ease the problems. Our group, Universal Village, realizes that the integration and interaction between parties in a system will maximize the effectiveness and benefit for the system. Based on this idea, this paper considers the smart city system as a whole, and talks about how smart healthcare interacts with infrastructures and functions inside and outside of the smart healthcare field. Then, it analyzes how a more powerful integrated system can be built from the smart healthcare system. In the end, several case studies are listed. Based on our analysis and the case studies, this paper then ended with the future prospects of the smart healthcare.

Analysis of Information Exchange: How Does It Affect Patient-Hospital Relationship?

Author(s): Xiao Yang, Yajun Fang, Berthold.K.P. Horn

Abstract: The purpose of this paper is to propose a systematic solution to improve human healthcare situation and to amend the current medical and healthcare systems. The paper first evaluates the current smart healthcare technologies and their progress in different regions, then identifies the major limitation of current smart healthcare systems, specifically the current challenges of patient-hospital relationship and how insufficient communication between hospitals and patients jeopardize the patient-hospital relationship. The paper analyzes several impacting factors, including the interactions between smart healthcare system and other smart systems under the framework of smart cities, and how these factors would affect the whole systems systematically. Under such a framework we discuss in this paper how to enhance the patient experience in hospital by smart healthcare technologies and solve the problems of unsatisfying relationship between patients and hospitals. The studies are conducted from the following three aspects: hospitals exchange information, patients learn about hospitals, and hospitals gather data from patients. The research introduces different examples of medical technology and of intersections between healthcare system and other systems. However, due to the difference of medical resources and the development of infrastructures in different countries, smart healthcare system still need amendment.

Recognizing Activities of Daily Living Using Binary Sensors

Author(s): Sudarshan S. Chawathe

Abstract: Activities of Daily Living (ADLs), or a person's routine activities of self-care, are important factors influencing the feasibility of home health care or aging in place for many individuals. Automated, sensor-based recognition of such activities affords home stay, greater independence and privacy, and improved quality of life to individuals who would require stay in a supervised or medical facility. This paper describes a data-driven framework for the design and deployment of such an automated system for activity recognition using simple, unobtrusive, and privacy-friendly binary sensors. It presents the results of an experimental study, with both numerical and qualitative observations, of this framework on a publicly available real dataset.

Machine Learning on Cataracts Classification Using SqueezeNet

Author(s): Xingzhi Qian, Evan W. Patton, Justin Swaney, Qian Xing, Tingying(Helen) Zeng

Abstract: Cataracts is a serious eye disease, affecting over 20 million people worldwide. It is the clouding of the lens, which blocks the light to go through the lens and project on the retina. As a result, the nerve cannot transfer the whole image to the brain, leading to blindness. A vast majority of cataracts patients are people who are over 50 years old. To classify different areas of cataracts in lens, we use supervised training of convolutional neural network to train 420 images of cataracts on the lens taken from slit-lamps. The experiment can make the future of classifying cataracts more easily and ophthalmologists can apply operations to different categories of cataracts within a shorter time to cure patients with cataracts. For those people in the countryside, even not so experienced doctors can take the photo of lens and use the program to classify cataracts correctly.

A Study on Multidimensional Medical Data Processing Based on Random Forest

Author(s): Lifeng Zhang, Hongyan Cui, Roy E.Welsch

Abstract: In the field of medical research, when researchers use physical examination indicators to diagnose diseases, it is often difficult to make decisions because of the large number of data dimensions. It is also tough to make effective decisions on whether or not to be ill according to relatively important attributes. Under such circumstances, this paper proposes a feature extraction method based on random forest, which extracts features from multidimensional data. With validation of the UCI diabetic retinopathy data, we designed a method to calculate the impact score of multi-dimensional attributes to the presence or absence of disease. Then, by selecting two groups of data with higher impact score and lower impact score. Last, we used neural network algorithm to make comparative verification. The experimental results show that the high-impact score data calculated by the random forest has certain advantages over the low-score data in disease diagnosis, both on the accuracy of the diagnosis model and the diagnosis. We choose to use this method to select fewer features with higher scores to diagnose diseases, and also achieve good results.

Plant Disease Identification Using Convolutional Neural Networks

Author(s): Kevin Zeng Qi, Justin Mark Swaney, Evan W. Patton

Abstract: Plant diseases are a major threat to food security for public health. The goal of this research is to develop an effective system that can detect these diseases before they become widespread. We combat this by innovatively training a convolutional neural network to detect and identify diseases from the RGB images of plant leaves. The architecture of the network is based on the Alexnet architecture. The dataset consisted of corn, tomato and apple leaf images. The results were to be very promising with a 92.22% accuracy when trained and tested on the specific labels of each disease and species.

First-Aid system design

Author(s): Haoran Ma, Yang Liu, Yajuan Fang, Berthold K.P.Horn

Abstract: For the new upgrade of an existing first-aid system, the method of combining mobile device with Internet is adopted to realize the real-time feedback of patients' location information, query the corresponding first-aid methods and call nearby resources, so as to shorten the time of first-aid for patients and save their lives.

Session 3a: Intelligent Communities

Time: 8:00am-10:30am, October 24th

Location: W20-306

Chair(s): Gilly Leshed

UniWifi, A Smart Network System

Author(s): Harry Zhou, Bruce Wang

Abstract: As people become more and more reliant on wifi to complete day to day tasks, individuals also become increasingly restricted to their homes or places that provide it. We propose an Intelligent Network System that could provide constant wifi connection to the masses so that anyone could roam anywhere within an urban area and remain connected to the internet. Our concept revolves around using the contemporary 'mesh zone' technology. In phase one, we believe that by having small yet powerful routers installed everywhere, mesh zones that be created to effectively cover areas small and large. In phase two, the potential of having routers moved to the skies becomes probable when combined with high performance drones. The goal is global connectivity. We envision for a future where every device around the globe is connected to one or many central network databases. This is important because all internet traffic could be monitored and therefore greatly eliminating most if not all potential intrusions to civilian safety all around the globe. There are three checkpoints that we would like to accomplish. First, to test the connectivity range of a mesh router with a commercial drone. Then to successfully build our own beta prototype flyer. And at last, to test our beta flyers with multiple mesh routers to complete a working mesh zone. Wifi routers today are not being used to their full potential as they ironically work independently to connect collective devices to the web. By implementing mesh, one could connect to secure and fast connection while having mobility freedom. One could truly stay connected anywhere and everywhere.

CoDAS, a Method for Envisioning Larger-Scaled Computational Artifacts Connecting Communities

Author(s): Carlos Araujo de Aguiar, Gilly Leshed, Alexander Bernard, John McKenzie, Camille Andrews, Keith Evan Green

Abstract: Information Technologies are increasingly embedded into artifacts of the physical world—furniture, rooms, buildings, and urban infrastructure—making communities around-the-globe more connected and, arguably, more intelligent. However, such larger-scaled, social computing artifacts arrive with critical concerns of cost, material choice, design requirements, fabrication means, robust and safe use, power, and resistance to vandalism and the elements. Given the complexity of realizing larger-scaled, computational artifacts, conventional design methods prove inadequate and potentially costly and dangerous if researchers move too quickly to full-scale prototyping. In this paper, we present CoDAS, a hybrid methodological approach that combines elements of well-known HCI methods to effectively develop larger-scale social computing artifacts.

A survey of Multi-controllers Consistency on SDN**Author(s):** Tao Yu, Yang Hong, Hongyan Cui, Hongxiang Jiang

Abstract: Software-Defined Network (SDN) is developing rapidly for its benefit of programmability. However, new challenges also appear. One of them is while we are applying distributed controllers in SDN networks, we must consider the consistency problem. In SDN networks, especially in a multi-controller architecture, it is a great challenge to maintain a global view consistency of the networks among all controllers, which is also key to issue flow regulations. Lacking of consistency in packets, flows, and networks level may result in serious errors. Besides, consistency problem also exists in data plane. How to keep all switches executing a same set of rules to avoid errors is often discussed. In this paper we'll conclude the different situations of consistency problems and provide the related research solutions. The methods in the paper not only regard to consistency of control plane, but also data plane. At last, we also introduced the two methods to evaluate the performance of consistency, those are strong consistency and final consistency.

Anonymous network communication based on SDN**Author(s):** Taiyu Wong, Hongyan Cui, Yuepeng Shen, Wenqi Lin, Tao Yu

Abstract: As more and more personal information is used in network services, network anonymity has received more and more attention. Attackers could endanger the victims' privacy by attacking or eavesdropping nodes during the networks routing. For example, attackers could retrieve the IP and MAC address of victims from network traffics, and use it to correlate the network behavior to individuals. The emerging Software Defined Network (SDN) technique provides a pretty flexible platform that can control the whole network by software programming, which propose a new solution to realize the network anonymity problem. In this paper, we propose a solution based on SDN to anonymize both MAC and IP addresses of network traffics in order to mitigate the privacy threats, and programing it. Furthermore, we test the anonymity function on our SDN Testbed. Our solution supports two working modes: a two-way anonymous mode which anonymizes the IP and MAC addresses of all data packets, and an one-way anonymous mode which anonymizes MAC and IP addresses of senders.

Friendly Acoustic Technology Enhance Neighborhood and Friendship**Author(s):** Zhang Xiangdong, Kuang Zheng, Yang Jun

Abstract: It is estimated that there are currently 80 million to 100 million square dance crowds in China. Due to noise pollution, there are often quarrels and conflicts between the square dance crowd and their neighbors. Even in order to compete for the venue, there will be disputes between different square dance teams. The directional sound product based on local sound field control technology, combined with big data and mobile internet technology, composed the intelligent square dance system. It provides an ideal solution for the above contradictions, and has been piloted in several communities in Suzhou, China, and has won unanimous praise from all parties. This system, as an example of an IoT complex, can be widely used elsewhere.

Method of intonation conversion for facilitating English communication between native and non-native speakers

Author(s): Tomoko Nariai, Hiroaki Kojima, Hiroyuki Obari, Shiroh Itai

Abstract: With the growth of the Internet and globalization, hardships in English speech communication became more serious for non-native speakers. It would be desirable to develop a speech communication device which can convert English speech into a more intelligible one for listeners. In this study, English speech was hypothesized to be more intelligible to non-native listeners by being modified into the listeners' native language speaking style. First, the characteristics of English between native and Japanese speeches were statistically analyzed. The analysis determined the modification model marked modification of intonation of native speakers' speech so as to include Japanese characteristics. The hypothesis was realized by speech modification generated by a speech analysis, modification and synthesis system, STRAIGHT. Then, the modified speeches were evaluated on the basis of listening experiments involving Japanese listeners. The experiments consisted of dictation tests and preference tests, and resulted in an increase in the scores. The results, therefore, verified the hypothesis. This also revealed the potential feasibility of the speech conversion method which facilitates spoken English communication.

Session 3b: New Lifestyles Enabled by Big Data

Time: 12:00pm-2:05pm, October 24th

Location: W20-306

Chair(s): Wei Ke

The Clustering for Clients in a Bank Based on Big Data

Author(s): Jie Zheng, Hongyan Cui, Xiaoqiu Li, Lingge Meng, Tian Wang

Abstract: Many technologies about data mining, such as clustering, have been widely applied in the context of bank to understand the behaviors of the clients and investors. Unlike some classic clustering validity index using compactness and separation, we employ Pairing Frequency Clustering Validity Index (PFCVI), which uses pairwise pattern information and focuses more on logical reasoning than geometrical features. We use PFCVI to evaluate the clustering quality under different c and find the optimal value of c is 11 based on the bank's data, and clients in the 11 classes have different savings values potential levels and different fluctuation pattern. Then, we sum up the above 11 classes into 5 categories with different fluctuation pattern – stabilized savings values category, fluctuant savings values category, risen savings values category, fallen savings values category and abnormal savings values category. Finally, we analyze each category with techniques like user profile and give some targeted advice for each category aimed at optimal market segment.

GENERATING POETRY WITH STEM-BASED LSTM NETWORK

Author(s): Yifan Wu, Tingying(Helen) Zeng, Evan W. Patton, Justin Swaney

Abstract: Natural language generation (NLG) of poetry has been a difficult task in machine learning. In this paper, we propose a two-stage poetry generation system inspired by the stemming process in natural language processing. The system first transfers the learning text into stem words and models the task as a sequence-to-sequence learning problem. The system then runs a separate model that transfers the generated stem words back to normal text. This system enables a way of text generation that achieves better readability in a resource limited setup compared to a single word- or character- based model.

NUBILUM AD HOMINEM: Taking smart homes steps further

Author(s): Chuyuan Zhang, Yajun Fang, Berthold K.P. Horn

Abstract: Smart home technologies are developed with the goal of offering convenience to their users, but the currently available technologies are reactive, either to user commands or to user routine, as opposed to being proactive, and are not capable of taking the environment around the user into consideration when making an analysis. In addition, most existing systems have a strictly top-down hierarchical structure, where a central device such as the user's mobile phone controls the system to the point where the lack thereof impacts the functionality of the system on a tremendous scale, and may sometimes result in a cascading failure rendering the entire system inoperable. This article focuses on the relationship and connection between various unconnected data points scattered across a person's quotidian life, as well as the decentralized connection between

smart home devices, both on a microscopic and on a community scale. It seeks to propose an alternative system that takes into account not only user commands and routines, but also pieces of information disseminated by the surrounding environment, which the user might not have perceived or understood, and incorporates them into its own process of analysis. Furthermore, the proposed system emphasizes modularization and decentralization, such that the addition and removal of a node should not impact the system outside of the specific functionality provided by the said node.

MyNeighbourhood-The Human Smart City Village

Author(s): Álvaro OLIVEIRA, Irani SANTOS

Abstract: This paper argues that cities themselves have to play a strategic and foundational role in the conceptualisation, development and implementation of a Human Smart City model, able to address the local or global societal challenges they face today. The Human Smart City concept aims at developing a citizen-driven, smart, all-inclusive and sustainable environment, with a new governance framework in which citizens and government engage in listening and talking to each other. This public governance model favours the emergence of a participatory innovation ecosystem that creates jobs. The MyNeighbourhood project aims at implementing this concept at a neighbourhood scale, demonstrating its viability and positive impact. It will identify the wishes, interest and needs of the citizens (referred as WIN) by involving them in a co-design process leading to the co-creation of solutions. "Smart" ICT services building upon data provided by the citizens are used to recreate the social bond between neighbours and their link to the physical place of the neighbourhood.

Analysis of the relationship between life satisfaction and waste behaviors

Author(s): Fuxin Du, Yajun Fang, Yang Liu, Berthold K.P. Horn

Abstract: With the advancement of technology and science, people's life becomes colorful and convenient. In order to suit for people's needs, the increasingly number of factories would product a wide range of products that may be not that necessary in people's life. However, producing these stuff seriously influence the environment, which not only is about the waste during the processing, but also causes the severe pollution to natural mother. Thus, it will be helpful for people to do some researches about investigating the relationship between life satisfaction and waste behavior, which may help scientists to find a feasible and valid way to keep the balance between the environmental protection and the growth in the living standards. This essay is mainly concerned with analyzing the correlation of index and giving the conclusion about how to balance the waste behavior and high living standard.

Session 3c: Smart Solutions with AI

Time: 2:05pm-4:25pm, October 24th

Location: W20-306

Chair(s): Xiyang Li

The Future of Optical Character Recognition use in Accounting.

Author(s): Lu Gerry

Abstract: In recent years, I have identified a problem. This problem is the disproportionate amount of lower income families facing the law because they are unable to pay their taxes without the help of an expensive accountant. My idea to solve this problem is to create a AI that can be used to easily help people with their taxes. I plan to do this through ORC. I propose a software that can take a photo of multiple receipts and then instantly be able to extract information from the photo such as totals, subtotals and GST. Then after using this information the software will fill in a tax return, ex: T1 tax return in Canada. In the future I want this to be available all people, thereby bypassing expensive accountants, and helping low income families to stay on the right side of the law.

FASTER R-CNN over ATTENTION: Shared Bike Detection in Surveillance Video

Author(s): Xuelin Yang, Xiyang Li

Abstract: The illegal parking of prevalent dockless shared bikes poses inconvenience and threat to traffic safety, which is mainly regulated by inefficient manual searching in the city. In this paper, we enable the effective regulation using detection results from surveillance videos. In state-of-the-art detection networks, advances like Faster R-CNN have reduced running time, exposing limitations in processing consecutive images. We introduce the model of Faster R-CNN over Attention (FoA), which is able to accomplish fine-grained detection of shared bikes in videos. We combine an Attention Region Extraction (ARE) with Faster R-CNN, and put forward an Anchor Box Optimization of the network. We also build a labeled data set of shared bikes with 4,291 images and 12,697 objects, and test the algorithm on it. The FoA, as well as the data set, can be utilized in other scenes of surveillance video detection.

Seat arrangement for an arena

Author(s): Haosen Cao, Yang Liu, Yajun Fang, Berthold K.P Horn

Abstract: This paper proposes that Crowd Capsule, designed by lending from well-known sociological theories of crowd control, would lessen the uncertainty of large venue crowd safety by not only reducing the chance of large-scale emergencies occurring by but also providing the plan for a structure that would reduce the loss of both human resources, health, and even life, due to unforeseen emergency situations.

A Simple Change Comparison Method for Image Sequences Based on Uncertainty Coefficient

Author(s): Ruzhang Zhao, Yajun Fang, Berthold K.P. Horn

Abstract: For identification of change information in image sequences, most studies focus on change detection in one image sequence, while few studies have considered the change level comparison between two different image sequences. Moreover, most studies require the detection of image information in details, for example, object detection. Based on Uncertainty Coefficient(UC), this paper proposes an innovative method “CCUC” for change comparison between two image sequences. The proposed method is computationally efficient and simple to implement. The change comparison stems from video monitoring system. The limited number of provided screens and a large number of monitoring cameras require the videos or image sequences ordered by change level. We demonstrate this new method by applying it on two publicly available image sequences. The results are able to show the method can distinguish the different change level for sequences.

A Continuous Integrated Website Architecture Design

Author(s): Yiyang Gao

Abstract: Website security has been questioned and noticed over centuries ago. Due to system failures and architecture design failures of our website, the Universal Village committee has decided to rebuild an entirely new website system for the Universal Village society. To achieve the requirements of a modern website, which includes having high performance and highly secured backend, and also having a pixel-perfect and user experience optimized frontend structure. Therefore, the Universal Village IT Committee were using separated architecture and using bleeding-edge technologies to enhance all factors of our new website.

Session 4: Data Management

Time: 8:00am-10:20am, October 24th

Location: 32-262

Chair(s): Wenqiang Wang

Analysis of the Uniformity of Light in a Plant Growth Chamber

Author(s): Yong Xu, Hanbin Wang, Walter Nsengiyumva

Abstract: Plant growth is greatly affected by light. However, the uniformity of light in plant growth chambers has always been a common problem that was not appropriately addressed. As this, the uniformity of light in a plant growth chamber illuminated by light-emitting diodes (LEDs) was investigated in this paper. The orthogonal experimental design method was used to test the influence of various factors on the uniformity of light intensity in a plant growth chamber using the lighting simulation software DIALux. The major factors investigated in this paper include the divergence angle, number and arrangement of LED lamps, as well as the reflectivity of the inner walls of the chamber and the minor factors include the vertical distance from the LED board and the distance from the board edges. The relative importance of influence of each factor on the uniformity of light in the chamber was obtained and finally, an optimized model of the plant growth chamber with a uniformly distributed illumination was obtained. Simulation results showed that reflectivity of the inner walls had the highest influence on the uniformity of light on the working plane, followed by the divergence angle of the LED lamps, and the number of LEDs had the lowest influence. Therefore, the number of LEDs may mainly affect the intensity of light on the working plane but not the uniformity on the plane's illumination significantly, especially when the distance from the LED board is relatively large. Results also showed that the uniformity of light increases vertically from the LED board and with the edge distance as well. Based on our simulation results, a three-dimensional optimal cultivation area in a plant growth chamber was suggested which achieved the uniformity of 0.93.

CovNN: A Covariance Neural Network Extended from CNN

Author(s): Yue Shen, Tianyou Zheng, Dandan Li, Zicai Wang

Abstract: Convolutional neural networks (CNNs) show commendable performance in computer vision, approaching high accuracy in a broad number of application domains. However, the training process of feature kernels in CNNs is easily affected by illumination intensity and feature interaction, which leads to overfitting. In this paper, we propose a covariance neural network (CovNN), which replaces the original convolutional operation with our covariance algorithm, to make the learned kernels more robust to different illumination conditions and irrelevant features. This covariance layer uses the 3D covariance between all the input feature maps and the corresponding group of kernels by sliding window method, and regularizes them without additional parameters. Moreover, the covariance layer can be seamlessly transplanted to a variety of neural network architectures extended from CNNs (e.g., ResNet, Faster R-CNN). We evaluate the proposed CovNN on several popular datasets for image recognition (MNIST, Fashion-MNIST, CIFAR 10 and AR) and classification of organs (Abdominal

Ultrasound Dataset). Experimental results demonstrate that CovNN achieves significant improvements over the state-of-the-art on most of them.

Simplifying Component Interaction with Actors and Databases

Author(s): Wei Ke, Lap-Man Hoi, Ka-Meng Siu

Abstract: Component-based software systems are of the majority nowadays. When it comes down to implementation, the interaction between components is just as important as the functionality itself. When invoking a function of a component, how to pass data arguments, how to receive return results, and when to expect a return are all the questions to ask. There are so many ways in which these can be done, that it introduces the complexity in the usability of a component. We present in this article an architecture for integrating heterogeneous components across different language and binary platforms, different processes and even different machines, based on a simple message passing mechanism --- the actor model, and the sharing of common and global data structures only through databases. We show the simplicity and flexibility of this architecture by restructuring a slot machine framework, which consists of components to drive modern and legacy hardware, follows a static workflow, and changes the visual appearance quite often. We argue that this architecture with restricted implementation choices can be used in a much broader range of software systems, helping produce software components that are more independent and easy to adopt.

A Survey on the Status of Open Data and Its Future

Author(s): Xiushi Wang, Yajun Fang, Yang Liu, Berthold K. P. Horn

Abstract: This survey paper looks at the open data, which is one of the most important elements of developing smart city and universal village. This paper focuses on the relationship between open data and smart city and the evaluation of open data projects. It describes the reason why data needs to be opened up, how open data should be evaluated, the current status of open data projects, and the challenges the open data developers are facing. Besides, the paper introduces the open data platform of the United Kingdom as a case study to explain open data project in the end.

Towards an AUV Swarm Based Mobile Underwater Sensor Network for Invasive Species Data Acquisition

Author(s): Mark Allison, Heather Dawson, Grant Rusin

Abstract: Ecological data acquisition, refinement, and analysis methods have not kept pace with advancements in mobile sensor technology and applications of machine learning techniques due to the typical stovepiping of the sciences. Environmental sensor networks are an emerging technology which leverages advances in distributed sensing to realize real time rich data streams for researchers. When this network is made mobile it presents a disruptive technology with the potential to reveal new phenomena and questions as observations, that were once too dangerous or costly to obtain, becomes possible. In this concept paper, we motivate and present preliminaries in our investigation pertaining to the

use of Autonomous Underwater Vehicles (AUVs) in swarms to realize a mobile sensor network targeting invasive species in the Great Lakes.

Session 5: Green Energy and Materials

Time: 10:20am-12:25pm, October 24th

Location: 32-262

Chair(s): Tingying (Helen) Zeng, Qiang Wang

Co-channel Interference of TD-LTE Wireless Network in Smart Grid

Author(s): Rongduo Liu, Jiadong Du, Qi Wang, Wei Xin, Delong Song, Xu Liu, Hailun Xia

Abstract: As a private wireless network of smart grid, TD-LTE network use the same frequency band with other dedicated TD-LTE networks. There is an issue of co-channel interference to be studied. The co-channel interference could be described by Reference Signal Receiving Power (RSRP), Signal to Interference Plus Noise Ratio (SINR) at certain scrambling level and different interference field intensity. This paper presents a method to test the tolerance of the interference field intensity and the reference value of SINR in a certain RSRP value, with QoS as the evaluation index. The paper firstly investigates the category of smart grid services and Quality of Service (QoS) attribute value base on the specifications of power grid. Then the definition and causes of co-channel interference in LTE network are analyzed, and the method to evaluate the co-channel interference is given. Furthermore, a test by using the proposed method is given in the laboratory environment. More than 200 times of tests are repeated, and the delay, packet loss rate and throughput are obtained. The conclusion is finally given by comparing the test value with the required value of QoS. The data obtained in this test will provide reference for the design and optimization of the TD-LTE wireless network. And the method can be further used in the selection of the critical value of the finer network terminal RSRP.

Integration of Solar PV Generation with Distribution Grid: Using Novel Adaptive Filter Based Control Technique

Author(s): Nishant Kumar, Bhim Singh, Bijaya Ketan Panigrahi

Abstract: In this work, a Novel Adaptive Filter (NAF) is proposed for optimal control of grid-integrated solar PV (Photovoltaic) generating system. The proposed NAF is the improved form of classical adaptive vectorial filter (AVF), where inherent problems of AVF technique, like unable to handle the phase imbalance and phase shift issues, are successfully mitigated. For performance evaluation of NAF based control technique, a single-stage topology of three-phase grid integrated solar PV system is taken, where the loads are connected at the PCC (Point of Common Coupling). The prime objective of proposed NAF based control technique is to meet the active power requirement of loads from generated solar PV power, and after fulfill the load demand, the excess power is supplied to the grid. However, when generated PV power is not sufficient for the load then the NAF based control

fulfills the load demand by taking extra required power from the grid. During this process, the power quality of the grid power is improved. The controller action provides, power factor correction, harmonics filtering and mitigation of other power quality issues. Moreover, when the solar irradiation is zero, then the voltage source converter acts as a distribution static compensator (DSTATCOM), which enhances the utilization factor of the system. The proposed techniques are modeled and their performances are verified experimentally on a developed prototype, in solar insolation variation conditions, unbalanced loading, as well as in different grid disturbances such as overvoltage, under-voltage, phase imbalance, harmonics distortion in the grid voltage etc.

Utility Grid Assisted Automated Solar PV Powered Energy-Efficient Eco-Friendly Water Pumping System With Improved Power Quality Performance

Author(s): Shadab Murshid, Bhim Singh

Abstract: This work proposes the development of a solar photovoltaic (PV) array powered permanent magnet synchronous motor (PMSM) driven water pumping system. Owing to intermittent nature of solar energy due to continuously varying insolation level, the presented system proposes the introduction of utility grid, which ensures a reliable and uninterrupted operation of water pump. The pump operates at a rated flow rate when integrated to the grid. The power flow from single phase utility grid is facilitated using a boost converter for power factor correction. Along with maintaining the DC link voltage, the boost converter improves the power quality performance in terms of reduced total harmonic distortion and unity power factor operation. An improved orthogonal signal generator (IOSG) is used for extraction of fundamental positive sequence component from the grid voltage. An incremental conductance algorithm is used for extracting maximum power from the PV array. A back emf based sensor-less technique is utilized for estimation of speed and position. The performance of proposed system is experimentally validated for different modes of operation during starting, steady state and varying insolation conditions using a developed laboratory prototype. The performance of the proposed system is also investigated under abnormal grid conditions. The proposed system performs satisfactorily under all operating condition confirming the power quality indices stated under IEEE- 519 standard, while drawing power from the grid.

Fault Ride-Through Operation of Grid Interfaced Solar PV System with Power Quality Improvement

Author(s): Priyank Shah, Bhim Singh

Abstract: This treatise proposes a generalized integrator (GI) based control scheme for low voltage ride-through operation of solar photovoltaic array (SPVA) with power quality (PQ) improvement features in the distribution grid. Under balanced/unbalanced grid voltage faults, the proposed strategy controls DC-DC converter in such a way that voltage source converter (VSC) currents are achieved within its permissible limits. Moreover, according to the recommended by the revised IEEE 1547.4 standard, the SPVA coupled VSC is adaptively supplied reactive power to the grid based on depth of grid voltage sag. The GI algorithm is

proposed here to estimate accurate fundamental load component (FLC) even under the presence of DC offset. Moreover, the effectiveness of the GI algorithm is illustrated with frequency domain analysis and Lissajous plot to extract FLC. Simulation results are exhibited to illustrate the capability of the proposed strategy for the line to ground fault in the grid side network. Experimental results demonstrate the satisfactory performance under various cases such as load currents imbalancing, a variation of irradiances, SPVA-DSTATCOM mode and line to ground fault.

Adaptive Generalized Predictive Control Scheme for Single Phase GPV System

Author(s): Vedantham Lakshmi Srinivas, Bhim Singh, Sukumar Mishra

Abstract: This paper proposes an adaptive generalized predictive controller (GPC) for single phase grid connected photovoltaic (GPV) system to ensure smooth active and reactive power control. Contrary to most other linear controllers, this non-linear adaptive control strategy offers quick stabilization of system parameters under variety of stochastic changes that occur in practical photovoltaic systems such as solar insolation changes, grid frequency changes, rapid perturbations in linear/ nonlinear/ induction motor loads. The developed controller has capability of providing smooth steady state and dynamic responses under such disturbances. The mathematical derivation of the controller is depicted and simulation results are provided to validate the effectiveness of the proposed control strategy. The comparative analysis depicts superior performance of the proposed controller, in comparison with linear power control strategy. With linear controllers, the injected active power is prone to constant fluctuations caused by different perturbation in solar PV system, thereby, resulting in corresponding fluctuations in DC link voltages, which increase the failure rate of electrolytic capacitors and the proposed control strategy serves as possible solution to handle the stochastic changes in PV system.

What Changes can UM bring to UV? (Ultimate Material & Universal Village)

Author(s): Sunny Wang

Special Session 8a: Intelligent Modeling and Simulation

Time: 8:00am-10:30am, October 24th

Location: Little Theatre(W16)

Chair(s): Lin Zhang

Discrete Event Modeling and Simulation Aspects to Improve Machine Learning Systems

Author(s): Laurent Capocchi, Jean-Francois Santucci, Bernard P. Zeigler

Abstract: Discrete Event Modeling and Simulation (M&S) and Machine Learning (ML) are two frameworks suited for system modeling which when combined can give powerful tools for system optimization for example. This paper details how discrete event M&S could be integrated into ML concepts and tools in order to improve the design and use of ML frameworks. An overview of different improvements are given and three concerning Reinforcement Learning (RL) are implemented in the framework of the DEVS formalism.

DEVS Modeling and Simulation of Financial Leverage Effect Based on Markov Decision Process

Author(s): E. Barbieri, L. Capocchi, J.F. Santucci

Abstract: Decision making during a financial asset optimization process leading to a potential leverage effect is a major issue in the management of an investment program such as European development programs. Modeling and simulation based on reinforcement learning can propose a decision-making policy in this kind of process. This paper presents a DEVS discrete event modeling and simulation approach from Markov decision making processes applied to the search for maximum leverage on self-financing capabilities in grant application instruction phase. The application of the approach presented in this paper is made on the search for the leverage effect linked to the price volatility of the main stock market indices (CAC40, NasDaq, etc.).

Smart-Parking: Integration and data management by modeling and simulation using connected objects according to the DEVS formalism

Author(s): Dominici Antoine, De Gentili Emmanuelle, Capocchi Laurent, Santucci Jean-Francois

Abstract: This paper deals with problems encountered in the current car parking. These problems can be highlighted as: few places in proportion to the need, more and more vehicles, insufficient public transport, intermodality undeveloped, uses of places not optimal linked to the payment policy and uses that evolve too slowly. A solution is proposed based on the smart city and mix smart parking with a heterogeneous solution of flow management, space availability management and transport system development involving modeling and simulation based on the DEVS (Discrete Event System specification) formalism.

A Dynamic Data Driven Application System to Manage Urban Agricultural Ecosystems in Smart Cities

Author(s): Adam Ghandar, Georgios Theodoropoulos, Bowen Zheng, Shijie

Chen, Yue Gong, Miner Zhong

Abstract: The world is currently facing significant challenges in feeding a growing population with declining resources. Urban agriculture and vertical farming have the potential to provide a revolutionary new food supply and distribution network capable of feeding large populations in the 21st Century; as well as increase quality and reduce negative impacts on the natural environment. The concept has attracted a lot of attention from governments and business throughout the world recently. This paper describes a framework for applying technologies from Agent Based Models, Simulation and Computational Intelligence to analyze, optimize and manage “ecosystems” for urban agriculture and vertical farming for food production from the perspective of stakeholders including consumers, producers, and policy makers.

Simulation of Production Modes for Cloud Manufacturing Enterprises

Author(s): Longfei Zhou, Lin Zhang, Lei Ren

Abstract: With the continuous development of new-generation information technology and new-generation artificial intelligence technology, the manufacturing enterprises become more autonomous and associated with each other than before. In the cloud manufacturing environment which is a kind of intelligent manufacturing model, the production modes of manufacturing enterprises are of great concern. The production modes are transforming from the traditional mass production mode to the demand-oriented mode in which the individualized product attributes are prominent. Through modeling and simulation, this paper studies the impact of different production modes on the operational efficiency of enterprises in the cloud manufacturing environment, and preliminarily explores the operating strategies and survival modes of manufacturing enterprises in the future global collaborative manufacturing environment.

Program Procedure Pattern Mining Model for Legacy Code

Author(s): Jingjing Zhao, Jianbin Liu, Liwei Zheng

Abstract: Finding the program procedure patterns by manual summarization is time-consuming and laborious. A program procedure pattern mining model is proposed integrated the data mining method. The contiguous sequential pattern mining method is applied to candidate pattern mining by analyzing the procedure features. A candidate pattern classification method is proposed to classify the candidate patterns into structure candidate patterns and structure relation candidate patterns using the data flow constraint. Then use the heuristic rules to filter and abstract the functional meanings of these patterns, and finally, the program procedure patterns are obtained. The experiment system is designed to mine the legacy code and obtains more than 179 kinds of reusable program procedure patterns, verifying the effectiveness of the model.

Special Session 8b: Future Intelligent Manufacturing

Time: 12:00pm-2:05pm, October 24th

Location: Little Theatre(W16)

Chair(s): Satarupa Mukherjee, Lin Zhang

Integrated optimization of supplier selection and service scheduling in cloud manufacturing environment

Author(s): Sisi Lin, Yuanjun Laili, Yongliang Luo

Abstract: Cloud Manufacturing environment enables enterprises to share their resources together for rental profits and customized production. The fact that most manufacturing devices are organized and controlled in a particular production line hinders the flexible use of the corresponding services in a cloud platform. Therefore, the collaborative selection of upper layer suppliers and the underlying manufacturing services is of great importance, but rarely considered. To address the problem, a two-layer integrated model of supplier selection and service scheduling is proposed to provide feasible solutions for different kinds of production requirements. The decomposition-based multi-objective evolutionary algorithm, i.e., MOEA/D, is applied to minimize the production time, the rental cost and the transportation cost for producing a customized product. We empirically demonstrate that the integrated optimization way is more efficient than the original two-step decision way in practice.

Machine vision for the quality assessment of emulsions in pharmaceutical processing

Author(s): Saritha Unnikrishnan, John Donovan, Russell Macpherson, David Tormey

Abstract: Emulsion quality evaluation using machine vision techniques depends on the efficiency of the image segmentation algorithms. Two different machine vision techniques are investigated to determine their competency in detecting droplets from in-process microscopic images of a cream emulsion. Histogram-based segmentation shows promising potential compared to edge and symmetry detection. A statistical study of the droplet characteristics was conducted. The results demonstrate that the histogram-based approach is more proficient in the progressive analysis of droplet evolution during emulsification. A real-time integration of the technique is proposed, as a soft sensor, to predict the optimum process time and to increase manufacturing efficiency in chemical industries.

A preliminary approach towards the trust issue in Cloud Manufacturing using Grounded Theory: Defining the problem domain

Author(s): Henzel Robert, Herzwurm Georg

Abstract: In Cloud Manufacturing trust is an important, underinvestigated issue. This paper proceeds the noncommittal phase of the grounded theory method approach by investigating the trust topic in several research streams, defining the problem domain. This novel approach fills a research gap. Findings were accomplished by a structured literature review and are able to help future researchers in pursuing the integrative phase in Grounded Theory by building on

the preliminary result of this paper.

A Manufacturing Task Scheduling Method Based on Public Goods Game on Cloud Manufacturing Model

Author(s): Tian Bai, Sicheng Liu, Lin Zhang

Abstract: In order to increase the resource utilization and reduce the idle in the process of implementing and running of cloud manufacturing, scheduling becomes a practical and critical issue. Different from most existing studies that focus on scenarios with intelligent optimization algorithms, this paper studies job scheduling of cloud manufacturing based on game theory, in which mathematical model of the public good game is put forward. Then, the problem of multi-job optimization of scheduling in cloud manufacturing is solved by BA Scale-free network and non-cooperative game. Finally, a numerical example is presented to demonstrate the feasibility of the approach.

Study on Modeling and Evaluation Method of Service-agent Network in Cloud Manufacturing

Author(s): Chun Zhao, Lin Zhang, Xiao Luo

Abstract: In the process of cloud manufacturing simulation platform, the service agent drives the manufacturing service to form a self-organization network, in order to conduct transactions and cooperation spontaneously. Thus, the service network of service agent and the cooperation network of service agent are formed. In this paper, the models of two kinds of networks are created by the theory of set pair analysis, and an evaluation method for two kinds of network models is proposed. Finally, the network evaluation method is validated by simulation data.

Special Session 8c: Effective Microorganisms Technology

Time: 12:00pm-2:55pm, October 24th

Location: 32-370

Chair(s): Masaki Shintani

Water quality improvement and biodiversity recovery in rivers, lakes and seas using Effective Microorganisms by citizens

Author(s): Yoshiki Ito, Teruo Higa

Abstract: United Networks for Earth Environment (U-net) is an authorized non-profit organization that actively solves the problem of environmental pollution, enriches the ecosystem, conserves biodiversity, and promotes the idea of coexistence using effective microorganisms (EM). The main activities of U-net are as follows: (1) supporting social contribution and environmental cleanup activities of its members such as creating a recycling-based society, promoting organic farming, and cleaning up rivers, lakes and seas using EM throughout Japan, (2) holding events and expanding the network, (3) providing public relations activities, (4) promoting environmental education such as cleaning swimming pools at school with EM, and (5) promoting projects and creating good models for the use of EM. We introduce case studies of water quality improvement and biodiversity recovery in rivers, lakes and seas using EM performed by citizens throughout the country.

Use of EM Technology (EM) in water treatment: Urban sewage water treatment plant, a city slaughter house, and a natural estuary in Guayaquil, Ecuador

Author(s): Fabian Castillo

Abstract: The following article describes three case studies where Effective Microorganisms (EM) proved to be successful at recovering natural aquatic ecosystems as well as treating sewage and industrial waste water. The first case was at a water treatment plant that received the sewage water from two populated sectors of about 1'100,000 people within Guayaquil, the largest city in Ecuador. The efficacy of EM treatment was compared to an already established water treatment system using electrical aerators. In both cases, pH was maintained at a neutral range after 8 weeks and hydrogen sulfide, main cause of foul odors, was not detected after 5 weeks. The most significant difference was in the cost and used of energy. The second case consisted of treating the facilities of a slaughterhouse processing 1000 animals a day with the objective of reducing foul odors. EM was sprayed in all areas of the facility including floors, pathways, sewers and surrounding areas. Although no measurable parameters were evaluated, workers were interviewed to determine efficacy in reducing foul odors. After 5 months of treatment, employees and foremen agreed that foul odors were reduced almost completely to the point that employees did not feel the need to use masks. In addition, there was a consensus that the working conditions had significantly improved. The third case was the treatment of a natural estuary being contaminated with sewage water. Water samples and sediments were taken from the area receiving sewage water from the city sewage system. The following parameters were evaluated: Acidity, phosphates, organic matter, hydrogen sulfide,

total suspended solids, populations of coliforms and salmonella. The results showed a significant decrease in phosphates, total suspended solids, organic matter and hydrogen sulfide, and a reduction in concentration of coliforms. Additionally, pH was maintained at neutral range allowing the proliferation of native life. These experiences demonstrate the versatility and efficacy of EM to mitigate water contamination due to human activities in populated cities.

Use of EM Technology in Intensive Shrimp Aquaculture: An Effective Research-Based Tool to Enhance Sustainability

Author(s): Gustavo F. Pinoargote, Toru Koshoji

Abstract: As the demand for farmed shrimp continues to grow worldwide, the use of probiotics to address the sustainability of intensive shrimp farming has gained much attention. Emerging diseases, such as acute hepatopancreatic necrosis disease (AHPND), pose a threat to sustainable intensification of shrimp aquaculture due to its devastating economic impact. This paper extends the application of Effective Microorganisms (EM) from a controlled setting to a commercial scale. A previous scientific study conducted on live shrimp evaluated the use of EM to mitigate the effects of the pathogenic *V. parahaemolyticus* strain that causes AHPND. In laboratory conditions, the analysis of shrimp survival and bacterial community composition in the gastrointestinal tract of shrimp showed 73.3% survival and higher weight gains (31.2%) versus the negative control (11.2%). In the present study, comparable results were obtained in a commercial shrimp farm located in Thailand, in a region where the shrimp industry had been decimated by AHPND. Survival rate increased from 58% to 91% and Food Conversion Rates decreased from 1.36 to 1.22. These results validate the efficacy of EM in inhibiting bacterial diseases and increasing the sustainability of intensive shrimp production systems.

Use of Effective Microorganisms® (EM®) for Sustainable Pathogen Control in Food Safety.

Author(s): Amber Gibby, Eric Lancaster

Abstract: TeraGanix, Inc. produces and distributes the original and certified brand, Effective Microorganisms (EM) for the United States. EM all-natural liquid probiotic comprises of three groups of microbes: Lactic Acid Bacteria, Yeast, and Photosynthetic Bacteria. Given that Lactic Acid Bacteria has been used for centuries for food preservation and fermentation, EM has the potential to be used as a biocontrol for common food-borne pathogens such as Salmonella, Listeria, and E. Coli. This paper is a gathering of research done to support EMs use in pathogen control as it relates to food safety.

Countermeasures against the radioactive contamination of agricultural crops by utilizing effective microorganisms (EM) for the agricultural land damaged in the Fukushima Daiichi nuclear power plant accident

Author(s): Shuichi Okumoto, Masaki Shintani, Aleksander Nikitin, Teruo Higa

Abstract: The accident that occurred in March 2011 at the Fukushima Daiichi Nuclear Power Plant resulted in the radioactive contamination of a huge area in

the Fukushima Prefecture. Fertilization by potassium chloride is recommended and implemented for reducing the transfer of radioactive cesium from soil to the crops grown on an agricultural land. However, excessive application of potassium chloride destroys the mineral balance of the soil, possibly leading to the deterioration of the quality of crops and an increase in cost. Further, because potassium chloride cannot be used in organic agriculture, alternative techniques are required to replace chemical fertilizers. Attempts to use effective microorganisms (EM) as countermeasures against radioactive contamination began in the late 1990s at the Institute of Radiobiology (IRB) in the Republic of Belarus. The application of EM to soil suppressed the transfer of radioactive materials from the soil to the crops. Based on these observations, we have been conducting surveys, research, and demonstration tests on EM-based countermeasures against radioactive contamination in the Fukushima Prefecture since May 2011. In this report, we present the research results and on-site demonstration of the suppression of the transfer of radioactive cesium to agricultural crops by EM.

Effective Microorganisms as a Potential Tool for the Remediation of ^{137}Cs -contaminated Soils

Author(s): Aleksander N. Nikitin, Shuichi Okumoto, Galina Z. Gutzeva, Masaki Shintani, Galina A. Leferd, Ihar A. Cheshyk, Teruo Higa

Abstract: During the development of a method using effective microorganisms (EM) to reduce the soil-to-plant transfer of ^{137}Cs on land contaminated with radioactive Cs, an unexpected effect of EM on the reduction of the ^{137}Cs activity in soil samples was observed. Laboratory experiments were then conducted to evaluate the impact of EM and fermented organic fertilizer (EM Bokashi) on the ^{137}Cs activity in soil samples to investigate this observation. The experimental results indicate an increase in the ^{137}Cs decay rate of up to 4 times the theoretical decay rate corresponding to the half-life of ^{137}Cs , which is equal to 30.17 years. Our results suggest that EM accelerates the radioactive decay of ^{137}Cs in soil.

Microorganisms open the future for mankind

Author(s): Teruo Higa

Abstract: The global environment and ecosystems are currently facing a critical situation. In order to directly address this issue and to pave a path for our future, it is essential to take a step back and redirect our focus on agriculture and microorganisms

Special Session 9b: Student Forum

Time: 8:00am-2:40pm, October 24th

Location: W20-307

Chair(s): Xuenan Ni, Xin Shu, Wenyang Gao, Haoran Ma

Discerning the growth pattern of water hyacinth in Lake Nokoue, Benin— applying satellite earth observation technology to inform local development

Author(s): Xuenan Ni, Ilham Ali, Danille Wood, Fohla Mouftaou

Abstract: The ideas of universal village and balanced development apply to the field of using advanced space technology to inform local development in some less developed areas. The use of the satellite earth observation technology and data enables decisions based on evidence that is previously unavailable. The prototype system for observing invasive water plant species in Benin aims to support decision-making for the public and private sector. Satellite earth observation technology supports global efforts to reach the United Nations Sustainable Development Goals. This project aims specifically to support Goal #15 (Life on Land) with a focus on Target #8 to prevent the introduction and significantly reduce the impact of invasive alien species. We worked in collaboration with Green Keeper Africa - a company based in Benin which processes the invasive water hyacinth plant into a fiber that absorbs oil-based pollution. More importantly, we partnered and engaged in the design and implementation of a space-enabled monitoring system to track and model the plant's growth in West Africa.

To find out the most appropriate resolution of satellite imagery, we compared varying pixel resolution satellite imagery, acquired at 30m, 10m, and 3m imagery from NASA Landsat 8, ESA Sentinel 2, and Planet Labs' Planetscope Doves, respectively. Images were analyzed for understanding of current and historical trends of water hyacinth growth in the study region of Cotonou, Benin. To identify general aquatic vegetation, we utilized multispectral imaging satellite data and applied various techniques for analyzing visible and infrared wavelength bands: false color imaging, normalized difference vegetation index (NDVI), and classification methods like the maximum likelihood classification.

By setting threshold values above 0.3 NDVI, we were able to discern dense aquatic vegetation on water bodies and generate extent maps showing historical and current trends on water hyacinth growth in Benin for about 30 years.

Historical trends revealed by NDVI measurements indicated a consistent peak in water hyacinth blooms during the month of November-December. While different locations experience different peak patterns across the year.

The availability of vegetation maps helps inform community members of invasive plant blooms and aids in facilitating removal efforts. Insights from this study are widely applicable in many similar regions of the world, as water hyacinth remains invasive in nearly 80 countries.

Real-time Learning-based Monitoring System for Water Contamination

Author(s): Qi Chen, Guanghua Cheng, Yajun Fang, Yang Liu, ZHANG Zejun, Yiyang Gao, Berthold K. P. Horn

Abstract: It is vital for a city to monitor water quality in real time since the quality of water has profound effect on residents' health. Unfortunately, it is impossible for human to monitor water's chemical composition frequently, which is an impossibly demanding task, let alone in real time. Thus, taking advantage of a highly efficient system can be an excellent solution. In this paper, we created a system called Real-time Intelligent Monitoring System for Water Quality, which enables a city to be responsive to potential outbreak of contamination and to protect city residents. The system is capable of processing and classifying the data extracted from visual images to considerably save more money and labor. In this case, two features Fast Fourier Transform (FFT) and Color Layout Descriptor (CLD) are introduced for Saliency features and color features respectively. FFT performs well in extracting saliency features and is not computationally intensive; CLD is able to represent the color features with high effectiveness and efficiency. Additionally, this system utilizes Support Vector Machine (SVM) based on such features that needs small size of training sets, trains very fast and can classify floating rubbish and any other scenarios of water pollution with satisfying efficiency. Till now, the accuracy has reached 75%, which encourages us. While the detection performance can be further improved, the efficient features & classifiers would serve as powerful methods to automatically monitor water pollution.

Intelligent Garbage Bin with True-False Classification

Author(s): Jieke Wang, Yang Liu, Cajun Fang, Berthold K.P. Horn

Abstract: Current intelligent garbage bins like Bin-E follow process of throwing and classifying. This article proposes for a new garbage bin with a different process. Classifying, when return true for this kind, it allows people to throw; otherwise it will be close. This garbage bin, with a lower cost, can force, tutor, and instruct people, especially travelers, to deal with their garbage in public areas.

Transcribing Latin Manuscripts in Respect to Linguistics

Author(s): Manqing Feng, Guoxin Huang, Chuyuan Zhang, Yang Liu, Yajun Fang, Berthold K.P. Horn

Abstract: Current text detection software, although can transcribe modern languages with high accuracy, has flaws detecting texts and sufficiently transcribe original Latin manuscripts. This paper focuses on establishing a system, aiming for transcribing Latin Manuscripts containing intricate abbreviations, combining basic object detection algorithms with linguistics. The method of projection was applied for image processing and algorithms are improved in respect to linguistic and topology. This paper only proposes a general approach for transcribing Latin manuscript in respect to linguistics.

Early Detection of Esophageal Cancer Using Computer Vision**Author(s):** Peize Li

Abstract: Due to the proliferation of usages of artificial intelligence, my aim of this research is to detect early esophageal cancer using computer vision and deep learning. Cancer, certainly the biggest issue in medical field right now, should alarm the researchers about its solution. All the cancer diagnoses are done by cancer experts, which are human beings, before. Therefore, the incorporation of computer vision and machine learning virtually will make the diagnosis more accurate and efficient. It will vastly eliminate the morality caused by the late detections and late diagnoses. Although this design can produce independent results, it certainly needs to be only a CAD (computer-aided design). Overall, the compromise of the experts' diagnoses and the computers' diagnoses shall be made.

Video-based Fall Detection for Seniors with Human Pose Estimation**Author(s):** Zhanyuan Huang, Yang Liu, Yajun Fang, Berthold K. P. Horn

Abstract: In recent years, aging of population and empty nest problem are becoming more and more severe. In addition, fall is the leading cause of death for seniors both in China and the U.S. Therefore, automatic fall detection for seniors is required in smart home and smart healthcare system. Currently, for its convenience and low cost, video-based method is the optimal method compared with other methods such as wearable sensor and ambient sensor in the field of indoor fall detection. In this paper, we propose a novel 2D video-based fall detection pipeline with human pose estimation. Firstly, we used OpenPose to extract the positions of human joints in raw data. Secondly, these data with augmented features became the input of a convolution neural network so that we can extract multi-layered features. Thirdly, a binary classification was conducted through neural network. For comparison, we also used SVM as the classifier. At last, we achieved relatively high sensitivity and specificity when compared our results with other state-of-the-art approaches on three public fall datasets.

Analogical Model of Merging Process in Urban Transportation System by Application of Oblique Shockwave Theory**Author(s):** Kening Sun, Guangyang Che, Yaqi Li

Abstract: Congestion in the merging roadways cannot be neglect, and it is necessary to build merging roadways in more massive scale by addressing it. In this paper, we compare the oblique shockwave in aerodynamic with the dynamic process in the merging roadways. Besides, we present the formation of the oblique shock wave in the turning section and merging section. Based on the similar mechanics between airflow and traffic flow, a traffic oblique shockwave model is proposed to explain the mechanics between the merging stream and the stream from the upstream. With this analogical model, we can obtain more regularities of the process of merging roadways.

An Emergency Ranking System for Intelligent Transportation Surveillance**Author(s):** Xuankai Fang

Abstract: The Intelligent Traffic Surveillance System which aims to enhance the quick reaction capability of the future smart city using several Computer Vision Technologies has been a hot research topic for a long time. Recent years, with the tide of the Artificial Intelligent development, new directions like using the Deep-Learning method has play a more and more significant role. This article will introduce an Intelligent Surveillance System for traffic emergency sorting. I built a traffic dataset of scenes like collision, explosion, bad weather, etc. Then I trained a neural network utilizing the Transfer Learning method and the dataset that can rank the images into different emergency levels. This system may alleviate the burden of the traffic surveillance in future smart city where a thousands of webcam needed to be focus and the city administrator can always find the situation that needs the most attention. Also, this article analyzes shortages of Deep-Learning method and make several feasible extensions which may be used to create a more impeccable system.

A Macroscopic Traffic Simulation Model to Mingle Manually Operated and Self-driving Cars

Author(s): Zihan Cao, Yang Liu, Yajun Fang, Longfei Zhou, Berthold K. P. Horn

Abstract: As the rapid development of AI, computer vision and automatic control technologies, self-driving cars have been well designed and developed. Since self-driving cars should coexist efficiently with human-driving cars, how to make practical strategies for them is increasingly significant. This paper optimizes cellular automaton to do simulation and quantizes the human factors as realistic and comprehensive as possible based on spectral clustering which is very suitable for large-scale simulation and crowd management for future smart cities. Compared with traditional analysis which record trajectories of cars, the new model employs unsupervised learning to augment average speed and reduce collision time by realizing algorithm optimization to reduce complexity and computational cost. This paper not only demonstrates the progress and results of traffic simulation, but also illustrates the concrete strategies for both self-driving cars and human drivers.

A Crowd Simulation Model Considering Individuals' Emotion and Energy: Proposing and Assessing Management Plans

Author(s): Xi Zhang, Yajun Fang, Yang Liu, Berthold K. P. Horn

Abstract: Large aggregation of crowd often leads to dangerous situation and may harm individuals' life. We innovated classic microscopic crowd simulation model by incorporating the information of assessing people' emotion and energy status. Under this improved microscopic simulation model, this paper also explores how to assess possible crowd management plans through a percolation model with an imbedded virtual lattice structure, with adaptive properties for different situations. We applied this model with some current popular crowd management approaches and proposed new more efficient guidance plans under several particular circumstances as well.

Preliminary Study on Index Construction of Medical Tourism Destination

Author(s): Qikai Su, Yajun Fang, Yang Liu, Berthold K. P. Horn

Abstract: With the growth of global medical demand, more and more people choose to go to other countries to treat their diseases and recuperate themselves. Medical tourism presents a trend of rapid development of industrialization. The purpose of this paper is to set up a comprehensive process which can construct an index of involved medical tourism centers for tourists to choose the most suitable medical tourism destination if all required data is collected. It is gradually improved from a basic framework, with the corresponding evaluation system added. Our result shows that it is a strict five-steps procedure: Preliminary determination of independent variables, Expert intervention, Use sample data to determine final scale, Determination of alternative destinations, Use sample data to determine final index.

Preliminary Study on Evaluation of Renewable Energy and Proposed Prediction Model and Index Analysis

Author(s): Jingji Zang, Yajun Fang, Yang Liu, Berthold K. P. Horn

Abstract: The paper first studied the traditional energy sources and their challenges, then, systematically introduced alternative energy and their features. We addressed the following three questions. 1. The sustainability of the current energy. 2. The environmental pollution due to energy consumption. 3. The pro and cons of different renewable energy and their usages of renewable energy in various countries. We also proposed a prediction model and index system for energy usages which was confirmed by experiment results. The paper is expected to serve as a general guidance on the smart energy management.

Special Session 9a&9c: City Forum & Industry

Time: 2:40pm-4:35pm, October 24th

Location: W20-307

Chair(s): Tao Ma

Knowledge based Smart Environment

Author(s): Xin Shu

Abstract: In the past, we regard the Earth as the liveliest place for humans to live, but many problems increasingly emerging in the planet ought to be as green as before. Environmental challenges in the world are intertwined, the first thing for us to solve the problems is to know the current status, so that we can better counter them. Recently, there is a trend that people want to combine technology with the environment to rescue our planet, and to improve the status. The most efficient way to modify the current way to benefit the environment is to learn about the state-of-the-art technologies, which is a new stage to achieve in the future – Smart City. Humanity has exploited the Earth's natural resources and modified the environment for thousands of years, but in the last two centuries human impact has increased hugely, in part because of population growth, in part because of technological changes and partly as a consequence of the way that development has been allowed to proceed. The last few decades have witnessed a growing awareness of, and concern for, environmental issues and since the mid-1980s these have been linked with calls for better approaches to development.

Smart Safety, A Survey on Smart Safety Technologies

Author(s): Hao Qiu, Yang Liu, Yajun Fang, Berthold K. P. Horn

Abstract: The rapid urbanization process has profound impact on many aspects of human beings. Many challenges and problems are shown during the process, particular in the field of safety. Thus, smart city is introduced to address these issues. This paper will focus on smart safety, one of the major components in a smart city, report current status and challenges, discuss possible interaction between smart safety and other components, and analyze the impact of smart safety system. Finally, several suggestions will be proposed to improve the effectiveness of the system.

Evaluation of Current WMS and Proposal for Future Advancement in UV

Author(s): Shunzhi Wen

Abstract: Due to the rapid increase in waste accumulation in recent decades along with economic development, the waste management system attracts more and more attention around the world. This paper studies the current waste management system, explores the correlation between the effectiveness of a country's waste management system and the country's developmental conditions, introduces and evaluates how the incoming new technologies innovate the current waste management system, and finally proposes the guideline on how different countries should innovate their current waste management system and work together to solve the current environmental crisis.

Use artificial intelligence and computer vision to reform metal scrap recycling

Author(s): Tian Tan, Zhonghe Wang

Abstract: Metal scrap recycling industry is currently widely integrated in socioeconomic system including secondary metal commodity trading, residential and industry waste recovery and reuse, and environmental protection. While metal scrap recycling deliver the most basic needs to ensure social functioning, it comes at the cost of high society cost due to its primitive mode of operation. Scrap recycling industry has 4 key factors, identify material, match scrap with user, process material, and control pollution. Scarce labour resources and scrap knowledge become main constraints in all 4 factors of the scrap recycling industry. Accordingly, technologies, such as artificial intelligence (AI) and big data, which increase efficiency of all 4 factors to dramatically improve the recovery ratio of renewable scrap sources without sacrificing natural environment or increasing social operation cost are critical to the all-round upgrade of metal scrap recycling in modern society. This article aims to provide a comprehensive metal scrap recycling system design based on AI and big data toward the goal of enabling efficient recycling of metal scrap. Specifically, it will provide an overview of current metal scrap recycling industry, highlight key technologies, such as computer vision and MPIRAN, could be used in identifying, matching and processing, and discuss various system designs that can reform metal scrap recycling industry chain. It will also summarize various development resources that enable researchers and practitioners to quickly get started in this field, and highlight important benchmarking metrics and design considerations that should be used for evaluating the very complex metal scrap recycling system design, optionally including algorithmic code signs, being proposed in academia and industry.

New Paradigms, Practices and Precursors; From the Misiones Pedagógicas (MP) of the Spanish Second Republic (SSR) to AI Democracy

Author(s): F. Bozzano-Barnes

Abstract: This paper addresses crucial issues, in a forum that is more qualified collectively than its author for this task. It is part of an iterative research activity that spans widely in time. It is a simple progress report. This paper is a critical overview of present and past sociotechnical change since the industrial revolution, focusing on critical processes, paradigms and practices synthetically. The idea is to explore the management of harmonious sociotechnical systems. But this will be done with an open systems approach, so the emphasis is on understanding different processes without an emphasis on logical coherence, but defining different voices and their potential impacts. Leaving the options open. Without closure, but inviting further dialogue and iterations.

Preliminary Study on Evaluation of Smart-Cities Technologies and Proposed UV Lifestyles

Author(s): Shengsheng Cao, Yanxi Chen, Guanghua Cheng, Fuxin Du, Wenyang Gao, Ziyang He, Shuqing Li, Shijun Lun, Haoran Ma, Qikai Su, Chuyuan Zhang, Tianyi Zhang, Zejun Zhang, Jie Zheng, Longfei Zhou, Yajun Fang

Abstract: Our current society is facing challenges in both sustainability and environmental pollution due to fast urbanization, limited resources, and increasing senior population. Smart cities which aim to increase efficiency and convenience would not be able to solve fundamental challenges caused by urban lifestyles. In 2013, the Universal Village concept was proposed to enhance human-nature harmony through prudent use of technologies and to address the eco-challenges due to fast urbanization.

This paper first studies the environmental implications due to urban lifestyles and proposes the suitable UV framework and detailed content of universal village lifestyle in order to address the eco-challenges. The paper then evaluates the development of current smart city technologies and assesses their validity with regard to the concept of Universal Village through systematic studies of several major intelligent systems.

Specifically, this paper discusses the subject of connectivity from four perspectives: feedback loop, mutual interaction, dynamic information loop, and material cycle. The paper evaluates whether information feedback loops could be formed for these major systems, and also explores the mutual interaction and dependence among the seemingly independent major systems. We discover that mutual interaction connects the aforementioned systems into an interconnected network and naturally forms dynamic information loops in which the decision of one system may be the required input of another system or vice versa. This implies that proper functioning of these systems requires extensive information sharing among them. One event might dynamically trigger different events. The last connectivity is a material cycle. We explore the whole life cycle of products, including impact from lifestyle, customers' need, product design, cloud manufacturing, sale channel, feedback collection from customers, reuse and recycling, scrapping, to final waste-disposal, etc., and study how to reduce the demand for resource and waste during the procedure. The idea is to include the perspective of UV lifestyle when designing products: considering the possibility in proactively reducing the need, sharing a product with different people, reusing product parts into the manufacturing, recycling reusable components of finished products before the products' being fully disassembled, etc. The advantage is to reduce the need for products and to avoid manufacturing the same components from raw materials directly, which demands less resource.

In summary, connectivity, as discussed from the four perspectives, would greatly contribute to the effectiveness and efficiency of our connected smart systems. Dynamic information loop helps coordinate resource allocation, decreases the collective costs, and reduces demand of natural resources from the natural environment, resulting in less damage to the environment which ultimately enhances system-wide harmony between human and its natural environment, and leads to human happiness in general.

Comparative Study on Children's Cognitive Development through Piano and Language Acquisition
Author(s): Chenchen Gong

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MIT Campus Map





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