SCIENCE AND INFORMATION CONFERENCE 2015

Proceedings of
Science and Information Conference 2015

July 28-30, 2015
London, United Kingdom

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IEEE Catalog Number - CFP 15SAA-USB

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Organized by
The Science and Information (SAI) Organization Limited
United Kingdom

web. www.conference.thesai.org
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PROCEEDINGS OF THE SCIENCE AND INFORMATION CONFERENCE 2015

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About the Conference

The Science and Information (SAI) Conference is a premier venue for researchers and industry practitioners to share their new ideas, original research results and practical development experiences from Computer Science, Electronics and Communication related areas.

The Science and Information Conference 2015 features specialized keynote lectures, knowledge talks, contributed papers, poster presentations, industrial talks, and tutorials. Its drive is to convene a high quality, well-attended, and up-to-date conference on technology and research. The keynote speakers are a diverse group with expertise in High Performance Computing and Networking, Informatics and Computing, Electrical Engineering and Computer Science, and Internet of Things.

The conference is hosted by The Science and Information Organization, and is being sponsored by Nvidia and IEEE. The Future & Emerging Technologies (FET) at the European Commission, EUREKA, Cambridge Wireless, British Computer Society, Digital Catapult and Springer are the knowledge partners while International Innovation is the Media Partner for this conference.

This conference is held in London, a vibrant and historical city which is home to multiple academic institutions and where visitors can enjoy a variety of activities and entertainment!

Conference Venue is America Square Conference Centre
Address: 1 America Square 17 Crosswall
London EC3N 2LB, United Kingdom

Preface

Welcome to the Science and Information (SAI) Conference 2015 which is held from July 28 to 30, 2015 in London, U.K.

The Science and Information Conference is a leading international conference for researchers and industry practitioners to share their new ideas, original research results and practical development experiences from Computer Science, Electronics and Communication related areas. The event features specialized keynote talks, contributed papers, special sessions, poster presentations, workshops, and tutorials on theory and practice, technologies and systems.

SAI 2015 has attracted 489 submissions from 60 countries. Each paper is reviewed by at least two program committee members, who are experts in the field. After stringent reviews, we finally decided to publish 198 as full papers, 15 as Poster Papers which are presented in the parallel sessions at the conference. Selected papers will appear in high impact International Journals and as book chapters in a book published by Springer.

Apart from the technical sessions, SAI2015 has a wide range of featured talks including keynotes from Thomas Sterling, Fahim Kawsar, Karlheinz Meier, Muriel Médard and Geyong Min; knowledge talks from Paul Galwas, Bob Crooks, Andrea Feltrin, Peter Stollenmayer, Peter Whale; industrial talk from Theo Priestley and tutorial from Kohei Arai.

The success of the SAI 2015 is attributed to the support of many people: authors, presenters, participants, keynote speakers, session chairs, organizing committee members, student volunteers, program committee members, steering committee members, and people in other various roles. We would like to thank them all for their valuable suggestions, advice, dedicated commitment and hard work which make the SAI Conference 2015 a success.

We would also like to acknowledge our appreciation to the following organisations for their sponsorship: Nvidia, IEEE, IET, Future & Emerging Technologies (FET) at the European Commission, EUREKA, Cambridge Wireless, British Computer Society, Digital Catapult and Springer and the conference organizer, The Science and Information (SAI) Organization.

It has been a great pleasure to serve as the General Chair for the SAI Conference 2015. We are sure this event helps further disseminate new ideas and the latest research results, foster a spirit of collaboration and build a reputed and respectable conference for the international community. On behalf of the SAI Conference team, we will strongly encourage you to contribute to the future SAI conferences as authors, speakers, presenters, sponsors and volunteers.

Professor Liming Chen
General Chair
Science and Information (SAI) Conference 2015

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NVIDIA's work in visual computing — the art and science of computer graphics — has led to thousands of patented inventions, breakthrough technologies, deep industry relationships and a globally recognized brand. For two decades, we've pioneered this uniquely powerful medium, which has transformed the PC from a tool for productivity into one for creativity and discovery.

Nvidia manufactures graphics processing units (GPUs), as well as system on a chip units (SOCs) for the mobile computing market. Nvidia's primary GPU product line, labeled "GeForce", is in direct competition with AMD's "Radeon" products. The GPU has propelled computer graphics from a feature into an ever-expanding industry — encompassing PC games, movie production, product design, medical diagnosis and scientific research, among other categories. GPUs are now driving new fields like computer vision, computational photography, image processing and augmented reality.

Nvidia also joined the gaming industry with its handheld Shield Portable and Shield Tablet, as well as the tablet market with the Tegra Note 7. In addition to GPU manufacturing, Nvidia provides parallel processing capabilities to researchers and scientists that allow them to efficiently run high-performance applications. They are deployed in supercomputing sites around the world. More recently, Nvidia has moved into the mobile computing market, where it produces Tegra mobile processors for smartphones and tablets, as well as vehicle navigation and entertainment systems.

Technical Sponsor

IEEE

IEEE creates an environment where members collaborate on world‐changing technologies – from computing and sustainable energy systems, to aerospace, communications, robotics, healthcare, and more.

IEEE is the world's largest professional association dedicated to advancing technological innovation and excellence for the benefit of humanity. IEEE and its members inspire a global community through IEEE's highly cited publications, conferences, technology standards, and professional and educational activities.

IEEE is led by a diverse body of elected and appointed volunteer members. The governance structure includes boards for operational areas as well as bodies representing members in the 45 Societies and technical Councils and ten worldwide geographic regions.

The United Kingdom and Ireland (UK and Ireland) Section of the IEEE has over 10,000 members. If you are an IEEE member and live in the United Kingdom or the Ireland, you are automatically a member of the UK and Ireland Section.

IEEE membership is open to professionals with varying levels of academic accomplishment and work experience. Member, Senior Member and Fellow grades are limited to those who have achieved professional competence and recognition, as demonstrated by the college degrees they have received and/or by their work experience. Associate grade is open to certain technical and nontechnical applicants who may benefit by membership and participation in the IEEE and, also, to those individuals progressing through education and work experience toward Member grade. All members – Associate, Member, Senior Member and Fellow pay the same low membership dues and receive the same IEEE membership benefits and services, although Associates may not vote in IEEE elections or hold volunteer offices for which the grade of Member or higher is required. Student member applications are available upon request. Student members have substantially discounted dues and fees far below what other members pay.

Knowledge Partners

Institution of Engineering and Technology

The IET is one of the world's largest engineering institutions with over 160,000 members in 127 countries. It is also the most multidisciplinary – to reflect the increasingly diverse nature of engineering in the 21st century.

The IET is working to engineer a better world by inspiring, informing and influencing our members, engineers and technicians, and all those who are touched by, or touch, the work of engineers.

The IET represents the engineering profession in matters of public concern and assists governments to make the public aware of engineering and technological issues. It provides advice on all areas of engineering, regularly advising Parliament and other agencies.

The IET also grants Chartered Engineer, Incorporated Engineer, Engineering Technician, and ICT Technician professional designations on behalf of the Engineering Council UK. IEng is roughly equivalent to North American Professional Engineer designations and CEng is set at a higher level. Both designations have far greater geographical recognition.

This is made possible through a number of networks for engineers established by the IET including the Professional Networks, worldwide groups of engineers sharing common technical and professional interests. Through the IET website, these networks provide up-to-date sector-specific news, stock a library of technical articles and give members the opportunity to exchange knowledge and ideas with peer groups through dedicated discussion forums. Particular areas of focus include education, IT, energy and the environment.

The IET has an educational role, seeking to support its members through their careers by offering a professional home for life, producing advice and guidance at all levels to secure the future of engineering.

For instance, the IET accredits degree courses worldwide in subjects relevant to electrical, electronic, manufacturing and information engineering. In addition, it secures funding for professional development schemes for engineering graduates including awards scholarships, grants and prizes.

For the public, the IET website provides factfiles on topics such as solar power, nuclear power, fuel cells, micro-generation and the possible effects on health of mobile phones and power lines.

The IET runs the bibliographic information service Inspec, which is a major indexing database of scientific and technical literature and publishes books, journals such as Electronics Letters, magazines such as Engineering & Technology and conference proceedings. Over 80,000 technical articles are available via the IET Digital Library

Future and Emerging Technologies, European Commission

As a part of the European Commission, FET plays an important role in the Digital Agenda for Europe Initiative. The group provides a combination of multidisciplinary, collaborative, long term and high risk research. Data collected from these analysis is often used to convert proof of concept into industrial systems and applications.

During the six year European Union's Research and Innovation Funding Program, better known as FP7, FET brought together data and research from many different disciplines including chemistry, nano- and molecular science, ethology, biology, neuro- and cognitive science. Additionally, FET thought outside the box and included research from non-science areas such as social sciences, economics, the arts, and humanities with astonishing results. FET conducted 320 projects with 2500 participants and 798 unique partnerships during this time.

FET actions are expected to initiate radically new lines of technology through unexplored collaborations between advanced multidisciplinary science and cutting-edge engineering. It will help Europe grasp leadership early on in those promising future technology areas able to renew the basis for future European competitiveness and growth, and that can make a difference for society in the decades to come.

Under Horizon 2020, FET actions have been allocated a provisional budget of 2 696 million euro.

The FET programme has three complementary lines of action to address different methodologies and scales, from new ideas to long-term challenges:

- FET Open funds projects on new ideas for radically new future technologies, at an early stage when there are few researchers working on a project topic. This can involve a wide range of new technological possibilities, inspired by cutting-edge science, unconventional collaborations or new research and innovation practices.
- FET Proactive nurtures emerging themes, seeking to establish a critical mass of European researchers in a number of promising exploratory research topics. This supports areas that are not yet ready for inclusion in industry research roadmaps, with the aim of building up and structuring new interdisciplinary research communities.
- FET Flagships are 1-billion, 10-years initiatives where hundreds of excellent European researchers unite forces to focus on solving an ambitious scientific and technological challenge, like understanding the Human Brain or developing the new materials of the future, such as Graphene.

British Computer Society

The British Computer Society is a professional body and a learned society that represents those working in Information Technology both in the United Kingdom and internationally. With a worldwide membership of over 82,000 members in over 100 countries, BCS is a registered charity and was incorporated by Royal Charter in 1984. Its objectives are to promote the study and application of communications technology and computing technology and to advance knowledge of education in ICT for the benefit of professional practitioners and the general public.

BCS is a member institution of Engineering Council UK, and therefore is responsible for regulation of ICT and computer science fields within the UK. The BCS is also a member of the Council of European Professional Informatics Societies (CEPIS) and the Seoul Accord for international tertiary degree recognition. BCS is also a member organisation of the Science Council through which it is licensed to award the designation of Chartered Scientist.

The mission of BCS, The Chartered Institute for IT, is to enable the information society. We promote wider social and economic progress through the advancement of information technology science and practice.

BCS strategic objectives:

- Bridging the gap between education practice and research
- Giving practitioners the professional development and career support they deserve
- Informing public policy on how IT can contribute to society
- Ensuring everyone benefits from IT
- Championing the global IT profession

Cambridge Wireless

CW is a leading and vibrant community with a rapidly expanding network of nearly 400 companies across the globe interested in the development and application of wireless and mobile technologies to solve business problems. CW connects those companies and stimulates collaborative innovation through a range of thought-provoking high-profile networking events.

In addition to these high profile VIP networking activities, CW runs 19 Special Interest Groups (SIGs), each focussed on a specific technology and/or business area. SIG meetings provide opportunities for member organisations to meet, learn from each other and explore opportunities to work together.

Eureka

EUREKA is a publicly-funded, intergovernmental network, involving over 40 countries. EUREKA's aim is to enhance European competitiveness by fostering innovation-driven entrepreneurship in Europe, between small and large industry, research institutes and universities. By doing this, EUREKA concentrates the existing potential of experts, of knowledge, research facilities and financial resources in a more efficient way. EUREKA is constantly proving its value through a wealth of success stories – innovative products, processes and services that have been launched onto the market over the last 30 years, creating additional turnover and jobs for European companies, small and large – and by supporting the internationalization of businesses with innovative ideas.

EUREKA is a leading open platform for international cooperation in innovation. It is present in over 40 countries and remains to this day the only initiative of its kind committed to the 'bottom-up'principle - ensuring that any R&D project with a good business plan receives the support it deserves, independent of its technological nature, or the type of organisations involved.

Digital Catapult

The Digital Catapult is to help UK businesses unlock new value from sharing proprietary data in faster, better and more trusted ways. The Digital Catapult Centres are the physical embodiment of this activity. It focuses specifically on four challenge areas:

- **Closed organisational data**
  Creating secure environments that allow UK organisations to safely mix their closed data and open it up to data innovators.
- **Personal Data**
  Helping to overcome the challenges of creating trust in the use of personal data.
- **Creative content**
  Unlocking new value in the creative industries by making the reuse of creative content easier. Firstly by working with the Copyright Hub to reduce licensing friction.
- **The Internet of Things**
  Including being a convening force in creating large scale Internet of Things demonstrators.

Springer

Springer is a global publishing company that publishes books, e-books and peer-reviewed journals in science, technical and medical (STM) publishing. Springer also hosts a number of scientific databases, including SpringerLink, Springer Protocols, and SpringerImages. Book publications include major reference works, textbooks, monographs and book series; more than 168,000 titles are available as e-books in 24 subject collections.

Media Partner

International Innovation

International Innovation is the free-to-access publication from Research Media. International Innovation provides global insight and analysis on current scientific research trends, as well as funding and policy issues. Coverage spans the breadth of scientific disciplines, with key focus on the interdisciplinary areas of healthcare, environment and technology.

SAI Computing Conference 2016

13 - 15 July 2016 | London, UK
Web. www.SAIConference.com/Computing2016
Contact. conference@thesai.org

SAI Computing Conference (formerly called Science and Information Conference) is a research conference held in London, UK since 2013. The conference series has featured keynote talks, special sessions, poster presentation, tutorials, workshops, and contributed papers each year. The goal of the conference is to be a premier venue for researchers and industry practitioners to share new ideas, research results and development experiences in the areas of Computer Science, Electronics and Communication.

Call for Papers for the SAI Computing Conference 2016 is now Open!
Please do share with your colleagues/student about this fantastic opportunity to meet and interact with researchers, scientists and professionals working in various domains of computing. !

Authors are kindly invited to submit their papers/ posters/ demo proposals as per the schedule below.

Early Bird Submission
Paper Submission: 01 November 2015
Acceptance Notification: 01 December 2015
Author Registration: 01 January 2016
Camera Ready Submission: 01 February 2016
Conference Dates: 13-15 July 2016

Regular Submission
Paper Submission: 15 December 2015
Acceptance Notification: 15 January 2016
Author Registration: 01 March 2016
Camera Ready Submission: 15 March 2016
Conference Dates: 13-15 July 2015

Conference Tracks

Technology Trends
Internet of Things
Cloud Computing
Big Data
Smart Cities
Machine to Machine
High Performance Computing
Mobile Applications
Knowledge Management
Social Computing
Software Engineering and Quality

Intelligent Systems
Artificial Intelligence
Neural Networks
Fuzzy Logic
Expert Systems
Agents and Multi-agent Systems
Natural Language Processing
Data Mining
Support Vector Machines
Ambient Intelligence
Sentiment Analysis

Machine Vision
Human Computer Interaction
Computer Vision
Image Processing
Robotics
Geographic Information Systems
Video Analysis
Medical Diagnosis
Segmentation Techniques
Augmented Reality
Virtual Reality

Security
Privacy
Surveillance
Biometrics
Internet Security
Electronic Data Interchange (EDI)
Web Services and Performance
Secure Transactions
Cryptography
Secure Protocols
Cyber Security

Communications
Connected Machines Networking
Wireless/ Mobile Communication
Quantum Computing
Satellite Communication Systems
3G/4G Network Evolutions
Mobile Adhoc Networks
Open Spectrum Solutions
Communication Protocols
Cognitive Radio

Electronics
Green Computing
Smart Grids
Sensing and Sensor Networks
E-Waste
Digital Circuits
Analog Circuits & Signal Processing
Design Automation
Computer Aided Network Design
Assembly and Packaging
Systems Architectures

e-Learning
e-Learning Tools
Mobile Learning
e-Learning Organisational Issues
Gamification
Collaborative Learning
Curriculum Content Desig
Educational Systems Design
Virtual Learning Environments
Web-based Learning
Delivery Systems and Environments

e-Business
e-Business Ontologies
e-Commerce Application Fields
e-Commerce Economics
e-Commerce Services
Digital Marketing
Enterprise Resource Planning
Data Analysis
Virtual Organisations
Business Intelligence
Web Analytics

SAI Intelligent Systems Conference (IntelliSys)

10 - 11 November 2015 | London, UK
Web. www.SAIConference.com/IntelliSys2015
Contact: IntelliSys@SAIConference.com

The Science and Information Organization is hosting the SAI Intelligent Systems Conference (IntelliSys 2015) from November 10-11, 2015 in London, UK. This conference will focus in areas of intelligent systems and artificial intelligence and how it applies to the real world. It is an opportunity for researchers in this field to meet and discuss solutions, scientific results, and methods in solving intriguing problems in this field.

The conference programme will include paper presentations, poster sessions and project demonstrations, along with prominent keynote speakers and industrial workshops. IntelliSys is planned to be a yearly conference and is predicated on the successful, annual Science and Information Conference that has been held in London since 2013.

Conference Topics include but are not limited to Artificial Intelligence, Machine Vision, Robotics, Ambient Intelligence, Security and Machine Learning.

Register for the conference today!

Conference Tracks

Artificial Intelligence
- Neural Networks
- Fuzzy Logic
- Genetic Algorithms
- Agents and Multi-Agent Systems
- Swarm Intelligence
- Expert Systems

Machine Vision
- Human Computer Interaction
- Image/Video Processing
- Pattern Recognition
- Bioinformatics
- Signal Processing
- Augmented Reality

Robotics
- Mobile Robots
- Space and underwater robots
- Assistive Robots
- Creative and Entertaining Robots
- Autonomous Robots
- Human-Robot Interaction

Ambient Intelligence
- Smart Buildings and Cities
- Internet of Things
- Ambient Assisted Living
- Smart Healthcare
- Intelligent Driving
- Data Science

Security
- Biometrics
- Spam Detection
- Intrusion Detection
- Security Intelligence
- Computer Forensics
- Big data analytics for security

Machine Learning
- Supervised/Unsupervised Learning
- Decision Making
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- Bayesian networks
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Keynote Speakers

Thomas Sterling

Indiana University

Keynote Talk - July 28, 2015 | 9:00 AM

Dr. Thomas Sterling holds the position of Professor of Informatics and Computing at the Indiana University (IU) School of Informatics and Computing as well as serves as Chief Scientist and Executive Associate Director of the Center for Research in Extreme Scale Technologies (CREST). Since receiving his Ph.D from MIT in 1984 as a Hertz Fellow Dr. Sterling has engaged in applied research in fields associated with parallel computing system structures, semantics, and operation in industry, government labs, and academia. Dr. Sterling is best known as the "father of Beowulf" for his pioneering research in commodity/Linux cluster computing. He was awarded the Gordon Bell Prize in 1997 with his collaborators for this work. He was the PI of the HTMT Project sponsored by NSF, DARPA, NSA, and NASA to explore advanced technologies and their implication for high-end system architectures. Other research projects included the DARPA DIVA PIM architecture project with USC-ISI, the Cray Cascade Petaflops architecture project sponsored by the DARPA HPCS Program, and the Gilgamesh high-density computing project at NASA JPL. Thomas Sterling is currently engaged in research associated with the innovative ParalleX execution model for extreme scale computing to establish the foundation principles to guide the co-design for the development of future generation Exascale computing systems by the end of this decade. ParalleX is currently the conceptual centerpiece of the XPRESS project as part of the DOE X-stack program and has been demonstrated in proof-of-concept in the HPX runtime system software. Dr. Sterling is the co-author of six books and holds six patents. He was the recipient of the 2013 Vanguard Award.

The Paradigm Shift beyond Exascale Computing

Abstract: The struggle to exploit near nano-scale semiconductor technologies to sustain exponential performance gain of the last two decades and more is forcing innovations in architecture, programming models, and supporting system software beyond the scope of conventional techniques even as legacy codes demand continuity. Contention, sometimes severe, between two strategies has forced a schism in the exascale research community: 1) the evolutionary incremental approach seeks to build on conventional practices in support of legacy codes and retained skill sets while address challenges of scalability; 2) the pathfinding strategy breaks with tradition to devise a revolutionary methods of exploiting the opportunities and addressing the myriad challenges of the new technologies driving the promise of computing forward. This Keynote presentation will summarize this period of paradigm shift between evolutionary and pathfinding strategies and provide a detailed description of early research results in pursuit of the latter. Specifically, the experimental ParalleX execution model will be described and justified in terms of the SLOWER performance model and experimental results using the HPX-5 runtime system that implements ParalleX will be presented. This system embodies the principles of global address space, multi-threading, message-driven computation, futures synchronization, and introspective scheduling and resource management. Tentative conclusions concerning the potential of dynamic adaptive runtime methods will be discussed based on results from a number of applications including adaptive mesh refinement and fast multipole methods among others. Questions from the participants are welcome throughout the presentation.

Fahim Kawsar

Director, Internet of Things Research, Bell Laboratories, Alcatel-Lucent

Keynote Talk - July 28, 2015 | 10:00 AM

Dr. Fahim Kawsar leads the Internet of Things research activity at Bell Labs. His current work focuses on building human centred software architectures, applications and interaction tools with awareness technologies (sensor-actuator-perception algorithm) in the cross-section of Ubiquitous Computing and Human Computer Interaction. He has a keen interest in understanding what aspects of system infrastructure can be part of the user experience and what design and interaction rationales lead to such system. Fahim's work has been published widely in international books and journals, presented at conferences across the world and has had projects commissioned. Fahim has a PhD in Computer Science from Waseda University, has worked before at Nokia Research, and Lancaster University.

Network Intelligence Driven Behavior Modeling for a Connected World

Abstract: In this talk I will challenge the massive sensorised approach for personal IoT applications drawing upon the failure of commercializing smart home research of last 15 years. I will argue that for wide scale adoption, and market penetration of personalized IoT services, existing network infrastructure should play the key role for sensing and learning, by eliminating the cost of deployment and management of many sensors. I will then zoom into Bell Labs' opportunistic network sensing approach that transforms quantified noises into social signals by discussing a number of case studies, that uses mobile network, home network and travel network signals instead of dedicated sensing infrastructure to extract rich and valuable contextual knowledge about personal and community behavior in multiple application domains including Enterprise, Urban City, and Lifestyle.

Karlheinz Meier

Heidelberg University

Keynote Talk - July 29, 2015 | 9:00 AM

Karlheinz Meier is a professor of experimental physics at Heidelberg University in Germany. He received his PhD in 1984 from Hamburg University. For more than 30 years he worked in experimental particle physics, contributing to several experiments at the CERN and DESY laboratories. He designed and implemented a large-scale data selection system for an LHC experiment at CERN: Since 2005 he has shifted his interest towards custom hardware implementations of neural circuits. He has initiated and led 2 major European initiatives in the field (FACETS and BrainScaleS) and is currently co-director of the Human Brain Project.

Neuromorphic Computing in the Human Brain Project

Abstract: The brain is characterized by extreme power efficiency, fault tolerance, compactness and the ability to develop and to learn. It can make predictions from noisy and unexpected input data. Any artificial system implementing all or some of those features is likely to have a large impact on the way we process information. With the increasingly detailed data from neuroscience and the availability of advanced VLSI process nodes the dream of building physical models of neural circuits on a meaningful scale of complexity is coming closer to realization. Such models deviate strongly from classical processor-memory based numerical machines as the two functions merge into a massively parallel network of almost identical cells. The lecture will introduce current projects worldwide and the approach proposed by the EU Human Brain Project to establish a systematic path from biological data, simulations on supercomputers and systematic reduction of cell complexity to derived neuromorphic hardware implementations with a very high degree of configurability.

Muriel Médard

MIT - Massachusetts Institute of Technology

Keynote Talk - July 30, 2015 | 9:00 AM

Muriel Médard is the Cecil E. Green Professor of the Electrical Engineering and Computer Science Department at MIT. Professor Médard received B.S. degrees in EECS and in Mathematics in 1989, a B.S. degree in Humanities in 1990, a M.S. degree in EE 1991, and a Sc D. degree in EE in 1995, all from MIT. Her research interests are in the areas of network coding and reliable communications, particularly for optical and wireless networks. She was awarded the IEEE Leon K. Kirchmayer Prize (2002), the IEEE Communication Society and Information Theory Society Joint Paper Award (2009), and the IEEE William R. Bennett Prize (2009). She received the 2004 MIT Harold E. Edgerton Faculty Achievement Award. She was named a Gilbreth Lecturer by the NAE in 2007. She is a Fellow of IEEE, and past President of the IEEE Information Theory Society.

Stormy Clouds - security in distributed cloud systems

Abstract: As massively distributed storage becomes the norm in cloud networks, they contend with new vulnerabilities imputed by the presence of data in different, possibly untrusted nodes. In this talk, we consider two such types of vulnerabilities. The first one is the risk posed to data stored at nodes that are untrusted. We show that coding alone can be substituted to encryption, with coded portions of data in trusted nodes acting as keys for coded data in untrusted ones. In general, we may interpret keys as representing the size of the list over which an adversary would need to generate guesses in order to recover the plaintext, leading to a natural connection between list decoding and secrecy. Under such a model, we show that algebraic block maximum distance separable (MDS) codes can be constructed so that lists satisfy certain secrecy criteria, which we define to generalize common perfect secrecy and weak secrecy notions. The second type of vulnerability concerns the risk of passwords' being guessed over some nodes storing data, as illustrated by recent cloud attacks. In this domain, the use of guesswork as metric shows that the dominant effect on vulnerability is not necessarily from a single node, but that it varies in time according to the number of guesses issued. We also introduce the notion of inscrutability, as the growth rate of the average number of probes that an attacker has to make, one at a time, using his best strategy, until he can correctly guess one or more secret strings from multiple randomly chosen strings.

Geyong Min

University of Exeter

Keynote Talk - July 30, 2015 | 10:30 AM

Professor Geyong Min is a Chair in High Performance Computing and Networking with the Computer Science discipline in the College of Engineering, Mathematics and Physical Sciences at the University of Exeter, UK. His recent research has been supported by European FP6/FP7, UK EPSRC, Royal Academy of Engineering, Royal Society, and industrial partners including Motorola, IBM, Huawei Technologies, INMARSAT, and InforSense Ltd. Prof. Prof. Min is the Co-ordinator of two recently funded FP7 projects: 1) Quality-of-Experience Improvement for Mobile Multimedia across Heterogeneous Wireless Networks (QUICK); and 2) Cross-Layer Investigation and Integration of Computing and Networking Aspects of Mobile Social Networks (CLIMBER). As a key team member and participant, he has made significant contributions to several EU projects, such as 1) Design and Engineering of the Future Generation Internet (NoE-FGi), 2) Enabling Convergence of IP Multimedia Services over Next Generation Networks Technology (VITAL), and 3) Design and Engineering of the Next Generation Internet: Towards the Convergence of Multi-Service Heterogeneous Networks (NoE-NGi).

Analytical Modelling and Quality-of-Service in Wireless Multimedia Networks

Abstract: With rapid innovation in sophisticated wireless communication technologies, the past years have witnessed a dramatic growth of mobile multimedia applications, for example, Live Mobile Video, 3D Video Stream, VoIP, Mobile TV, and so on. These content-rich and resource-hungry multimedia applications generate complex traffic patterns and have high demands of Quality-of-Service (QoS). However, the inherent features of wireless communications, such as scarce bandwidth, limited transmission range, error-prone channels, and heterogeneous access technologies, lead to a high level of dynamics of available communication resources and pose great challenges on multimedia applications over wireless networks. In this talk, heterogeneous stochastic models will be firstly presented to capture the traffic characteristics (e.g., burstiness, self-similarity and large-lag correlation) of multimedia applications. An analytical performance model will then be presented for a hybrid traffic scheduling mechanism that integrates the fundamental scheduling schemes in a hierarchical manner and serves as a promising strategy for QoS differentiation in wireless multimedia network. The accuracy of the model is validated through extensive comparison between the analytical results and those obtained from simulation experiments of the actual system subject to the real-world multimedia applications. The model is then used as a cost-effective performance optimization tool for resource allocation and management in wireless multimedia networks. Finally, the related emerging issues and future directions will be presented and discussed.

Knowledge Talks

Paul Galwas

Security Architect, Digital Catapult
Knowledge Talk - July 28, 2015 | 11:30 AM

Paul Galwas is the Digital Catapult's Security Architect. He has 15+ years' experience in security R&D. At nCipher, Secerno and Cellcrypt, he worked on security protocols, secure identity, digital asset protection and secure payment systems, and with UK and US Governments on classified mobile security. He was an early member of Open Group Jericho Forum, and the Trusted Computer Group. At Computervision, Telxon and Prime, Paul developed early Wi-Fi technologies and mobile handheld systems, after spearheading 3D modelling and realistic imaging. He holds a PhD and MA in science from Cambridge University.

Smart City opportunity: privacy-preserving citizen mobility services

Abstract: Data is the lifeblood of "Smart" cities. We are keenly interested in our and our friends' mobility around the city. This offers exciting new market opportunities around people's spatio-temporal travel data. Yet data-linkage threatens our privacy, especially since our movements and interactions are so predictable, and there are strong correlations between our social interactions and locations, which greatly compound the risks. So there is an opportunity to differentiate services by seeking to increase awareness, transparency and trust by leveraging new privacy-preserving technologies when processing spatio-temporal data.

Bob Crooks

Department for the Environment Food and Rural Affairs (Defra), UK Government & British Computer Society
Knowledge Talk - July 28, 2015 | 12:00 PM

Since obtaining his Masters (distinction) in the Analysis and Design of Information Management Systems at the London School of Economics in 1981, Bob has been involved in all aspects of the IT profession including project management, software development, systems analysis and design, and training, and successfully led the procurement and implementation of fishing vessel tracking and reporting systems for the UK Fisheries Departments through three implementations. He is currently working for the UK's Department for the Environment Food and Rural Affairs (Defra) where he is their lead for Sustainable and Innovative use of ICT. Bob is deputy chair of the UK Cabinet Office's Green ICT Delivery Unit (GDU) where he heads up a working group on Green ICT metrics. He has led annual assessments for the GDU, contributing analyses to all its 3 Annual reports. A fourth annual round of assessments is now underway across all UK 17 central UK government departments. Bob chairs the British Computer Society's (BCS) Green ICT Specialist Group which promotes Green ICT practices across its membership of some 1,400 ICT professionals. He is a member of the Association of Project Managers (APM) as well as a BCS Chartered ICT professional.

Green ICT matters …

Abstract: Green IT has become a hackneyed term for an area of information system impacts that is of increasing importance, both on the demand and supply side. With its consumption of scarce resources and energy supplies, and increasing demands for more capacity and provision (even in the UK, we don't all have smart phones), we need to ensure efficiency in our manufacture, operation and disposal of ICT assets as we supply more of them

With the increasing complexity of living on this planet, the continuing rise in global population and the finite resources we have available, we need ICT to be able to respond to the challenges and supply

- Reductions in the footprints of our lives, so we can "tread" more lightly on the planet
- The means for collecting, analysing and managing the data and information necessary to make the right decisions at the right time at all levels in our society
- Services that enable communities to work together in cities, cities to work together in countries and countries to work together around the globe

I will explore the range of concerns that sustainable green ICT covers from the manufacture of ICT assets, their use and operation to their ultimate disposal, and how that use is helping us sustain ourselves, our communities and lives on this planet

Andrea Feltrin

European Commission - Future and Emerging Technologies (FET)

Knowledge Talk - July 29, 2015 | 10:15 AM

Dr Andrea Feltrin holds a M.S. degree with honours in Physics from Trieste University in Italy. His early research interests focused on laser optics and he developed them in the field of semiconductor optoelectronics earning a PhD from the Swiss Federal Institute of Technology in 2004. He was awarded a research grant to work on semiconductor material engineering for space solar cell applications at the Texas Centre for Advanced Materials (NASA sponsored research lab in Houston, USA). In 2006 he returned to Switzerland to lead a team at the University of Neuchatel that pioneered thin film silicon solar energy technologies setting up and implementing R&D projects with European industry. In 2010 he joined Kaneka, a leading Japanese solar energy and chemical corporation, as Chief Senior Researcher developing high efficiency silicon solar cells and managing the R&D project portfolio with partners in Europe and worldwide. Since 2013 he is Project Officer at the European Commission in the Future and Emerging Technologies (FET) Unit, where he joined the team implementing the exascale challenge of the High Performance Computing (HPC) strategy in H2020.

Funding disruptive technologies for European competitiveness and growth

Abstract: Future and Emerging Technologies (FET) is a funding programme under the H2020 EU Framework Programme for Research and Innovation with the mission to turn Europe's excellent science base into a competitive advantage by uncovering radically new technological possibilities. It helps Europe to grasp leadership early on in new and emerging technology areas that promise to renew the basis for European competitiveness and growth and that will make a difference for society in the decades to come. It brings closer science, engineering and society and accelerate the transition from upstream research to technology development and transformational impact. FET actions help to create in Europe a fertile ground for responsible and dynamic multi-disciplinary collaborations on future and emerging technologies and for kick-starting new European research and innovation eco-systems around them. These will be the seeds for future industrial leadership and for tackling society's grand challenges in new ways.

Peter Stollenmayer

Celtic Office Strategy Director of the Celtic-Plus, EUREKA

Knowledge Talk - July 29, 2015 | 10:45 AM

Peter Stollenmayer has worked in telecommunications for more than 25 years. After he got his master's degree in electrical engineering from the University of Stuttgart in 1981, he worked with Deutsche Telekom (at that time "Deutsche Bundespost") in the areas of PABXs and ISDN standards. He was involved in standardizing ISDN-PABXs from the very early days. He was member of the ETSI Board and of the ETNO strategic group on standardization issues from 1996 to 1998. In 1997 he changed to Eurescom, where he has led many projects in the area of telecommunication users and markets. He was coordinator of the FP6 Integrated Projects NM2 (New Media for a New Millennium), TA2 (Together Anywhere, Together Anytime) and Vconect (Video Communication for Networked Communities). Since mid-2014 he has been strategic director of the Celtic Office, hosted by Eurescom.

EUREKA and Celtic-Plus - Opportunities for Collaboration in R&D

Abstract: EUREKA is an intergovernmental network launched in 1985, to support market-oriented R&D and innovation projects by industry, research centres and universities across all technological sectors. It is composed of 41 members, including the European Union represented by the Commission. With its flexible and decentralised network, EUREKA offers project partners rapid access to skills and expertise across Europe and national public and private funding schemes. Celtic-Plus is the industry-driven European research programme for implementing the vision of a Smart Connected World. It covers a broad range of areas in ICT, including communication infrastructures, services, applications and multimedia. The programme started in 2003 and is operated as an ICT Cluster under the umbrella of EUREKA, the intergovernmental network for market-driven industrial R&D. Participation through the regular project calls is open to any organization ready to contribute to the Smart Connected World vision. The collaborative Celtic-Plus research projects are financed through public and private funding. The presentation will introduce EUREKA and Celtic-Plus, explain how they work, what the benefits are, and how European organisations can participate in the programme. The EUREKA Smart City Initiative and the Celtic-Plus Programme will be described, and some selected high potential Celtic-Plus projects illuminated.

Peter Whale

Board member, Cambridge Wireless & Director of Product Marketing, Iotic-Labs
Knowledge Talk - July 29, 2015 | 11:30 AM

Peter is an accomplished leader in innovation and technology with a track record of conceiving and commercialising breakthrough technology-based products. Peter is Director of Product Marketing with Iotic Labs Ltd, a disruptive start-up with a vision to enable Things to interact on the Internet just like people do. Previously Director of Product Management with Qualcomm Technologies Incorporated, Peter was responsible for innovation and product commercialisation of IP in the field of machine learning into a portfolio of products that have benefited millions of users every day around the globe. Prior to Qualcomm, Peter was a key member of the leadership team at TTPCom, which played an early and pivotal role in the development of digital GSM and the emergence of Internet-enabled mobile phones. Peter developed and sold software solutions shipped in over 100 million handsets, and managed relationships with a number of blue chip customers. Peter has been a board member of CW (Cambridge Wireless) since 2009. Peter is a long-standing SIG Champion of the Future Devices SIG, and has conceived and delivered many innovative and successful events along with his fellow co-champions. Peter is co-author of Essentials of Mobile Handset Design, published by Cambridge University Press, a book that addresses the complex blend of design and technology factors needed to create great mobile devices.

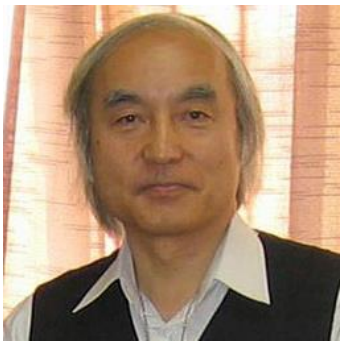
The Future of Wireless will be nothing like the past

Abstract: One thing seems certain: the future of wireless will be nothing like the past. Billions of "things" will be connected using networks quite unlike the ones we use today. Many new products, devices and appliances will be wirelessly connected, and opportunities to transform whole new industry sectors abound. Wireless is finding new application in the home, within government and businesses, in our hospitals, in our cars and in our cities. Major growth challenges exist too. Smartphone penetration will approach ubiquity, average revenue per user is declining, data usage is expanding rapidly. Value has moved to cloud providers with expertise in software and analytics providing innovative consumer services. There is not enough spectrum for future growth and agreement is lacking on potentially conflicting requirements for 5G. With change brings opportunity, new questions to ask and new problems to solve. The technology revolution has only just begun! This talk will briefly review the technical, social and business trends influencing the future of wireless, and then draw out some of the key areas of academic research likely to be of particular interest in the future to industry.

Tutorial

Kohei Arai

Saga University, Japan
Tutorial - July 30, 2015 | 11:30 AM



Dr Kohei Arai, a Scientist, Professor and Author. He is currently Professor at Saga University, Japan and Adjunct Prof. of the University of Arizona, USA since 1998. Dr Arai received PhD degree in Information Science from Nihon University in June 1982 and MS degree in Electronics Engineering from Nihon University in March 1974. His current research concerns are Satellite Remote Sensing, Radiative Transfer Equation, Human-Computer Interaction, Image Recognition and Understanding, Non-Linear Optimization Theory and Wavelet Analysis. Dr Arai holds 42 patents and received numerous awards, including the Patent Award of the Year. Dr Arai has been featured in Japan Times and Italian Newspapers for his work on Eyes only Computer System. He has worked on several global research collaboration projects during his career. He wrote 31 books and published 490 journal papers and 390 of conference papers.

Rescue system with vital sign monitoring of sensor network

Abstract: Method and system for human action detections with acceleration sensors for the proposed rescue system for disabled and elderly persons who need a help in evacuation from disaster areas is proposed. Not only vital signs (blood pressure, heart beat pulse rate, body temperature, bless and consciousness) but also, the location and attitude of the persons have to be monitored for the proposed rescue system. The attitude can be measured with acceleration sensors. In particular, it is better to discriminate the attitudes, sitting, standing up, and lying down. Also, action speed has to be detected. Experimental results show that these attitude monitoring can be done with acceleration sensors.

Industrial Talk

Theo Priestley

Technology Speaker
Industrial Talk - July 30, 2015 | 11:30 AM

Theo Priestley is an independent technology evangelist and has been providing industry analysis and advisory services, opinion and commentary on technology and software trends since 2007. A senior technologist and advisor to the C-level, he is able to articulate and shape the IT roadmap and strategic direction of clients to take advantage of industry trends. Theo is an authority on BPM (Business Process Management) and trusted industry thought leader on the business and consumer impacts of Big Data, Cloud, Mobile and Social, M2M, Internet of Things as well as understanding future disruptive technologies. Theo was Vice President and Software AG's global Chief Technology Evangelist and previously consulted on small and large scale business and technology transformation projects.

The Future of Work: How 100 Children See Technology Improve Their Working Life

Abstract: In 2014 I embarked on an interesting project: to survey 100 school children about how they see the work environment being shaped for them by the time they reach working age. Is it all spaceships and teleporters, or are our children more in tune with the future than we are ?

Natural Disaster Detection Using Wavelet and Artificial Neural Network

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***Abstract*—Indonesia, by the location of its geographic and geologic, it have more potential encounters for natural disasters. This nation is traversed by three tectonic plates, namely: Indo-Australian, the Eurasian and the Pacific plates. One of the tools employed to detect danger and send an early disaster warning is sensor device for ocean waves, but it has drawbacks related to the very limited time gap between information/warnings obtained and the real disaster event, which is only less than 30 minutes. Natural disaster early detection information system is essential to prevent potential danger. The system can make use of the pattern recognition of satellite imagery sequences that take place before and during the natural disaster. This study is conducted to determine the right wavelet to compress the satellite image sequences and to perform the pattern recognition process of a natural disaster employing an artificial neural network. This study makes use of satellite imagery sequences of tornadoes and hurricanes.**

Keywords—component; disaster detection; pattern recognition; Wavelet; Artificial Neural Network

I. INTRODUCTION

One of the common problemsfaced by image processing usersis the size ofmemory. Pictures can say thousands of words, but their size also take space to store. When a picture is distributed on thetransmission the bandwith needed isas big as the size of the image file. This brings consequences to telecomunication technology that is to compress image to save bandwith, time to distribute the image and lower the memory cost.

Patern recognition isone amethodto detect a disaster of many ways attempting to minimize disaster casulties. This research is an attempt to reach this goal. Through a pattern recognition taken fromsatellite image sequence and by performing anartificial neural network, we try to give a more acurate prediction and faster image processing in order to minimize the casulties cause by disaster.

Geographically and geologically, Indonesia potentially encountersvarious natural disasters. Efforts to prevent or detect natural disasters are developed continuesly in order to produce fast and accurate early predictions. One of the efforts that hasbeen done is the installation of a sensor which can detect the changes of ocean waves.The sensoris placed in the middle of the ocean. However, the sensor has some weaknesses, such as the time gapbetween the information obtained andthe occurrence of natural disasters is very short, probably less than 30 minutes. Hence, there is a need to innovate a detector which can provide information at least 24 hours in advance, so that people can evacuate themselves long before a natural disaster occurs.

II. LITERATURE REVIEW

A. Image Compression Using Wavelet

Computers that being used in efforts to achieve required resolution for multimedia applications or large image databases always have limitation.This is due to the increasing quality of digital images that also increase the size of an image.To overcome this problem, compression process is became more needed [6].

Good quality image mean larger size, therefore it need more memory. However, most images contain duplicate data that can be seen in the colour combination, and also where a pixel has the same intensity with neighboring pixels, so somepixel waste storage space. An image contains a lot of the same parts (regions), so redundancy can be seen in these same sections that do not need to be coded repeatedly as it creates waste. Image compression can only reduces the redundancy of the image data stored or transmitted, and then the image can be reconstructed in accordance with human visual perception [9].

There is technique for image data compression that using wavelet transformation. In this compression method, the wavelet transformation get advantages when it detects a very small difference between the original image and the reconstruction image, even after quantization process.The non-negative threshold value will make the image elements with a very small value to be zeroed, so it can produce a very sparse matrix [8].This sparse matrix is useful for stored and transmitted the image data, in addition to the results of the reconstruction that have a very small value of MSE or as good as the original image when visually seen.

Nowadays, wavelet applications and ressearch are get much attention in research topic; one of them is for image analysis. In example, wavelet decomposes the original signal into signals in several frequencies (called multi-resolution analysis), and an analysis can be performed by Discrete Wavelet Transform [5] or the standard decomposition techniques and the non-standard with Haar wavelet [2]. Image

signature generated by wavelet is taken from wavelet coefficient at a certain level (e.g. 3, 4 or 5) and can be resized into much smaller than the original one.

B. Artificial Neural Network

Artificial Neural Network (ANN) is an example method that use a network of a small processing unit group modeled based on human neural network. ANN is a system that can be adaptive, to solve problems it can change its structure based on external or internal information from the network. It can be simply said that, ANN is a non-linear statistical modeling tool. In other case for finding patterns in the data, ANN can be used to model complex relationships between inputs and outputs. ANN concept are originated on the paper of McCulloch and Pitts (1943), this paper attempts to formulate a mathematical model of brain cells.

According to Haykin [4], a neural network is a parallel-distributed processor. This method tendency are to keep knowledge acquired from the experience and keep it available. It resembles the brain works in two ways: 1. Knowledge acquired through a learning process. 2. Strength of the relationship between nerve cells, or known as synaptic weights, this is also being used to store knowledge.

This method are good to be used in many case of patern recognition. ANN ability are being used in many case to solved patern recognition problem.

C. Pattern Recognition

Pattern is an entity that is defined and can be identified and given a name by its features. Pattern recognition can be defined as "the act of taking raw data and act on data classification" [3][7]. Pattern recognition aims to determine the groups or categories of pattern based on the characteristics owned by the pattern. A pattern recognition system acquires data over a sensing device or sensor, sets the form of data representation, as well as makes the process of analysis and classification of data. Data can be formed as image or a one-dimensional signal based on changes in time.

There are two stages and objectives of apattern recognition process, i.e. [1]: (1) Putting pattern into an unknown class of patterns known as clustering or unguided classification. (2) Identify patterns as a member of a class that is already known. The process is called supervised classification.

The early use of pattern recognition is to recognise the characteristics and classification of white blood cells. But after a few years, pattern recognition methods have been applied to a number of ,very small object forms such as bacteria, viruses, and cells. Moreover, pattern recognition technique is also used for satellite data processing to produce information about the condition of the soil, plant varieties, weather patterns, and the Earth's surface topography.

III. Research Methods

D. Research Materials

Test images used as research materials are in the form of a satellite imagery sequence. While satellite still imagesare displayed in sequence, they give the impression to the eyes as a moving image. The test images used for this study are two types of movement sequences of satellite imagery, one is of atornado and one of a storm, which were then tested with Haar, Coiflet1, Coiflet3, Symlet2, Symlet5, 1AJS, AJS2, andAJS 3.

Fig. 1. Example of Satellite Imagery

The example study image materials are obtained through various sites. The data that obtained in the form of video are converted into many images by disassemble the frame in the video. After a picture is taken, the image will be processed further.

E. Research Process

This research is done by performing these steps:

1) Preparing videos and disassemble the videos;

2) Processing the image data to fit in;

3) Designing and building the program to compress satellite imagery sequences by using wavelet;

4) Testing the eight selected wavelet to PSNR and the percentage of compression ratio on satellite imagery sequences.

Processing of satellite imagery sequences with wavelet transformation will results in multi-resolution of the original image. This research used wavelet because the it has the ability to bring out features that special on the images test. The wavelet transformation abilities are useful as a feature extraction method and also reducing the dimension of the input. By using the Learning Vector Quantization (LVQ) neural networks, Test images that have been reduced further are processed for pattern recognition. As the input basis of artificial neural network use some sizes of vector images, which is 16 x 16, 32 x 32 and 64 x 64, and then compares its effect on recognition performance.

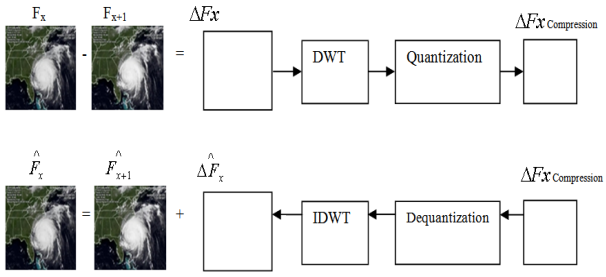


Fig. 2. Compression Process of Satellite Imagery

IV. RESULT AND DISCUSSION

A. Compression of Satellite Imagery Sequences Using Selected Wavelet

This research applies some testing for satellite imagery sequences inter-frame compression to PSNR and compression ratio.

The case that being use for satellite imagery sequences consist of two types of disasters, tornadoes and hurricanes. Each of natural disaster is represented by 10 images sequences with a size of 512 x 512 pixels. The eight wavelets used are Haar, Coiflet1, Coiflet3, Symlet2, Symlet5, 1AJS, AJS2, and AJS 3.

B. Testing of Selected Wavelets to Compression Ratio

Based on Table 1 and Figure 3, for tornado image sequences the results show that the wavelet producing the highest compression ratio is Haar then followed by Symlet 2 and AJS 1. Haar has the highest compression ratio because it has the least amount of filter length, which is 2, while the Symlet 2 and AJS 1 have filter length of 4.

As for the hurricane image sequences it shows that the wavelets producingthe highest compression ratio are Symlet 2 and AJS 1.The Comparison result are can be seen in table 1. Comparison of Selected Wavelets to Compression Ratio.

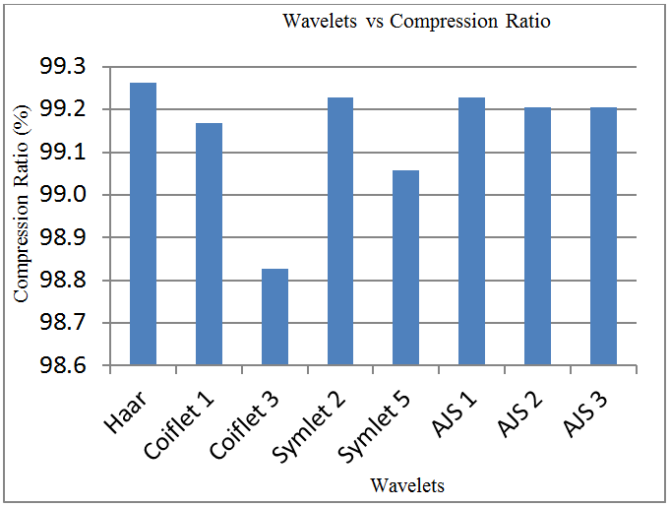
C. Testing of Selected Wavelets to PSNR

Based on Table 2 and Figure 4, for tornado image sequences it showsthat the AJS 2 wavelet yields the highest PSNR value, followed by Symlet 2 and AJS 3. This shows that the AJS 2 wavelet produces reconstruction image that is closest to the original image when compared with the other wavelets.

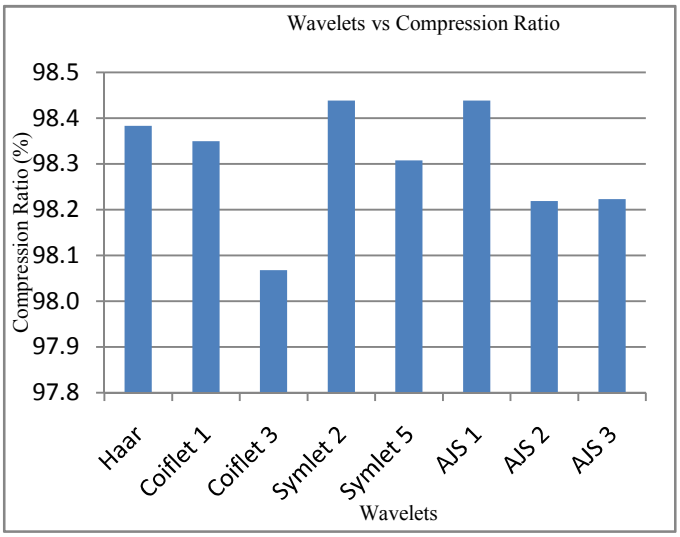
As for the hurricane image sequences, it appears that AJS 2 wavelet yields the highest PSNR value, followed by Symlet 2 and AJS 3. This shows that the AJS 2 wavelet produces reconstruction image that is closest to the original image when compared with the other wavelet.

TABLE I. COMPARISON OF SELECTED WAVELETS TO COMPRESSION RATIO

No	Wavelet	Compression Ratio (%): Tornado	Compression Ratio (%): Hurricane
1	Haar	99.26233	98.38333
2	Coiflet 1	99.16833	98.34967
3	Coiflet 3	98.826	98.068
4	Symlet 2	99.229	98.43867
5	Symlet 5	99.058	98.30767
6	AJS 1	99.22867	98.43833
7	AJS 2	99.20567	98.21867
8	AJS 3	99.20567	98.22333



a. Tornado Image Sequences

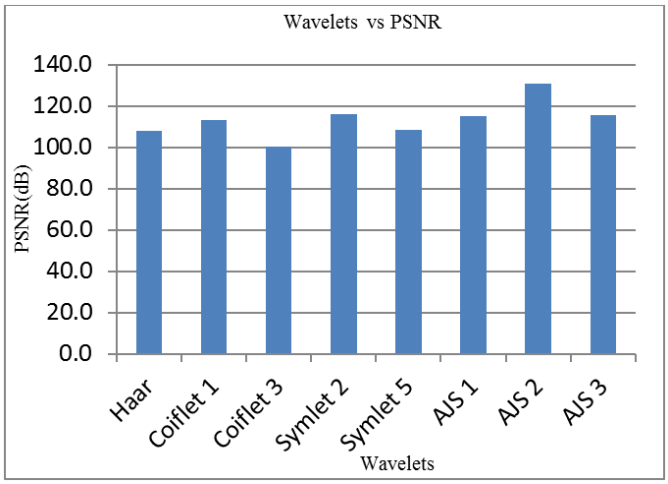


b. Hurricane Image Sequences

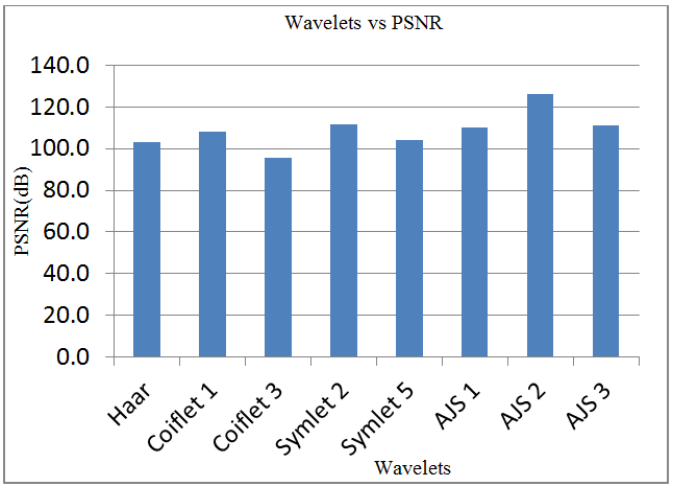
Fig. 3. Comparisons of Selected Wavelets to Compression Ratio

TABLE II. COMPARISON OF SELECTED WAVELETS TO PSNR

No	Wavelet	PSNR (dB): Tornado	PSNR (dB): Hurricane
1	Haar	108.0033	103.11
2	Coiflet 1	113.33	108.2767
3	Coiflet 3	100.1637	95.423
4	Symlet 2	115.9733	111.4967
5	Symlet 5	108.6467	103.94
6	AJS 1	115.07	110.0767
7	AJS 2	130.7467	126.1633
8	AJS 3	115.6133	111.1367



a. Tornado Image Sequences



b. Hurricane Image Sequences

Fig. 4. Comparisons of Selected Wavelets to PSNR

D. Pattern Recognition of Satellite Imagery Sequences

Having obtained the best wavelets to compress the images, the next step is to use the wavelets to the beginning of processing image sequences for pattern recognition. The pattern recognition program with pre-treatment using wavelet and learning process using LVQ.

V. CONCLUSION

Based on the test results and discussion, several conclusions can be made as follow:

1) Three wavelets that produce high PSNR of satellite imagery sequences respectively are AJS 2, Symlet 2 and AJS 3.

2) Pattern recognition of satellite imagery sequences can be preprocessed using wavelet, followed by the learning process using Learning Vector Quantization (LVQ) neural networks.

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