esprit Tech

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HONORIS UNITED UNIVERSITIES

RDI
Research
Development
Innovation

Annual Report

2021-2022 Academic year

“At ESPRIT, we foster a supportive environment that promotes research, creativity, and innovation with a special emphasis on translating discoveries and innovations into tangible outputs that will contribute to the socio-economic development of the region. In doing so, we strive to engage our students in the process of scientific inquiry, under the mentorship of our faculty and with the support of our industrial partners.”

Professor Tahar Ben Lakhdar, ESPRIT CEO and Co-founder

Contents

ESPRIT-Tech

The Research, Development, and Innovation Office

Welcome

Research, Development, and Innovation (RDI) have been among the strategic priorities at ESPRIT since its inception. In 2010, the university established ESPRIT-Tech (the RDI office) to oversee the various RDI activities and to work actively with concerned stakeholders to outline the research policies, strategies, and priorities.

ESPRIT puts a special focus on applied research and innovation by promoting RDI activities whose outputs have practical socio-economic impacts, without undermining pure academic research.

As we emerged from the Covid-19 pandemic, RDI productivity has bounced back to normal with a sharp 50% increase in the number of international conference paper publications. This was expected given the lift on travel bans and restrictions in 2021.

The 2021-2022 academic year also witnessed the introduction of a new initiative to boost research productivity and research excellence. It consists of the ESPRIT Research Incentive Funds (RIF).

I invite you to explore this catalog and learn more about our various RDI activities, events, initiatives, and achievements.

We look forward to establishing new collaborative RDI partnerships with the local community, the private as well as the public sectors. These strategic collaborations will lay the foundations for a more active role of ESPRIT in the socio-economic development of Tunisia.

Prof. Faouzi Kamoun
Director ESPRIT-Tech
Tel: (216) 99 423 944
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Research Teams

#	Name	Domain	Coordinator	Contact Email address
Information & Communications Technologies (ICT)				
1	ESPRIT-Cloud	Cloud Computing & Security	Manel Madhioub	Manel.madhioub@esprit.tn
2	Wireless Com	Wireless communications	Safa Zhioua Cherif	safa.zhiouacherif@esprit.tn
3	SSD	Sustainable Social Development	Soumaya Argoubi	Soumaya.argoubi@esprit.tn
4	M2M	Ambient & embedded systems	Feten Teber	Feten.teber@esprit.tn
5	WSN-RFID	Wireless sensor networks and RFID	Abderrazak Hachani	Abderrazak.hachani@esprit.tn
6	ESPRIT-Mobile	Mobile applications	Imed Amri	Imed.amri@esprit.tn
7	DASC	Data Science & AI	Sami Sifi	Sami.sifi@esprit.tn
8	Imagin	Computer vision / image processing	Naouel Boughattas	Naouel.boughattas@esprit.tn
9	I2S	Intelligent Information Systems	Syrine Karoui	Syrine.karoui@esprit.tn
	Electromechanical & Industrial Engineering			
10	ICAR	Robotics	Maher Mkhinni	Maher.mkhinni@esprit.tn
11	EVIS	Electric vehicle innovation systems	Toufik Chaouachi	Taoufik.chaouach@esprit.tn
12	ESPRIT-LEAN	Lean & Industry 4.0	Nacef Sifi	Nacef.sifi@esprit.tn
13	INOBI	Industrial engineering for a better life	Salah Bousbia	Salah.bousbia@esprit.tn
14	ETM	ESPRIT's Tomorrows Materials	Ameni Ellouze	Ameni.ellouze@esprit.tn
Civil & Building Engineering				
15	REEE	Renewable energy & energy efficiency	Imen Guebebia	Imen.guebebia@esprit.tn
16	SBM	Smart Building management	Asma Karaoui	Asma.karoui@esprit.tn
Applied Mathematics				
17	GRAFICS	Risk management	Mohamed Anis Ben Lasmar	Mohamedanis.benlasmar@esprit.tn
18	MMSN	Mathematical modeling and numerical simulations	Mohamed Hedi Riahi	Mohamedhedi.riahi@esprit.tn
Management & Pedagogical Innovation				
19	MAIN' Team	Management & Innovation	Inés Mhaya	Ines.mhaya@esprit.tn
20	ALEER	Engineering Education Research	Lamjed Bettaieb	Lamjed.bettaieb@esprit.tn

Research Themes

#	Research Team	Research Themes
1	ESPRIT-Cloud	⇒ Infrastructure as a service ⇒ Virtualization technologies ⇒ Cloud security ⇒ Cloud federations ⇒ Platform as a service ⇒ Learning-based Cloud
2	Wireless Com	⇒ Future Wireless Networks ⇒ UAV-based Aerial Networks ⇒ Smart agriculture (UAVs & AI) ⇒ Wireless communication for Public Safety ⇒ E-health
3	SSD	⇒ Behavioral Analysis ⇒ Privacy ⇒ Serious Games ⇒ E-justice: Social development to achieve peace, human rights, and effective governance
4	M2M	⇒ Healthcare ⇒ Smart homes ⇒ Smart agriculture
5	WSN-RFID	⇒ Design of interconnected objects ⇒ Digital Transformation ⇒ Localization and tracking ⇒ Logistic management ⇒ IoT applications
6	ESPRIT-Mobile	⇒ IoT ⇒ Blockchain ⇒ M-Health ⇒ Augmented Reality / AR ⇒ Virtual Reality / VR & Mixed Reality / MR
7	DASC	⇒ Machine Learning & AI applications ⇒ Social media data analytics ⇒ Education 4.0 ⇒ Risk Cartography
8	ImageIn	⇒ Machine learning for computer vision ⇒ Medical imaging ⇒ Shape recognition ⇒ Image processing
9	I2S	⇒ Intelligent Information Systems (IIS) architectures ⇒ IIS security ⇒ Decision-support systems ⇒ Big data & AI for IIS ⇒ DevOps for IIS
10	ICAR	⇒ Automation and Robotics ⇒ MEMS and IoT applied for mechatronics
11	EVIS	⇒ Vehicle's mechanical structures ⇒ Vehicle's aerodynamics ⇒ Electric power converters ⇒ Battery charging and management systems
12	ESPRIT-LEAN	⇒ Industry 4.0 tools and applications

#	Research Team	Research Themes
		⇒ Pedagogical innovation for Lean education ⇒ Lean Agriculture
13	INOBI	⇒ Innovative pedagogical approaches for industrial engineering education ⇒ Industrial engineering solutions for social innovation and better life
14	ETM	⇒ Valorization of waste in plastic/composite materials ⇒ Valorization of natural fibers resulting from their use as reinforcement in composite materials ⇒ New ecological concretes made with carbonated aggregates
15	REEE	⇒ Energy audit ⇒ Energy management and optimization ⇒ Sustainable development & Smart cities
16	SBM	⇒ Methods to improve occupant comfort ⇒ Smart building applications ⇒ Building Information Modelling (BIM)
17	GRAFICS	⇒ Data Mining, Scoring and Big data tools for decision support and actuarial applications ⇒ Efficient algorithms for stochastic control, numerical and statistical processing ⇒ Sensitivity analysis, quantification of uncertainty, and uncertainty modeling ⇒ Rare events analysis for optimal decision making and risk management
18	MMSN	⇒ Applications of mathematical models and simulation techniques: ⇒ Finance: Inverse problem of estimating volatility in the Black and Scholes model ⇒ Environment: Parametric estimation in hydrogeology ⇒ Oil and Gas: Numerical modeling of the impact of rock mechanics in oil reservoirs on flow in porous media ⇒ Biology: modeling electrical activities of the hearts ⇒ Civil engineering: Mixed 3D-1D formulation for the analysis of composite beams
19	MAIN 'Team	⇒ Digital Marketing & Data Marketing ⇒ Innovation management ⇒ Development economics ⇒ Business Finance ⇒ Human resources ⇒ Entrepreneurship
20	ALEER	⇒ Active learning in engineering education ⇒ Collaborative project approaches in Engineering education ⇒ Case studies in Engineering education & lessons-learned ⇒ Learning outcome assessment ⇒ Digital technologies in Engineering education

Major organized RDI events

2021-2022

Risk Management in the Digital Era

Workshop : **Gestion des risques à l'ère du numérique**
Mercredi 18 mai 2022
Esprit, Pôle Technologique El Ghazela, Amphi, Bloc L

On May 18, 2022, ESPRIT, via its GRAFiCS (Risk Management in Insurance and Finance via Stochastic Control) research team hosted a 1-day workshop under the theme "Risk management in the digital age". The event was co-organized with Le Mans University and its affiliated “Institute of Risk & Insurance” as well as with “Manceau Laboratory of Mathematics”. The objective of the Workshop was to share the various challenges and opportunities pertaining to the usage of digital technologies in risk and actuarial management.

E5T: Energies, Energetic efficiencies, Economy, Environment & Territories Spring School

On April 14, 2022, and in collaboration with Dauphine- Tunis , ESPRIT co-hosted the fourth edition of the E5t Spring school. The event was also live streamed for remote participants. E5t "Energy, Energy Efficiency, Economy, Environment and Territories" is an operational think tank created in 2011. Its *main* mission is to conduct and support activities and actions of general interest intended to promote the protection of the environment by carrying out a strategic reflection on the transition towards the energy autonomy of territories.

This fourth edition, co-hosted by ESPRIT and Dauphine, was organized under the theme: “Africa: territories of active innovation in the face of climate change”. Seven Esprit researchers contributed to 2 panel discussions:

1. Technological innovation: Accelerator of sustainable growth in Africa
2. Africa, Future Applications: Transport – Agriculture and Mobility

AI Summer School

ESPRIT hosted the first Mediterranean and African Summer School in Artificial Intelligence (MASSAI) event during the period June 13-17, 2022. MASSAI was organized by ESPRIT School of Engineering and ESPRIT School of Business, in collaboration with ENIT-LAMSIN and the Deep Learning Institute of Nvidia. The main goal of MASSAI was to build capacity among young African graduating students, researchers, and engineers around recent developments in AI and its applications. The aim of MASSAI was twofold:

- Contribute towards the development of the African potential and stimulate entrepreneurial initiatives in the field of AI.
- Contribute to enriching the AI ecosystem in the region by providing an opportunity to foster collaboration among the different academic actors and industrial players in the AI field.

MASSAI focused on applied AI through a combination of in-depth tutorials, practical labs and instructor led workshops. MASSAI was delivered in hybrid mode which allowed participants from 14 different countries to benefit from the different scientific and training activities. The flexibility of the delivery modes (face-to-face / blended / hybrid) enabled participants who did not have the financial means to be physically present at the event to fully benefit from MASSAI remotely. In addition, the Deep Learning Institute of Nvidia's certification workshops were delivered in blended mode thanks to the support of ESPRIT Teaching Assistants who accompanied the international participants via zoom.

In addition to the tutorials and workshops, practical case studies were presented via livestreaming of testimonies from 4 international AI companies (Foot vision, Dat4Job, ASPETAR, Nvidia).

Major highlights:

- Participation of students from around 14 countries.
- Participation of students and faculty members from the Honoris United Universities (HUU) network at MASSAI, including 15 from EMSI Morocco.
- 95 attendees certified during the “Before MASSAI” program in “Fundamentals of Deep Learning” workshop and 82 certified in “Fundamentals in accelerated computing”.
- About 110 students were certified in "AI applications in anomaly detection" workshop, 80 in face-to-face mode and 30 in online mode. The same number of attendees as above were certified in “Applications of AI for Predictive Maintenance” workshop / About 100 attendees were certified in “Transformer Based Natural Language Processing Models” workshop / 90 attendees were certified in “Conversational AI Applications” workshop

More information about this event can be found at https://massai.esprit.tn/

WEITA - 2022

During the period July 20-21, 2022, and as part of the recently established New Frontiers Workshop Series on "Emerging ICT trends & applications" (WEITA), ESPRIT School of Engineering & School of Business held a two-day hybrid workshop on "Generative AI in the digital transformation era: Technical approaches and use cases". The event was organized in collaboration with EMSI (Morocco), IBM, NVIDIA, and the IEEE (Tunisia Section). It was held at ESPRIT and live steamed for remote participants. The main aims of this workshop were to:
(1) contribute towards capacity building in the field of Generative AI,
(2) raise awareness about the potential role Generative AI can play in business innovation, digital transformation, and value creation,
(3) engage the audience to reflect upon the ethical, legal, and societal issue underlying the usage Generative AI, and
(4) seed collaborations and promoting the sharing of ideas, and perspectives in this area.

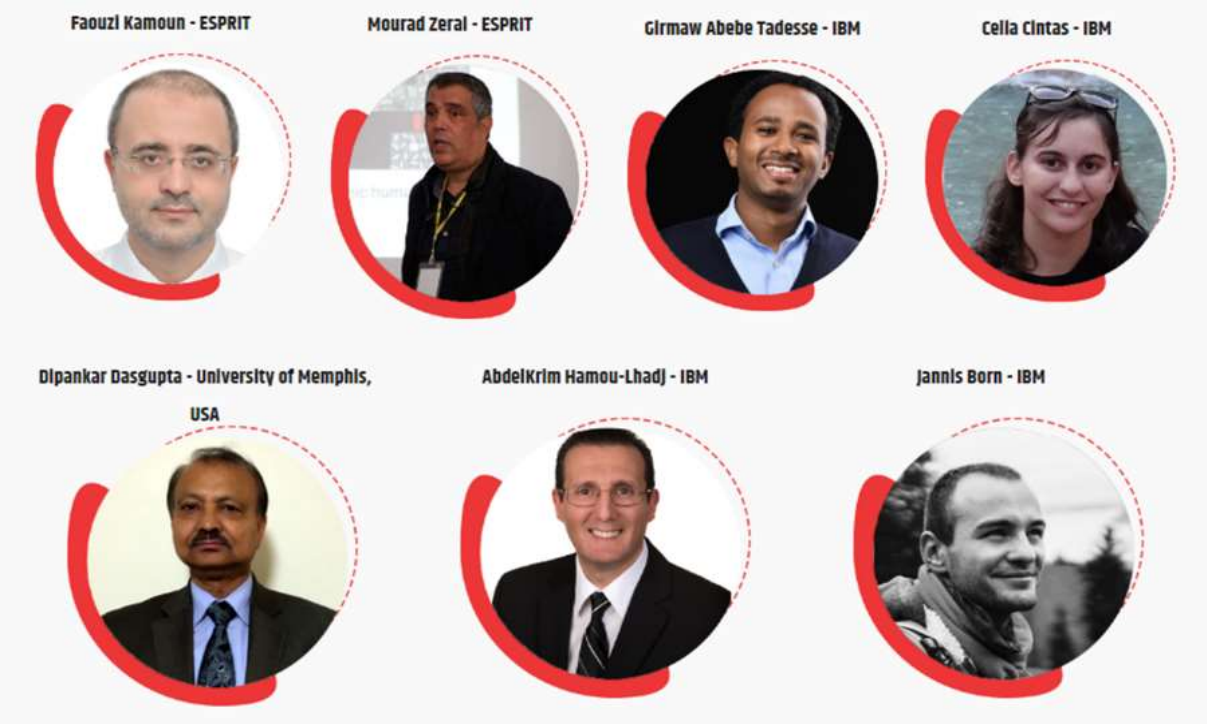
The event was structured around four main themes:
1- Generative AI approaches: Including Generative Adversarial Network (GAN), Transformer-based models, Autoregressive Convolutional Neural Networks (AR-CNNs), and Variational Autoencoders (VAEs)
2- Generative AI real-life business use cases and applications
3- Generative AI Misuses: Ethical and legal issues

4- NVIDIA certified hands-on training on building Generative AI models:
" Application of AI for anomaly detection"

Two faculty members from ESPRIT contributed as guest speakers in this workshop. Overall, around 328 participants attended the event (online & face-to-face), among whom 15 participants were from Morocco. Further, 25 participants (students and faculty) successfully obtained the NVIDIA " Application of AI for anomaly detection" Workshop certificates.

More information about the event can be found at https://www.esb.tn/weita/

WEITA 2022 Speakers



RDI Summer Internships

To promote the active engagement of ESPRIT students in the process of scientific inquiry and innovation, the various ESPRIT-Tech research teams have contributed during Summer 2022 with 103 research project proposals, some of which involved more than one student. These projects are categorized as follows:

Ref ID	Domains	Number of proposed projects
TIC	Informatics, Telecom, computer science	56
EME	Electrical engineering/ mechanical engineering	4
GC	Civil Engineering	2
AM	Applied Mathematics, including many projects involving AI, ML, DS, and python programming.	41

A research catalog was developed and shared among ESPRIT students. For each project, students were provided with detailed information regarding the project's ID, coordinates of the primary investigator(s), title, keywords, objectives, deliverables, required competencies, targeted classes and levels (year-of-study:1-4), duration (1-3 months) and some bibliographical references.
For the 103 project proposals, EPRIT-Tech received 1745 applications. The heads of the RDI teams tried their best to accommodate the maximum number of students by assigning more than one student to the same project (either to work as a team or independently by pursuing different approaches). Some of these summer research internship activities has led to publications.

R&D Awards

Research Incentive Funds

During the 2021-2022 academic year, we introduced ESPRIT Research Incentive Funds (RIF) "aka. FARDI- Fonds d'Appui à la Recherche Development Innovation" as a new initiative to promote and encourage research productivity and research excellence. Proposals from ESPRIT research teams are evaluated by a RIF committee composed of 4 members:

- The Director of ESPRIT-Tech (Chair)
- Three members appointed by the Director of ESPRIT-Tech

Proposals were evaluated based on four main criteria: eligibility, relevance, impact, and effectiveness of the implementation. Priority was given to multi-disciplinary applied projects that engage students and that involve the participation of local organizations and industrial partners. The maximum eligible funding is 6,000 Dinars for a 1-year project proposal and 9,000 Dinars for a 2-year proposal.

ESPRIT-Tech received 8 applications during the academic year 2021-2022, among which 3 were accepted for funding:

Project Title	Primary Investigator	Project duration
Intelligent environment monitoring system to assess radioactive effects due to electromagnetic field radiations	Hafawa MESSAOUDI	1 year
Artificial Intelligence in the service of new generation networks (5G and beyond)	Sawsan SELMI	2 years
Real Estate Data Analysis and Classification REDAC	Wissal NEJI	2 years

Research Award

In 2020, we instated the research award to further promote and celebrate research accomplishments by highlighting the work of a faculty member who has particularly distinguished himself by the variety and the quality of his RDI activities and productions. The research award for the 2021-2022 academic year was granted to ***M. Abderrazek Hachani*** (WSN-RFID research team).

Faculty - Ph.D candidates and graduates

During the 2021-2022 academic year, 13 ESPRIT instructors have successfully completed their PhD degree as illustrated in the table below.

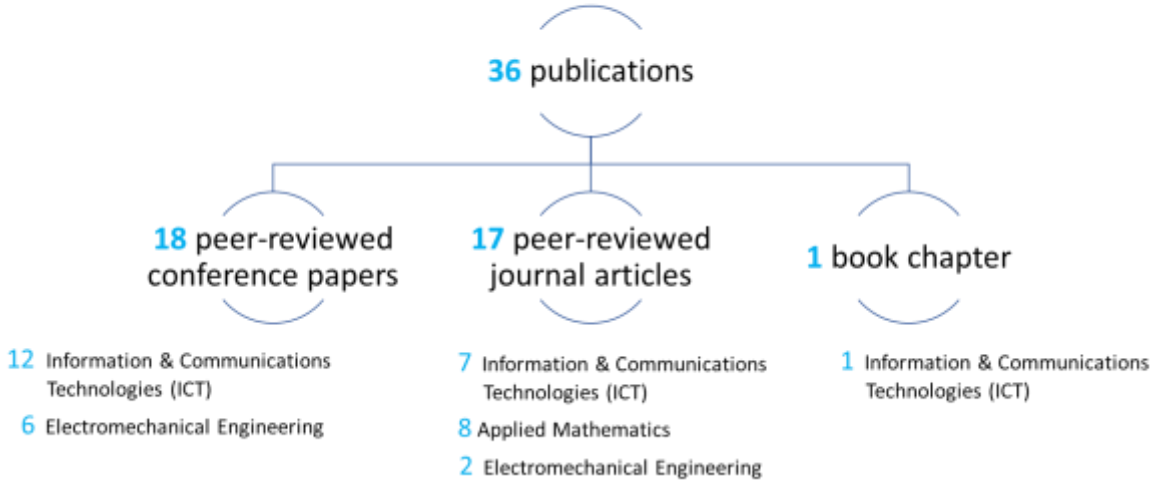
Faculty name	Thesis defense date
Rim Douss	24 /06/2022
Hamdi Gabsi	11/01/2022
Nesrine Ben Salah	27 /06/2022
Aziza Zaouga	07/04/2022
Sonia Mesbah	22/09/2021
Emna Hosni	28/06/2022
Wiem Zaouga	12/01/2022
Sarra ABIDI	13/01/2022
Adel Jebali	30/12/2021
Hiba Lahmer	30/10/2021
Amel Ksentini	28/09/2021
Syrine CHABCHOUB	18/12/2021
Zouhour Hammouda	05/03/2022

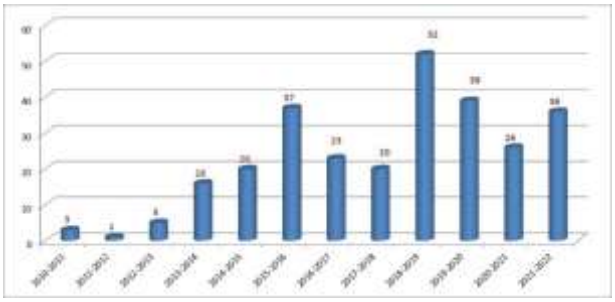
In addition, 9 faculty members are currently pursuing their PhD studies at research laboratories affiliated with public universities:

Faculty name	Thesis title
Asma AYARI	Classification automatique d'apprenants et stratégies d'adaptation dans le cadre d'un apprentissage Auto-régulé
Amel HAJJI	Modélisation et analyse de la performance des cellules de production manufacturières sujettes aux perturbations aléatoires
Jihen Hlel	Socio-digital transition
Nidhal Ayari	Optimisation de la couverture réseau dans les réseaux d'objets connectés sans fils agricoles et opérants dans le domaine du sub-Ghz
Yosra Hajjaji	Remote Sensing Big Data Analysis: A Novel Approach based on IoT and Deep Learning for smart Environmental Services
Yosra Jmal	Optimisation du parcours des patients aux services d'urgences
Yassine Boussaâ	Stabilité dynamique des réseaux électriques avec une intégration massive des énergies renouvelables. Analyse par l'opérateur de Koopman.
Safa Lasmar	Planification robuste des soins à domicile
Sihem Omri	Holistic Memory based Artificial Intelligence for Dynamic Smart Contexts

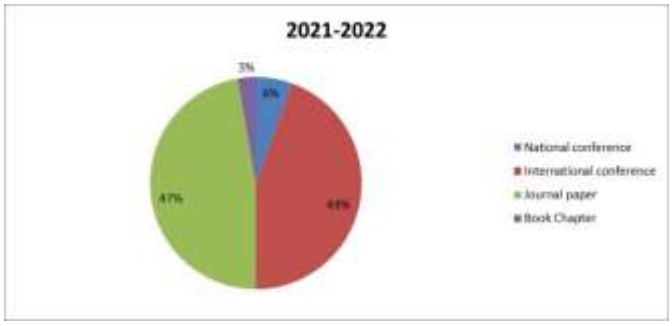
RDI publications highlights

2021-2022 Academic Year (AY)





Historical evolution of RDI publications



Repartition of RDI publications 2021-2022

Information & Communications Technologies

ICT RDI Publications

(2021-2022 AY)

#		Type[1]	Abstract on Page #
1	**N. Masmoudi**, W. Jaafar, **S. Cherif**, **J. B. Abderrazak** and H. Yanikomeroglu, "UAV-Based Crowd Surveillance in Post COVID-19 Era," in IEEE Access, vol. 9, pp. 162276-162290, 2021, doi: 10.1109/ACCESS.2021.3133796	**JA**	**28**
2	Z. Khalid, F. Iqbal, **F. Kamoun**, L.A. Khan, B. Shah. Forensic investigation of Cisco WebEx desktop client, web and Android smartphone applications, Annals of Telecommunications, Springer. pp 1-26. 2022. https://doi.org/10.1007/s12243-022-00919-6	**JA**	**29**
3	A Esseghir, **F Kamoun**, **O. Hraiech**, AKER: An open-source security platform integrating IDS and SIEM functions with encrypted traffic analytic capability, Journal of Cyber Security Technology, Taylor & Francis. 6:1-2. DOI: 10.1080/23742917.2022.2058836, pp. 27-64, 2022.	**JA**	**30**
4	**F Kamoun**, M El Barachi, F Belqasmi, **A Hachani**. A smart spontaneous crowd evacuation system for large multi-exit exhibition centers based on IoT., International Journal of Ubiquitous Systems and Pervasive Networks 16 (2), pp. 55-62, 2022. DOI: 10.5383/JUSPN.16.02.001.	**JA**	**31**
5	**Adel Jebali**, Salma Sassi & Abderrazak Jemai (2021) Secure data outsourcing in presence of the inference problem: issues and directions, Journal of Information and Telecommunication, 5:1, 16-34, DOI: 10.1080/24751839.2020.1819633.	**JA**	**32**
6	**Adel Jebali**, Salma Sassi, Abderrazak Jemai, Richard Chbeir, Secure data outsourcing in presence of the inference problem: A graph-based approach, Journal of Parallel and Distributed Computing, Volume 160, 2022, Pages 1-15, ISSN 0743-7315, https://doi.org/10.1016/j.jpdc.2021.09.006.	**JA**	**33**
7	**S. Argoubi**, **K. Maalaoui** and L. A. Saidane, "HCQ: Hierarchical Cross-layer approach for QoS provisioning in WSN," 2022 International Wireless Communications and Mobile Computing (IWCMC), 2022, pp. 518-523, doi: 10.1109/IWCMC55113.2022.9824793.	**CP**	**34**
8	**A. Ayari**, **M. Chaabouni** and H. B. Ghezala, "Studying the impact of learning situation on learner model," 2022 IEEE Global Engineering Education Conference (EDUCON), 2022, pp. 757-762, doi: 10.1109/EDUCON52537.2022.9766518.	**CP**	**35**
9	F. Outaya, **F. Kamoun**, **A. Chemek**, **H. Bargaoui**, Ansar Yasar. On the design and implementation of an on-board test bed system for V2V road hazard signaling, Procedia of Computer Science, Vol. 203. Elsevier. (MobiSPC 2022), pp. 119-126, 2022. https://doi.org/10.1016/j.procs.2022.07.017.	**CP**	**36**
10	Z Khalid, F Iqbal, **F Kamoun**, M Hussain, LA Khan. Forensic Analysis of the Cisco WebEx Application. 2021 5th Cyber Security in Networking Conference (CSNet), 90-97. 2021. Abu Dhabi, UAE. doi: 10.1109/CSNet52717.2021.961464.	**CP**	**37**
11	**Boughattas, N.**, **Jabnoun, H.** (2022). Autism Spectrum Disorder (ASD) Detection Using Machine Learning Algorithms. In: Aloulou, H., Abdulrazak, B., de Marassé-Enouf, A., Mokhtari, M. (eds) Participative Urban Health and Healthy Aging in the	**CP**	**38**

1* JA: Journal Article – CP: Conference paper - BC : Book Chapter

#		Type[1]	Abstract on Page #
	Age of AI. ICOST 2022. Lecture Notes in Computer Science, vol 13287. Springer, Cham. https://doi.org/10.1007/978-3-031-09593-1_18		
12	**M.S. Ben Yahia** (2022). "Validation of No-linear Model of electrochemical impedance of a PEM fuel cell using the EIS Spectrum Analyzer". International Conference on Sciences of Electronic, Technologies of Information and Telecommunications (2022 IEEE SETIT), May 28-30, 2022.	**CP**	**39**
13	**A. K. Inoubli** and **D. M. B. Khedher**, "Serious games in management to support the active construction of knowledge in engineering studies," 2022 IEEE Global Engineering Education Conference (EDUCON), 2022, pp. 628-633, doi: 10.1109/EDUCON52537.2022.9766664.	**CP**	**40**
14	**F. Ziadi**, **N. Boughattas** and **W. Neji**, "Reform of active pedagogy in the age of Covid," 2022 IEEE Global Engineering Education Conference (EDUCON), 2022, pp. 634-639, doi: 10.1109/EDUCON52537.2022.9766780.	**CP**	**41**
15	M. Aissa, **B. Bouhdid** and A. B. Mnaouer, "Enhanced Fuzzy logic-based Cluster Stability in Vehicular ad hoc Network," 2021 International Symposium on Networks, Computers and Communications (ISNCC), 2021, pp. 1-6, doi: 10.1109/ISNCC52172.2021.9615872.	**CP**	**42**
16	W. Andari, S. Ghozzi, **M. S. Ben Yahia**, H. Allagui and A. Mami, "Supervisory control design for a PEM fuel cell electric vehicle," 2021 12th International Renewable Energy Congress (IREC), 2021, pp. 1-5, doi: 10.1109/IREC52758.2021.9624829	**CP**	**43**
17	Harrabi, M., Driss, O.B., **Ghedira, K**. (2021). Hybrid Biogeography-Based Optimization Algorithm for Job Shop Scheduling Problem with Time Lags and Single Transport Robot. In: Wojtkiewicz, K., Treur, J., Pimenidis, E., Maleszka, M. (eds) Advances in Computational Collective Intelligence. ICCCI 2021. Communications in Computer and Information Science, vol 1463. Springer, Cham. https://doi.org/10.1007/978-3-030-88113-9_7	**CP**	**44**
18	Marzouki, Bilel, Belkahla-Driss, **Ghedira, Khaled**. (2022). Improved Chemical Reaction Optimization for Distributed Flexible Job Shop Problem with Transportation Times, 10th IFAC Conference on Manufacturing Modelling, Management and Control, June 22-24, 2022, Nantes, France.	**CP**	**45**
19	**Cherni, T.** & Cherni, B. (2022). EFL Future Engineers' Language Anxiety: Final Project Presentations and Oral Examinations. PUPIL: International Journal of Teaching, Education and Learning, 6(1), 232-252.	**JA**	**46**
20	**Sarra Abidi,** Fathia Bettaher and Myriam Fakhri, Towards a Personalized Web Services Composition Approach, In: Information Systems, Kazuyuki Matsumoto (Ed.), July 21, 2021. Pp. 1-16. DOI: 10.5772/intechopen.97813	**BC**	**47**

Electromechanical Engineering

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Electromechanical Engineering RDI Publications (2021-2022 AY)

#	RDI publication	Type[2]	Abstract on Page #
1	**Asma Ouled Bedhief**, Comparing Mixed-Integer Programming and Constraint Programming Models for the Hybrid Flow Shop Scheduling Problem with Dedicated Machines, Journal Européen des Systèmes Automatisés Vol. 54, No. 4,2021, pp. 591-597.	JA	48
2	**Nahla Touati**, Imen Saidi and Dhaou Soudani, Improved filter design in internal model control: application to hybrid feed drive mechatronic system, International Journal of Intelligent Engineering Informatics Vol. 9, No. 6, Inderscience, 2022.	JA	49
3	**M. Merai**, M.W. Naouar, A.A. Naassani, I. and E. Monmasson "A Systematic Design methodology for a single-phase transfer delay based PLL operating under distorted grid voltages", ELECTRIMACS Conf., Nancy, France, Mai 2022.	CP	50
4	**S. Batis** and H. Alla, "Control approach for a class of hybrid systems," 2021 International Conference on Control, Automation and Diagnosis (ICCAD), 2021, pp. 1-8, doi: 10.1109/ICCAD52417.2021.9638753.	CP	51
5	**I. Sayahi** and **S. Ismail**. (2022). "Design and Implementation of an Embedded Vision System for Industrial Inspection," 2022 IEEE 9th International Conference on Sciences of Electronics, Technologies of Information and Telecommunications (SETIT), 2022, pp. 567-572, doi: 10.1109/SETIT54465.2022.9875471.	CP	52
6	**Maher MKHININI**, **Intissar SAYAHI**, **Thameur CHERNI**. (2022). "How to improve pedagogy through the use of tools?". International conference on pedagogical innovation. July 20, 21 and 22 2022, in Sousse -Tunisia.	CP	53
7	**M. H. Sassi**, **A. Karoui**, M. Ayadi and I. Shahrour, "Design of a Modular System for Measurement of Ambient Environmental Parameters "MSMAEP" for indoor environment quality assessment," 2021 IEEE 2nd International Conference on Signal, Control and Communication (SCC), 2021, pp. 246-251, doi: 10.1109/SCC53769.2021.9768355.	CP	54
8	**Maher MKHININI, Intissar SAYAHI, Ikram Maaoui Ben Hassine**, Control of an Autonomous Surface Vehicle with Variable Load by Predictive Control, The 2022 International Conference on Information Technology & Smart Industrial Systems, Paris, France, July 15 – 17, 2022, pp. 1-6.	CP	55

2* JA : Journal Article ; CP : Conference Paper

Applied Mathematics

Applied Mathematics RDI Publications (2021-2022 AY)

#	RDI publication	Type[3]	Abstract on Page #
1	**Emna Ghorbel**, Kaouthar Kammoun, Mahdi Louati, Akram Sallem. (2022). Estimation of the parameters of a Wishart extension on symmetric matrices, Journal of the Korean Statistical Society. https://doi.org/10.1007/s42952-022-00176-2	JA	56
2	**Ben Elouefi, R**., & Saâdaoui, F. (2022). Inverse-probability-weighted log rank test for stratified survival data with missing measurements. Statistical Neerlandica, 1– 17. https://doi.org/10.1111/stan.12276	JA	57
3	**Jbalia, A**. Stability estimate for an inverse problem of a hyperbolic heat equation from boundary measurement. Indian J Pure Appl Math (2022). https://doi.org/10.1007/s13226-022-00247-4.	JA	58
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5	**Ben Aziza Sahar** and Toumi Salwa, A probabilistic numerical method for a class of mean field games, Stochastics and Dynamics, Vol. 22, No. 04, 2250008 (2022). https://doi.org/10.1142/S0219493722500083.	JA	60
6	Najmedine Attia, **Meriem Ben Hadj Khalifa**. (2021). Note on The Multifractal Formalism of Covering Number on The Galton-Watson Tree, Kragujevac Journal of Mathematics Volume 49(1), Pages 43–60.	JA	61
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8	A. Rebai, **L. Boukhris**, **L. Ncib** and **M.-A. Ben Lasmar**. (2021). "Unsupervised Learning Diversification Applied on the Tunisian Stock Market Before and During the Covid-19 Crisis", International Journal of Management Research and Economics. https://doi.org/10.51483/IJMRE.1.4.2021.24-47	JA	63

3* JA : Journal Article

Appendix: Paper Abstracts

UAV-Based Crowd Surveillance in Post COVID-19 Era

Nizar Masmoudi; Wael Jaafar; **Safa Cherif**; **Jihene Ben Abderrazak**; Halim Yanikomer

ABSTRACT:

Since outdoor events are gradually allowed within the current pandemic situation, a close monitoring of the crowd activity is needed to avoid undesired contact and disease transmission. In this context, unmanned aerial vehicles (UAVs) can be occasionally used to watch these activities, to ensure that health measures are applied, and to trigger alerts when an anomaly is detected. Consequently, we propose in this paper a complete UAV framework for intelligent monitoring of post COVID-19 outdoor activities. Specifically, we propose a three-step approach. In the first, captured images are analyzed using machine learning to detect and locate individuals. The second step consists of a novel coordinates mapping approach to evaluate distances among individuals and cluster them, while the third step provides an energy-efficient and reliable UAV trajectory to further inspect clusters for restrictions violation. Obtained results provide important insights towards the efficient design of the framework: 1) Efficient detection of individuals depends on the angle from which the images were captured, 2) coordinates mapping is very sensitive to estimate errors in individuals' bounding boxes, and 3) UAV trajectory design algorithm 2-Opt is recommended for practical real-time deployments due to its low-complexity and near-optimal performance.

Keywords: Autonomous aerial vehicles, Cameras, Surveillance, Social factors, Human factors, COVID-19, Detectors

N. Masmoudi, W. Jaafar, **S. Cherif**, **J. B. Abderrazak** and H. Yanikomeroglu, "UAV-Based Crowd Surveillance in Post COVID-19 Era," in IEEE Access, vol. 9, pp. 162276-162290, 2021, doi: 10.1109/ACCESS.2021.3133796

Forensic investigation of Cisco WebEx desktop client, web, and Android smartphone applications

Zainab Khalid, Farkhund Iqbal, **Faouzi Kamoun**, Liaqat Ali Khan & Babar Shah

ABSTRACT:

Digital forensic analysis of videoconferencing applications has received considerable attention recently, owing to the wider adoption and diffusion of such applications following the recent COVID-19 pandemic. In this contribution, we present a detailed forensic analysis of Cisco WebEx which is among the top three videoconferencing applications available today. More precisely, we present the results of the forensic investigation of Cisco WebEx desktop client, web, and Android smartphone applications. We focus on three digital forensic areas, namely memory, disk space, and network forensics. From the extracted artifacts, it is evident that valuable user data can be retrieved from different data localities. These include user credentials, emails, user IDs, profile photos, chat messages, shared media, meeting information including meeting passwords, contacts, Advanced Encryption Standard (AES) keys, keyword searches, timestamps, and call logs. We develop a memory parsing tool for Cisco WebEx based on the extracted artifacts. Additionally, we identify anti-forensic artifacts such as deleted chat messages. Although network communications are encrypted, we successfully retrieve useful artifacts such as IPs of server domains and host devices along with message/event timestamps.

Keywords: Cisco WebEx , Disk-space forensics , Memory forensics, Network forensics ,Videoconferencing , VoIP forensics

Z. Khalid, F. Iqbal, **F. Kamoun**, L.A. Khan, B. Shah. Forensic investigation of Cisco WebEx desktop client, web and Android smartphone applications, Annals of Telecommunications, Springer. pp 1-26. 2022. **https://doi.org/10.1007/s12243-022-00919-6**

AKER: An open-source security platform integrating IDS and SIEM functions with encrypted traffic analytic capability

Amir Esseghir, **Faouzi Kamoun, Oussema Hraiech**

ABSTRACT:

This research proposes Aker, an open-source security platform that integrates IDS and SIEM functions while supporting the automated investigation of threats hidden in encrypted traffic. Aker is based on open-source technologies, whose aim is to simplify and integrate network monitoring and security alerts management through
coherent and interconnected dashboards. Aker enables the detection of malware concealed in encrypted traffic and uses a heuristic-based decision-tree model to classify these threats into different severity levels, based on seven specific criteria and indicators originating mainly from TLS handshake unencrypted metadata, and HTTP/ DNS contextual flows linked to the encrypted traffic. Our approach does not require deep packet inspection nor intensive traffic analysis, but rather relies on the analysis of a reduced set of network telemetry indicators and session descriptors. Aker permits to automate data collection and investigation while providing user-friendly dedicated dashboards to provide SOC analysts and threat intelligence experts with valuable decision support tools. We present the design and implementation aspects of the proposed platform along with some validation results.

Keywords: Security information and event management; SIEM; intrusion detection systems; IDS; encrypted traffic analytics; cybersecurity solutions; open source

A Esseghir, **F Kamoun**, **O. Hraiech**, AKER: An open-source security platform integrating IDS and SIEM functions with encrypted traffic analytic capability, Journal of Cyber Security Technology, Taylor & Francis. 6:1-2. DOI: 10.1080/23742917.2022.2058836, pp. 27-64, 2022.

A smart spontaneous crowd evacuation system for large multi-exit exhibition centers based on IoT

Faouzi Kamoun, May El Barachi, Fatna Belqasmi**, Abderrazak Hachani**

ABSTRACT:

Plans to mass evacuate visitors in an exhibition center in the case of emergency situations are critical for public safety and disaster management. Efficient crowd evacuation during mass gatherings has been an active research area during the past years. In this paper, we consider the challenging problem of finding in near real-time the most efficient and safest evacuation pathways in a multi-exit exhibition center while the fire hazard spreads. We first propose a system composed of sensor nodes to collect pertinent safety data associated with the changing environmental conditions. We then present a spontaneous dynamic evacuation system that considers the changing conditions in the risks associated with each hallway segment in terms of walking distance, heat, two major asphyxiant fire gases and crowd congestion. Our IoT-based system activates smart panels placed at major junctions of the hallways to visually guide evacuees towards the safest escape direction under the existing circumstances. The proposed algorithms aim to minimize the total evacuation time of all evacuees, while circumventing congested and perilous aisles, balancing traffic loads, and guaranteeing high scalability and reasonable computational efficiency. This work can pave the way towards the development of next generation smart exhibition centers, where crowd safety is among the top priorities**.**

Keywords: Evacuation system, crowd management, indoor navigation, smart exhibition center, fire evacuation, IoT

F Kamoun, M El Barachi, F Belqasmi, **A Hachani**. A smart spontaneous crowd evacuation system for large multi-exit exhibition centers based on IoT., International Journal of Ubiquitous Systems and Pervasive Networks 16 (2), pp. 55-62, 2022. **DOI:10.5383/JUSPN.16.02.001.**

Secure data outsourcing in presence of the inference problem: Issues and directions

Adel Jebali, Salma Sassi , Abderrazak Jemai

ABSTRACT:

With the emergence of cloud computing paradigms, secure data outsourcing has become one of the crucial challenges which strongly imposes itself. Data owners place their data among cloud service providers in order to increase flexibility, optimize storage, enhance data manipulation, and decrease processing time. Nevertheless, from a security point of view, access control is a major challenge in this situation seeing that the security policy of the data owner must be preserved when data is moved to the cloud. Nonetheless, the lack of a comprehensive and systematic review motivated us to construct this reviewing paper on this research problem. Here, we discuss current and emerging research on privacy and confidentiality concerns in data outsourcing and pinpoint potential issues that are still unresolved.

Keywords: Cloud computing, data outsourcing, access control, inference leakage, secrecy and privacy

Adel Jebali, Salma Sassi & Abderrazak Jemai (2021) Secure data outsourcing in presence of the inference problem: issues and directions, Journal of Information and Telecommunication, 5:1, 16-34, DOI:10.1080/24751839.2020.1819633.

Secure data outsourcing in presence of the inference problem: A graph-based approach

Adel Jebali, Salma Sassi, Abderrazak Jemai, Richard Chbeir

ABSTRACT:

In light of the emergence of Database-as-a-Service paradigm, secure data outsourcing has become one of the crucial challenges which strongly imposes itself. In such a scenario, access control is considered as a major challenge. In fact, access control policies of the data owner must be preserved when data is moved to the cloud. Here, we address this problem by considering inference leakage that could be produced by exploiting functional dependencies. The proposed approach is based on vertical partitioning to produce a set of secure sub-schemas stored in separated partitions in the distributed system. Then, we extend this approach by presenting a secure query processing model to preserve access control policies when querying data from distributed partitions. The effectiveness of our algorithms is confirmed through observations from a variety of conducted experiments.

Keywords: Access control**,** Inference control**,** Data dependencies, Distributed databases**,** Security and privacy

Adel Jebali, Salma Sassi, Abderrazak Jemai, Richard Chbeir, Secure data outsourcing in presence of the inference problem: A graph-based approach, Journal of Parallel and Distributed Computing, Volume 160, 2022, Pages 1-15, ISSN 0743-7315, https://doi.org/10.1016/j.jpdc.2021.09.006

HCQ: Hierarchical Cross-layer approach for QoS provisioning in WSN

Soumaya Argoubi, Karima Maalaoui, Leila Azouz Saidane

ABSTRACT:

Due to the constraints of wireless communications in general and wireless sensor networks in particular, the layered model is poor in mechanisms to support QoS (Quality of service) in such networks. However, the cross-layer model proposes different techniques and architectures allowing collaboration between layers to overcome the limitations of the layered model. In this context, we have proposed the HCQ (Hierarchical Cross-layer approach for QoS provisioning in WSN) model which uses a cross-layer architecture allowing the support of QoS in a monitoring application with different types of traffic. Indeed, our contribution involves three layers, namely, the application layer, the network layer, and the MAC (Medium Access Control) layer. Synchronization between the three layers is implemented allowing the same interpretation of the assigned priorities.

Keywords: Cross-layer, Service differentiation, MAC, Routing, QoS, Energy Delay, WSN

S. Argoubi, **K. Maalaoui** and L. A. Saidane, "HCQ: Hierarchical Cross-layer approach for QoS provisioning in WSN," 2022 International Wireless Communications and Mobile Computing (IWCMC), 2022, pp. 518-523, doi:10.1109/IWCMC55113.2022.9824793.

Studying the impact of learning situation on learner model

Asma Ayari, Mariem Chaabouni, Henda Ben Ghezala

ABSTRACT:

To reduce the spread of COVID-19 pandemic, educational institutions were closed in all countries. This closure deteriorated the level of all learners and resulted in a considerable disturbance of the education system. In this context, distance learning was the best solution. This paper reports the findings obtained Likert scale survey in April 2020 sent to learners and teachers at the Tunisian universities. In this survey, the interviewees were asked about their opinions concerning e-learning in the new situation resulting from covid19 crisis. After describing the existing learner models, we present the findings provided by examining the impact of the learning situation on the learner model. Learners and teachers were asked to capture four profile dimensions: interaction, involvement, motivation, and emotions during the COVID -19 health crisis. The analysis of the obtained results show that a new learning situation negatively influences the learner model, which proves the importance of considering the situational dimension in such a learner model.

Keywords: Learner model, learning situation, COVID-19, coronavirus pandemic

A. Ayari, M. **Chaabouni** and H. B. Ghezala, "Studying the impact of learning situation on learner model," 2022 IEEE Global Engineering Education Conference (EDUCON), 2022, pp. 757-762, doi: 10.1109/EDUCON52537.2022.9766518.

On the design and implementation of an on-board test bed system for V2V road hazard signaling

Fatma Outay, **Faouzi Kamoun, Anouar Chemek. Hichem Bargaoui,** Ansar Yasar

ABSTRACT:

This paper describes the design, implementation, and testing of an ITS-G5 prototype Road hazard Signaling (RHS) system that is inspired by the concept of crowdsourcing. Our approach enables drivers to interact with a touchscreen onboard interface to send ITS-G5 decentralized environmental notification messages (DENM) in order to warn nearby vehicles against the presence of a hazardous situation. These messages are analyzed, filtered for relevance, and presented to concerned drivers via the Onboard Units (OBUs) so that precautionary measures can be taken. We describe the design and implementation aspects of the proposed system and update the open source cargeo6 implementation of the ITS GeoNetworking protocol stack. We successfully implemented and validated the prototype system using an indoor testbed and carried various performance analysis experiments.

Keywords: Intelligent transportation systems; road hazard signaling; road safety; V2V applications; cooperative systems; enabling technologies.

F. Outay, **F. Kamoun**, **A. Chemek**, **H. Bargaoui**, Ansar Yasar. On the design and implementation of an on-board test bed system for V2V road hazard signaling, Procedia of Computer Science, Vol. 203. Elsevier. The 19th International Conference on Mobile Systems and Pervasive Computing (MobiSPC), August 9-11, 2022, Niagara Falls, Canada, pp. 119-126, 2022. https://doi.org/10.1016/j.procs.2022.07.017.

Forensic Analysis of the Cisco WebEx Application

Zainab Khalid, Farkhund Iqbal, **Faouzi Kamoun**, Mohammed Hussain, Liaqat Ali Khan

ABSTRACT:

The COVID-19 pandemic has triggered a surge in the usage of videoconferencing applications around the globe. While this trend provided a convenient alternative to face-to-face meetings, it has also opened the door for new scenarios of malicious attacks. The security and privacy of the (videoconference) participants' data has therefore become a major concern. Despite its importance, the forensic analysis of videoconferencing applications remains a relatively under researched area. This paper presents a detailed analysis of the Cisco WebEx videoconferencing application on a Windows OS in the areas of memory forensics, disk-space forensics, and network forensics. From the extracted artifacts, it is evident that valuable user data can be retrieved from different sources. These include user emails, user IDs, profile photos, sent and deleted chat messages, shared media, meeting information including meeting passwords, Advanced Encryption Standard (AES) keys, keyword searches, timestamps, and log files. Although network communications are encrypted, some useful artifacts can be retrieved such as IPs of server domains and host devices along with message/event timestamps. Digital certificate of the video conferencing communications is also retrieved.

Keywords: Teleconferencing, Pandemics, Forensics, Keyword search, Passwords, Media, Market research

Z Khalid, F Iqbal, **F Kamoun**, M Hussain, LA Khan. Forensic Analysis of the Cisco WebEx Application. 2021 5th Cyber Security in Networking Conference (CSNet), 90-97. 2021. Abu Dhabi, UAE. Doi:10.1109/CSNet52717.2021.961464.

Autism Spectrum Disorder (ASD) Detection Using Machine Learning Algorithms

Naouel Boughattas , Hanen Jabnoun

ABSTRACT:

Some diseases are characterized by persistent deficits in brain activity. Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder. It appears in early childhood and evolves throughout life and needs to be detected early to accelerate the treatment and recovery process. These deficits may be detected using medical imaging techniques. In this paper, we present machine learning algorithms allowing to detect peoples with ASD from normal peoples. We used data from the ABIDE dataset. We tested 3 algorithms: Support Vector Machines (SVM), Long Short-Term Memory (LSTM) and Convolutional Neural Network (CNN). The best result was obtained using CNN algorithm with an accuracy equal to 95%.

Keywords: Autism, Machine learning, CNN, LSTM, SVM, ABIDE, Fmri

Boughattas, N., **Jabnoun, H.** (2022). Autism Spectrum Disorder (ASD) Detection Using Machine Learning Algorithms. In: Aloulou, H., Abdulrazak, B., de Marassé-Enouf, A., Mokhtari, M. (eds) Participative Urban Health and Healthy Aging in the Age of AI. ICOST 2022. Lecture Notes in Computer Science, vol 13287. Springer, Cham. https://doi.org/10.1007/978-3-031-09593-1_18

Validation of No-linear Model of electrochemical impedance of a PEM fuel cell using the EIS Spectrum Analyzer

Mohamed Sélmene Ben Yahia

ABSTRACT:

In this research work we are interested in modeling the impedance of a PEM fuel cell. We used excerpts from experimental measurements proven by the actual stack. The battery used is the Ballard Power 50W. We have established a fuel cell model that describes the electrochemical phenomena by a complex impedance include all the parameters of the fuel cell. This model is given in the form of mathematical equations describing the non-linearity of the model. The frequency behavior of the impedance model of the fuel cell using the electrochemical impedance spectroscopy method. The frequency behavior is based on the Nyquist graph or the Bode diagram. In this work, we focused on the impedance spectrum found by the Nyquist diagram. We used the software "EIS Spectrum Analyzer" to visualize the influence of different electrochemical components such as resistors, capacitive, inductive and Warburg impedances in the frequency domain.

Keywords: Circuit impedance; PEM Fuel Cell; modelling; Electrochemical; parameters identification

M.S. Ben Yahia (2022). "Validation of No-linear Model of electrochemical impedance of a PEM fuel cell using the EIS Spectrum Analyzer". International Conference on Sciences of Electronic, Technologies of Information and Telecommunications (2022 IEEE SETIT), May 28-30, 2022.

Serious games in management to support the active construction of knowledge in engineering studies

Amira Kamel Inoubli, Dhouha Melliti Ben Khedher

ABSTRACT:

University education has always sought to be in tune with generational and employability characteristics. Indeed, in recent years, the learner, overwhelmed by technological change, has continued to show quite different concerns and relationships to education. They find it difficult to stay focused and receptive for hours on end, especially when knowledge is conveyed in a frontal and purely theoretical manner. To address these issues, we have opted for an active pedagogy approach through "gamification" specifically in the teaching of management to engineering students. This paper seeks to describe the adoption of "Memoboost Game" and "World Cafe Strategy", serious games for engineering courses in Computer Science, Electromechanics and Civil Engineering at ESPRIT (High school of Engineering and Technology). The aim of these games is to help engineering students to understand the analysis of the business environment and its strategic orientations in order to better understand their professional careers. Based on a peer-learning approach, these games have led to the analytical aspect of the learners towards a better collective construction of knowledge. They were successfully used in the framework of a business environment course aimed, as already mentioned, at a population of engineering students with no prerequisites in the field of management. This experimentation showed that the learning process was accelerated. This article presents the process of these games, the experimentation that was carried out and the results achieved.

Keywords: Knowledge engineering, Analytical models, Visualization, Engineering profession, Sociology, Games, Serious games.

K. Inoubli and **D. M. B. Khedher**, "Serious games in management to support the active construction of knowledge in engineering studies," 2022 IEEE Global Engineering Education Conference (EDUCON), 2022, pp. 628-633, doi: 10.1109/EDUCON52537.2022.9766664.

Reform of active pedagogy in the age of Covid

Faten Ziadi, Naouel Boughattas, Wissal Neji

ABSTRACT:

With the dramatic emergence of the Covid-19 Virus, teachers in schools and universities have been challenged to move from face-to-face to distance learning. This required an update on the materials and the workflow to adapt the teaching approach to the online context and ensure the learning quality. In this work, we will present the adopted approach in a particular course which is procedural programming, a course given for the first-year engineering students at our engineering school. We use two pedagogical approaches for teaching this course: the flipped classroom and the problem-based learning (PBL). The challenge was how to assure team working and provide the same coaching quality, facilitating, problem solving, group management and so on using the same teaching load. Major changes have been made to the current approach, including scripting sessions and teams' coaching. A pedagogical scenario has been developed to enable coaching via video conferences while keeping the active aspect. Students work on their problem situation through collaborative tools and in the virtual presence of their coach. An e-learning platform has been adopted to allow asynchronous interactions. Our reform also affected the length of sessions, assessment and the types of teaching materials used to substitute physical presence in a classroom and the use of a blackboard.

Keywords: COVID-19, Computer aided instruction, Electronic learning, Education, Teamwork, Online services, Problem-solving

F. Ziadi, **N. Boughattas** and **W. Neji**, "Reform of active pedagogy in the age of Covid," 2022 IEEE Global Engineering Education Conference (EDUCON), 2022, pp. 634-639, doi:10.1109/EDUCON52537.2022.9766780.

Enhanced Fuzzy logic-based Cluster Stability in Vehicular ad hoc Network

Mohamed Aissa, **Badia Bouhdid**, Adel Ben Mnaouer

ABSTRACT:

Vehicular ad hoc network (VANET) nodes are characterized by their high mobility and by exhibiting different mobility patterns. Therefore, VANET clustering schemes are required to account for the mobility parameters among neighboring nodes to produce relatively stable clustering schemes. In this article, we propose a novel cluster-head (CH) selection scheme for VANETs. This scheme is based on a fuzzy logic-powered, k-hop distributed clustering algorithm. It deals efficiently with scalability and stability issues of VANETs and is able to achieve highly stable clustering topologies as compared with other schemes. Our proposed clustering scheme strives to maintain a safe intervehicle distance as a one prime metric for CH selection. Moreover, a major contribution of our work is the proposal of a novel strategy for constructing fuzzy logic-based clustering algorithms useful for VANETs. This proposed solution is useful in an Internet of things-based setting that involves controlled vehicle-to-vehicle communication. We first derive mathematically, a new average distance estimation formula that is used as a metric for selecting CHs, leading to safer clusters that avoid collisions with front and rear vehicles. Furthermore, the new proposed scheme creates stable clusters by reducing re-clustering overhead and prolonging clusters' lifetimes. We propose a clustering scheme for VANETs that considers the safe inheritance between vehicles as one of important metrics for cluster head selection. We present a new strategy for constructing fuzzy clustering algorithms in VANETs. We first derive mathematically a new average distance estimation scheme that is used as metric to select cluster heads which provide safe clusters. This contributes to avoiding collisions and creating stable clusters by reducing replastering overhead and prolonging cluster lifetime.

Keywords: Measurement, Computers, Network topology, Scalability, Computational modeling, Vehicular ad hoc networks, Clustering algorithms

M. Aissa, **B. Bouhdid** and A. B. Mnaouer, "Enhanced Fuzzy logic-based Cluster Stability in Vehicular ad hoc Network," 2021 International Symposium on Networks, Computers and Communications (ISNCC), 2021, pp.1-6, https://doi: 10.1109/ISNCC52172.2021.9615872.

Supervisory control design for a PEM fuel cell electric vehicle

Wahib Andari, Samir Ghozzi, **Mohamed Sélmene Ben Yahia**, Hatem Allagui, Abdelkader Mami

ABSTRACT:

This paper proposes an energy management strategy for an electrical hybrid vehicle which is composed of a Proton exchange membrane (PEM) fuel cell and a supercapacitor storage device. In this paper, the mathematical model for the proposed driving chain, comprising the PEM Fuel Cell, boost converter, inverter, and vehicular structure, was modeled in MATLAB/Simulink. The proposed algorithm is evaluated for the Highway Fuel Economy Test (HWFET) driving cycle. The obtained results demonstrate the effectiveness of the proposed energy management strategy in reduction of the hydrogen consumption.

Keywords: Road transportation, Protons, Renewable energy sources, Hydrogen, Fuel cells, Supercapacitors, Supervisory control

W. Andari, S. Ghozzi, **M. S. Ben Yahia**, H. Allagui and A. Mami, "Supervisory control design for a PEM fuel cell electric vehicle," 2021 12th International Renewable Energy Congress (IREC), 2021, pp. 1-5, doi: 10.1109/IREC52758.2021.9624829.

Hybrid Biogeography-Based Optimization Algorithm for Job Shop Scheduling Problem with Time Lags and Single Transport Robot

Madiha Harrabi, Olfa Belkahla Driss, **Khaled Ghedira**

ABSTRACT:

We are interesting for the Job shop Scheduling Problem with Time Lags and Single Transport Robot (JSPTL-STR). This problem is a new extension of the Job shop Scheduling Problem, in which, we consider two additional constraints; the minimum and maximum time lags constraints between finish and start time of two operations and transportation time constraints of different operations between different machines using a single robot. After the completion of an operation on a machine, it needs to be transported using transport robot to the next machine taking some time. The objective is to determine a feasible schedule of machine operations and transport operations with minimal make span (Completion time of the last operation executed). This problem belongs to a category of problems known as NP-hard problem. Biogeography-Based Optimization (BBO) algorithm is an evolutionary algorithm inspired by the migration of species between habitats. It has successfully solved optimization problems in many different domains and has demonstrated excellent performance. To assess the performance of the proposed algorithm, a series of experiments on new proposed benchmark instances for JSPTL-STR are performed.

Keywords: Optimization Scheduling, Job shop, Time lags

Harrabi, M., Driss, O.B., **Ghedira, K.** (2021). Hybrid Biogeography-Based Optimization Algorithm for Job Shop Scheduling Problem with Time Lags and Single Transport Robot. In: Wojtkiewicz, K., Treur, J., Pimenidis, E., Maleszka, M. (eds) Advances in Computational Collective Intelligence. ICCCI 2021. Communications in Computer and Information Science, vol 1463. Springer, Cham.
https://doi.org/10.1007/978-3-030-88113-9_7

Improved Chemical Reaction Optimization for Distributed Flexible Job Shop Problem with Transportation Times

Bilel Marzouki, Olfa Belkahla-Driss, **Khaled Ghedira**

ABSTRACT:

In this paper, we study a new variant of the Distributed Flexible Job shop Scheduling Problem introducing transportation time between machines as additional constraints. The problem is called Distributed Flexible Job shop Scheduling Problem with Transportation times and denoted by DFJSPT. In DFJSPT, each operation can be executed on one of the available machines in a set of geographically distributed factories. Each factory has a set of machines on which a set of jobs must be executed and the transport of jobs between machines is made by one or several transport robots. The DFJSPT combines three NP-Hard problems: The problem of assigning jobs to machines, the distribution problem of jobs to factories, and the robot routing problem. In this paper, we study the DFJSPT with a single robot in each factory and we propose an improved Chemical Reaction Optimization (CRO) metaheuristic to solve it in order to minimize the makespan to which we have made improvements in the classic CRO optimization phases in our algorithm. This phase consists of four functions: The crossover-Synthesis function, where we applied one point crossover known operator for the synthesis function, The mutation-OnWall function, where we applied the swap technique, The decomposition function, where we used the inversion mutation technique in this function and the Inter-Molecular, where we applied the two point crossover operator. We tested our approach on two different categories of instances that we designed on purpose, the first category is composed of instances of flexible job shop scheduling problem with transportation times to which we have integrated the constraints of jobs distribution between factories, the second category is composed of instances of distributed and flexible job shop scheduling problem to which we have integrated the constraints of Transportation times.

Keywords: Scheduling, Production planning and scheduling, Heuristic and Metaheuristics.

Marzouki, Bilel, Belkahla-Driss, **Ghedira, Khaled**. (2022). Improved Chemical Reaction Optimization for Distributed Flexible Job Shop Problem with Transportation Times, 10th IFAC Conference on Manufacturing Modelling, Management and Control, June 22-24, 2022, Nantes, France.
https://www.sciopen.com/article_pdf/1546694674261557250.pdf

EFL Future Engineers' Language Anxiety: Final Project Presentations and Oral Examinations

Thameur Cherni, Badreddine Charni

ABSTRACT:

For many years, undergraduate students' foreign language anxiety (FLA) has been investigated. These students have experienced different levels of FLA due to several variables leading them to feel anxious during final summative examinations. In this context, several EFL future engineers show anxiety when performing classroom final project presentations and oral examinations at ESPRIT, School of Engineering, Tunisia. Despite the significance of FLA for research and researching, few studies missed the correlation between anxiety and final oral assessments in Tunisian academic settings. Thus, the researchers in this study were interested in reviewing the factors and causes of anxiety as experienced by EFL students so that the right strategies can be implemented.
This study collected data from 129 participants of both electromechanical and civil PUPIL: International Journal of Teaching, Education and Learning ISSN 2457-0648 233 engineering second-year students through an adapted version of the Foreign Language Classroom Anxiety Scale (FLCAS) developed by Horwitz, et al. (1986). The results show eight factors and six causes impeding undergraduate students from speaking their minds orally. It follows some implications for language teaching are offered to reduce EFL Future Engineers' English Language Anxiety while performing Final Project Presentations and Oral Examinations.

Keywords: Anxiety, Foreign Language Anxiety, Second-year students, Factors, Causes, Oral Performances.

Cherni, T. & **Cherni**, B. (2022). EFL Future Engineers' Language Anxiety: Final Project Presentations and Oral Examinations. PUPIL: International Journal of Teaching, Education and Learning, 6(1), 232-252.

Towards a Personalized Web Services Composition Approach

Sarra Abidi, Fathia Bettaher and Myriam Fakhri

ABSTRACT:

Generally available Web Services (WS) cannot meet the complex needs of users and their adaptation to the environment remains a major problem for the design of information systems. The web services composition comes to address the satisfaction of new and complex needs such as the process we find in most organizations. Its purpose is to perform several services to meet user demand. The satisfaction of a user needs a dynamic and reusable environment to meet those needs. In this context, the user interactions are essential. From there, in this work, we define two objectives: i) propose a service composition approach that allows dynamic services composition, and its purpose is to meet a need. ii) Propose a personalization approach for Web services composition which allows the reuse of services while adopting for the context of each user. Our approach is based on the use of ontologies and user profile.

Keywords: Web services composition, personalization, ontologies, user profile

Sarra Abidi, Fathia Bettaher and Myriam Fakhri, Towards a Personalized Web Services Composition Approach, In: Information Systems, Kazuyuki Matsumoto (Ed.), July 21, 2021. Pp. 1-16. DOI: 10.5772/intechopen.97813

Comparing Mixed-Integer Programming and Constraint Programming Models for the Hybrid Flow Shop Scheduling Problem with Dedicated Machines

Asma Ouled Bedhief

ABSTRACT:

The paper considers a two-stage hybrid flow shop scheduling problem with dedicated machines and release dates. Each job must be first processed on the single machine of stage 1, and then, the job is processed on one of the two dedicated machines of stage 2, depending on its type. Moreover, the jobs are available for processing at their respective release dates. Our goal is to obtain a schedule that minimizes the make span. This problem is strongly NP-hard. In this paper, two mathematical models are developed for the problem: a mixed-integer programming model and a constraint programming model. The performance of these two models is compared on different problem configurations. And the results show that the constraint programming outperforms the mixed-integer programming in finding optimal solutions for large problem sizes (450 jobs) with very reasonable computing times.

Keywords: Hybrid flow shop scheduling, dedicated machines, mixed-integer programming, constraint programming, Cplex, CP optimizer

Asma Ouled Bedhief, Comparing Mixed-Integer Programming and Constraint Programming Models for the Hybrid Flow Shop Scheduling Problem with Dedicated Machines, Journal Européen des Systèmes Automatisés Vol. 54, No. 4,2021, pp. 591-597.

Improved filter design in internal model control: application to hybrid feed drive mechatronic system

Nahla Touati, Imen Saidi and Dhaou Soudani

ABSTRACT:

In this paper, the internal model control (IMC) is proposed for over actuated systems for high frequency bands. To deal with redundancy, the method of virtual outputs is considered to square the system and design the controller obtained by a specific inversion technique. An improved low-pass filter is then inserted in the IMC structure in order to attenuate the sensitivity of the controller, improve the system performance and the robustness of the structure towards disturbances and uncertainties. The proposed filter design aims to increase the bandwidth of the system. Furthermore, to evaluate its efficiency, an application to control a mechanical linear system, namely hybrid feed drive system, is described. The obtained simulation results are shown to be satisfactory by considering a series of different scenarios.

Keywords: IMC; internal model control; over actuated system; virtual outputs; hybrid feed drive; low-pass filter; robustness.

Nahla Touati, Imen Saidi and Dhaou Soudani, Improved filter design in internal model control: application to hybrid feed drive mechatronic system, International Journal of Intelligent Engineering Informatics Vol. 9, No. 6, Inderscience, 2022.

A Systematic Design methodology for a single-phase transfer delay based PLL operating under distorted grid voltages

Meriem Merai, Mohamed Wissem Naouar , Ahmad Ammar Naasani , Eric Monmasson

ABSTRACT:

Standard Transfer Delay based Phase-Locked Loop (TD-PLL) is a simple and popular grid synchronization method used for the control of single phase Grid connected Converters (GcCs). The main drawback of the TD-PLL is that it is affected by the harmonics of the line voltage, which lead to a double-line frequency error in the estimated grid voltage phase. To tackle this problem, this paper presents a systematic TDPLL design methodology that allows cancellation of the double-line frequency in the estimated grid voltage phase, even when the measured grid voltage is highly distorted. Numerous results were presented and discussed to show the effectiveness of the proposed design methodology.

Keywords: Transfer delay, PLL, Harmonics, grid synchronization

M. Merai, M.W. Naouar, A.A. Naassani, I. and E. Monmasson “A Systematic Design methodology for a single-phase transfer delay based PLL operating under distorted grid voltages”, ELECTRIMACS Conf., Nancy, France, Mai 2022.

Control approach for a class of hybrid systems

Sonia Batis, Hassane Alla

ABSTRACT :

A control synthesis approach is proposed for hybrid systems modeled with rectangular hybrid automata. After adding the desired control specifications (constraints) to the automaton transition guard, the control purpose is to establish in a maximal permissive way the transitions that respect those constraints. The approach is illustrated via a traffic section system.

Keywords: Hybrid systems; Rectangular Hybrid Automata; Reachable State Spaces; Maximal Permissive Control; Forward Analysis

S. Batis and H. Alla, "Control approach for a class of hybrid systems," 2021 International Conference on Control, Automation and Diagnosis (ICCAD), 2021, pp. 1-8, doi:10.1109/ICCAD52417.2021.9638753.

Design and Implementation of an Embedded Vision System for Industrial Inspection

Intissar Sayahi, Sarra Ismail

ABSTRACT:

Nowadays, the advantages offered by image processing and deep learning increased their efficiency popularity. Thus, vision systems are widely motivating researchers to develop new protocols and features to optimize existing ones. Of course, technical challenges do not lack since the integration of image acquisition and processing unit's industrial environment poses considerable problems. In context, we adopted in our work the hybrid approach combining hardware design and software development. This approach makes the system compact, robust, and reliable, especially in industrial field to ensure several operations quality inspection and verification. The proposed solution is to design an industrial embedded vision system that matches scalable hardware architectures to adaptable algorithms. this paper, we propose an efficient model to automate quality control in an industrial production line. This work aims to integrate the concept of the multi-tasking image processing in the manufacturing field by offering a whole pack of various inspection operations, from surface to dimensional inspections, based on simple hardware implementations, optical setups, and deep learning algorithms.

Keywords: image processing, deep learning, inspection, quality, database, python, Industrial vision system

I. Sayahi and **S. Ismail**. (2022). "Design and Implementation of an Embedded Vision System for Industrial Inspection," 2022 IEEE 9th International Conference on Sciences of Electronics, Technologies of Information and Telecommunications (SETIT), 2022, pp. 567-572, doi: 10.1109/SETIT54465.2022.9875471.

How to improve pedagogy through the use of tools?

Maher Mkhinini, Intissar Sayahi, Thameur Cherni

ABSTRACT:

Through this work I will explain how to use survey tools conducted within an engineering educational institution to improve the performance of teaching, reform its education and advance learning. Similarly, we will exploit a survey work done outside the school "extra school" in order to acquire useful information in a quantitative and qualitative way. According to the results and the sampling carried out on a wide industry sector. We will proceed to a reform of the study plan.

Keywords: Teaching practice, teaching, learning, performance, enhancing tools

Maher MKHININI, **Intissar SAYAHI**, **Thameur CHERNI**. (2022). "How to improve pedagogy through the use of tools?". International conference on pedagogical innovation. July 20, 21 and 22 2022, Sousse -Tunisia.

Design of a Modular System for Measurement of Ambient Environmental Parameters "MSMAEP" for indoor environment quality assessment

Mehdi Hadj Sassi; Asma Karoui; Mounir Ayadi; Isam Shahrour

ABSTRACT:

Nowadays the conditions of interior comfort in a workspace have become a serious matter. On the one hand by the owner of the space but above all for his occupants. The question of working conditions takes, now, into counts indoor environmental quality (IEQ). This the question of interior comfort conditions also arises in the field of higher education. Indeed, the teaching conditions differs from one method to another, meaning that the configuration of a classroom, the student's number and dispatching varies depending on the method used to teach [1]. The main goal of our work is to express and define the comfort in a classroom, depending on the occupant activity, using infield measurement and occupant feedback. This will lead us to know if the local regulation regarding the comfort is in adequation with the real perception of comfort. To achieve that assessment, the IoT played a major role. This study consists of the measurement of various parameters relative to comfort conditions in a classroom, measurement of temperature, humidity, air quality and variations in lighting. Several connected measurement modules devices have been implemented in order to be able to carry out our study. Several scenarios are considered, such as the state of lighting, ventilation of the rooms. The outcome of this work will give us a tool allowing us to assess the comfort in different classroom.

Keywords: Temperature measurement, Humidity measurement, Education, Lighting, Ventilation, Regulation, Real-time systems

M. H. Sassi, **A. Karoui**, M. Ayadi and I. Shahrour, "Design of a Modular System for Measurement of Ambient Environmental Parameters "MSMAEP" for indoor environment quality assessment," 2021 IEEE 2nd International Conference on Signal, Control and Communication (SCC), 2021, pp. 246-251, doi:10.1109/SCC53769.2021.9768355.

Control of an Autonomous Surface Vehicle with Variable Load by Predictive Control

Maher MKHININI, Intissar SAYAHI, Ikram Maaoui Ben Hassine

ABSTRACT:

In the field of marine environment protection, the clean-up of polluted areas is increasingly a difficult task. Indeed, the exhaustive exploitation of this environment, in particular oil exploitation, drilling platforms or waste resulting from the intentional or accidental dumping of rubbish in the sea by man, has only increased the rate of pollution of these environments. Consequently, getting rid of this waste and hydrocarbons has become a complicated, costly and time-consuming operation. This is the context of the Sea-neT project, which aims to offer e-capable, flexible and inexpensive solutions for the de-pollution of aquatic areas, particularly for sheltered areas (coasts, ports, rivers, canals, lakes, etc.). As the carrier of this project, the company IADYS has set up the Jellyfishbot, a small remotely operated clean-up robot that collects macro-waste and hydrocarbons. In order to improve the performance of this robot and to automate it in an intelligent and predictive way . This work is carried out in the framework of an ESPRIT end-of-study project in collaboration with the Laboratoire d'Analyse, de Conception et de Commande des Systèmes (LACS) at ENIT and Laboratoire d'Informatique, de Robotique et de Micro-électronique de Montpellier (LIRMM)..

Keywords: Predictive control, dynamic system, water zone Robot

Maher Mkhinini, Intissar Sayahi, Ikram Maaoui Ben Hassine, Control of an Autonomous Surface Vehicle with Variable Load by Predictive Control, the 2022 International Conference on Information Technology & Smart Industrial Systems, Paris, France, July 15 – 17, 2022, pp. 1-6.

Estimation of the parameters of a Wishart extension on symmetric matrices

Emna Ghorbel, Kaouthar Kammoun, Mahdi Louati, Akram Sallem

ABSTRACT:

This paper deals with the parameters of a natural extension of the Wishart distribution, that is the Reisz distribution on the space of symmetric matrices. We estimate the shape parameter using two different approaches. The first one is based on the method of moments; we give its expression and investigate some of its properties. The second represents the maximum likelihood estimator. Unfortunately, in this case we do not have an explicit formula for this estimator. This latter is expressed in terms of the digamma function and sample mean of log-gamma variables. However, we derive the strong consistency and asymptotic normality properties of this estimator. A numerical comparative study between the two estimators is carried out in order to test the performance of the proposed approaches. For the second parameter, that is the scale parameter, we prove that the distribution of the maximum likelihood estimator given by Kammoun et al. (J Statist Prob Lett 126:127–131, 2017) is related to the Reisz distribution. We examine some properties concerning this estimator and we assess its performance by a numerical study.

Keywords: Cholesky decomposition, Digamma function, Maximum likelihood estimator , Mean Squared Error, Method of moments , Riesz distribution

Emna Ghorbel, Kaouthar Kammoun, Mahdi Louati, Akram Sallem. (2022). Estimation of the parameters of a Wishart extension on symmetric matrices, Journal of the Korean Statistical Society. https://doi.org/10.1007/s42952-022-00176-2

Inverse-probability-weighted log rank test for stratified survival data with missing measurements

Rim Ben Elouefi, Foued Saâdaoui

ABSTRACT:

The stratified log rank test can be used to compare survival distributions of several groups of patients, while adjusting for the effect of some discrete variable that may be predictive of the survival outcome. In practice, it can happen that this discrete variable is missing for some patients. An inverse-probability-weighted version of the stratified log rank statistic is introduced to tackle this issue. Its asymptotic distribution is derived under the null hypothesis of equality of the survival distributions. A simulation study is conducted to assess behavior of the proposed test statistic in finite samples. An analysis of a medical dataset illustrates the methodology.

Keywords: Inverse-probability-weighting, logrank test, medical application, simulation, statistical mathematics

Ben Elouefi, R., & Saâdaoui, F. (2022). Inverse-probability-weighted log rank test for stratified survival data with missing measurements. Statistical Neerlandica, 1– 17. https://doi.org/10.1111/stan.12276

Stability estimates for an inverse problem of a hyperbolic heat equation from boundary measurement

Aymen Jbalia

ABSTRACT

We are concerned with an inverse problem arising in thermal imaging in a bounded domain $\subset Rn$, n = 2, 3. This inverse problem consists in the determination of the heat exchange coefficient q(x) appearing in the boundary of a hyperbolic heat equation with Robin boundary condition. A double logarithmic stability estimate is developed.

Keywords: Inverse problem, Hyperbolic heat equation, Robin boundary condition , Double logarithmic stability estimate

Jbalia, A. Stability estimate for an inverse problem of a hyperbolic heat equation from boundary measurement. Indian J Pure Appl Math (2022). https://doi.org/10.1007/s13226-022-00247-4.

Modeling tropospheric ozone and particulate matter in Tunis, Tunisia using generalized additive model

Zouhour Hammouda, Leila Hedhili Zaier and Nadège Blond

ABSTRACT:

The main purpose of this paper is to analyze the sensitivity of tropospheric ozone and particulate matter concentrations to changes in local scale meteorology with the aid of meteorological variables (wind speed, wind direction, relative humidity, solar radiation, and temperature) and intensity of traffic using hourly concentration of NO_X, which are measured in three different locations in Tunis, (i.e., Gazela, Mannouba and Bab Aliwa). In order to quantify the impact of meteorological conditions and precursor concentrations on air pollution, a general model was developed where the logarithm of the hourly concentrations of O_3 and PM_{10} were modeled as a sum of non-linear functions using the framework of Generalized Additive Models (GAMs). Partial effects of each predictor is presented. We obtain a good fit with R^2 = 85% for the response variable O_3 at Bab Aliwa station. Results show the aggregate impact of meteorological variables in the models explained 29% of the variance in PM_{10} and 41% in O_3. This indicates that local meteorological condition is an active driver of air quality in Tunis. The time variables (hour of the day, day of the week and month) also have an effect. This is especially true for the time variable "month" that contributes significantly to the description of the study area.

Keywords: Air pollution, Particulate Matter, Tropospheric Ozone, GAM, meteorology, traffic

Hammouda, Zouhour, Zaier, Leila Hedhili, & Blond, Nadège. (2021). Modeling tropospheric ozone and particulate matter in Tunis, Tunisia using generalized additive model. Clean Air Journal, 31(2), 1-16. https://dx.doi.org/10.17159/caj/2021/31/2.8880

A probabilistic numerical method for a class of mean field games, Stochastics and Dynamics

Sahar Ben Aziz and Salwa Toumi

ABSTRACT:

The Mean Field Games PDEs system is at the heart of the Mean Field Games theory initiated by [J.-M. Lasry and P.-L. Lions, Jeux à champ moyen. I–le cas stationnaire, *C. R. Math.* **343** (2006) 619–625 ; J.-M. Lasry and P.-L. Lions, Jeux à champ moyen. II–horizon fini et control optimal, *C. R. Math.* **343** (2006) 679–684; J.-M. Lasry and P.-L. Lions, Mean field games, *Jpn. J. Math.* **2** (2007) 229–260] which constitutes a seminal contribution to the modeling and analysis of games with a large number of players. We propose here a numerical method of resolution of such systems based on the construction of a discrete mean field game where the controlled state-variable is a Markov chain approximating the controlled stochastic differential equation [H. Kushner and P. G. Dupuis, *Numerical Methods for Stochastic Control Problems in Continuous Time*, Stochastic Modeling and Applied Probability, Vol. 24 (Springer Science & Business Media, 2013)]. In particular, existence and uniqueness properties of the discrete MFG are investigated with convergence results under adequate assumptions.

Keywords: Mean field games, Markov chain approximation, numerical methods

Ben Aziza Sahar and Toumi Salwa, A probabilistic numerical method for a class of mean field games, Stochastics and Dynamics, Vol. 22, No. 04, 2250008 (2022).
https://doi.org/10.1142/S0219493722500083.

Note on The Multifractal Formalism of Covering Number on The Galton-Watson Tree

Najmedine Attia, **Meriem Ben Hadj Khalifa**

ABSTRACT:

We consider, for t in the boundary of Galton-Watson tree (∂T), the covering number Nn(t) by cylinder of generation n. For a suitable set I and a sequence (sn,γ), we establish almost surely, and uniformly on γ, the Hausdorff and packing dimensions of the set $\{t \in \partial T : N_n(t) - nb \sim s_{n,\gamma}\}$ for $b \in I$

Keywords: Random covering, Hausdorff dimension, indexed martingale, GaltonWatson tree.

Najmedine Attia, **Meriem Ben Hadj Khalifa**. (2021). Note on The Multifractal Formalism of Covering Number on The Galton-Watson Tree, Kragujevac Journal of Mathematics Volume 49(1), Pages 43–60. https://arxiv.org/abs/2210.01092

On shifting the principal eigenvalue of Dirichlet problem to infinity with non-transversal incompressible drift

Brice Franke, Damak Mondher, Nassim Athmouni, **Nejib Yaakoubi**

ABSTRACT:

We prove that it is always possible to add some divergence free drift vector eld to some spherical Dirichlet problem, such that the resulting principal eigenvalue lies above a prescribed bound. The drift vector eld can be chosen to vanish on the boundary and such that its ow lines always keep some distance to the boundary.

Keywords: Comparison measure, principal eigenvalue , non-self adjoint generator, Faber-Krahn type inequality.

Brice Franke, Damak Mondher, Nassim Athmouni, **Nejib Yaakoubi**. On shifting the principal eigenvalue of Dirichlet problem to infinity with non-transversal incompressible drift. 2021. ffhal-03502864. https://hal.archives-ouvertes.fr/hal-03502864

Unsupervised Learning Diversification Applied on the Tunisian Stock Market Before and During the Covid-19 Crisis

Ahmed Rebai, Louay Boukhris, **Lotfi Ncib , Mohamed Anis Ben Lasmer**

ABSTRACT:

Financial data, related to companies listed on the Tunisian stock exchange, were collected, and analyzed according to the methodology applied in machine learning on over 2 different time periods. A particular interest was focused on the periods before and during the COVID-19 crisis. The results obtained in this article show, on the one hand, that an empirical diversification based on unsupervised learning algorithms is possible and on the other hand, a good coherence with the corporates financial state in Tunisia. This article shows, for instance, that the kmeans algorithm makes it possible to segment companies according to several criteria and to discover the aberrant behavior of certain companies with an abnormal financial situation. These results were confirmed by other outlier detection algorithms.

Keywords: Unsupervised learning, Stock market, Finance, CAPM (Capital Asset Pricing Model), Machine learning, Asset management

Rebai, L. Boukhris, **L. Ncib** and **M.-A. Ben Lasmar** (2021). "Unsupervised Learning Diversification Applied on the Tunisian Stock Market Before and During the Covid-19 Crisis" International Journal of Management Research and Economics.
https://doi.org/10.51483/IJMRE.1.4.2021.24-47

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