11th International Conference on Energy and City of the Future,
Les Mureaux, France, 21-22 November 2024

EVF'2024

Book of Abstracts

VENUE
CHIMM - Centre Hospitalier Intercommunal Meulan les Mureaux,
1 Rue Baptiste Marcet
78130 Les Mureaux

Contents

About EVF Conference Series

The EVF Series « Energy and City of the Future » EVF' was created by ECAM-EPMI (Cergy-Pontoise, France), University of Lorraine (France) and Queens University (Canada).

EVF conferences aim to bring together academic researchers, industrial, scientists and city political actors to exchange their experiences and research results about all aspects (historical, societal, environmental, conceptual, methodological, practices ...) dealing with the Energy and the City of the Future. The previous editions were organized in Cergy-Pontoise France (2014); Tetouan Morrocco (2015); Kingston Canada (2016); Longwy France (2017); Fès Morrocco (2018); Pune India (2019), Remote (2020), Cergy-Pontoise France (2021), El Jadida Morocco (2022), Nouakchott Mauritania (2023).

How could one not have the city of tomorrow in one's mind and in particular in this period which has faced several singular episodes.

IPCC reports are bringing more and more new elements about the urgency of the climate situation which has become perceptible beyond scientific experience and its fine and evolving sensors. Animals with their sensitive sensors have already perceived certain changes in advance of mankind. Man is able today to perceive abnormal changes in a reduced life cycle, which underlines how close the danger has become.

The other element being the pandemic which has affected the whole planet and is forcing ordinary citizens to think about the future of the Life "VIE" and the City "VILLE". Reversed migrations from the city to the countryside, for example, have been observed following the progressive and repetitive confinements in different countries.

In this context, the topic of the City of the future, already topical, has been legitimized by decision-makers as well as by modern-day thinkers. Previous editions have also allowed a serious scientific foundation in both French-speaking (France, Morocco editions) and English-speaking (Canada, India editions) countries

EVF Series Chairs and Committees

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Mohamed Said Mohamed SIDIYA (Université de Nouakchott Al Aasriya, Mauritanie).

Aouatif SAAD (Ibn Tofaïl University, Kénitra, Maro).

Imad TAWFIQ (ISAE-Supméca, France).

EVF'2024 Program

Thursday November 21, 2024

8h00 Reception and welcome coffee on CHIMM site

9h00 Opening ceremony

Words and speeches from Chairs and organizers
Dominique TURPIN (President SenergyLab)
François GARAY (Maire des Mureaux)
Sébastien KRAÜTH (CHIMM)
Ikram DARCHERIF (Directrice Générale ECAM-EPMI)
Mohamed EL GANAOUI (Professeur Université de Lorraine)

Round table

Synergies entre les mondes académiques, institutionnels et industriels : partenariats et attentes des territoires
Synergies between the academic, institutional and industrial worlds: partnerships and expectations of territories
Participants : Marie-Gabrielle MERY, Dominique TURPIN, François GARAY, Ikram DARCHERIF, Mohammed EL GANAOUI, Rafik ABSI

10h30 Invited Plenary Conference

Geoffrey LEVERMORE (*Nobel price and EVF Series Godfather)*
Emeritus Prof, University of Manchester, UK
Climate change and the urban heat island

Professor Geoff Levermore, Nobel price and EVF Series Godfather

Plenary Conferences

11h10 Kamil GRECKI
Founder at Archiverse.io, Poland
Digital twin and technology in AEC industry
Paper 37 : TH7 - Factories of the futur

11h50 Nidam ABDI
Territorial Challenges, Les Mesnuls, France
Bonnes pratiques mondiales en matière de transitions numériques et énergétiques des territoires
Paper 30 : TH1 - City and buildings of the future

12h30 – 14h00 : Lunch break and Posters

14h00 Special Session and Round Table

Energie Solaire photovoltaïque ; Autoconsommation collective
Photovoltaic Solar Energy; Collective self-consumption

Plenary Conferences

- Pierre-Olivier LOGERAIS ; Paper 41; TH2 : Energy and management
  Univ Paris Est Créteil, CERTES, IUT de Sénart-Fontainebleau, Lieusaint, France
  Durabilité des centrales photovoltaïques en milieux désertiques : de la conception aux stratégies de maintenance

- Djaffar OULD ABDESLAM ; TH2 : Energy and management
  Université de Haute Alsace, IUT de Mulhouse, Institut IRIMAS, Mulhouse, France
  L'IA au service de la gestion de l'énergie. Le cas du projet INTERREG ASIMUTE : Autoconsommation Intelligente de l'Energie

Round Table

Autoconsommation collective : cas de l'énergie solaire photovoltaïque en milieu urbain
Collective self-consumption: the case of photovoltaic solar energy in an urban environment
PART'Ener, PART'Extern & MASTERPIECE
Participants : Patrice AUCLAIR, Philippe GOUT, Marc FLEURY, Djaffar OULD ABDESLAM, Pierre-Olivier LOGERAIS, Marie-Gabrielle MERY, Rafik ABSI

Session 1A

15h30 Oral presentation ; Paper 43 ; TH1 - City and buildings of the future ;
Wendong LI, Mourad RAHIM, Mohammed EL GANAOUI, Rachid BENNACER ;
Optimizing Building Envelope Performance through the Dynamic Integration of Phase Change Materials
University of Lorraine & ENS Paris Saclay, France

15h50 Oral presentation ; Paper 6 ; TH2 - Energy and management ;
Maïssa LAKEHAL AYAT, Abla CHAKER & Rafik ABSI ;
Validation of the numerical model of a concentrated photovoltaic-thermal hybrid collector using TRYSYS

16h10 Oral presentation ; Paper 11 ; TH1 - City and buildings of the future ;
Chuhan ZHAO, Souad MORSLI, Mohammed EL GANAOUI ;
Enhancing Indoor Air Quality: A Comparative Study of Air Age and CO_2 Levels Across Various Ventilation Scenarios
University of Lorraine, France

16h30 Oral presentation ; Paper 39 ; TH2 - Energy and management ;
Labouda BA, Fatma TANGOUR, Rafik ABSI ; Ikram EL ABBASSI ;
Analysis of Digital Twins Applications in Energy Efficiency: Systematic Review
ECAM-EPMI, France

16h50 Oral presentation ; Paper 36 ; TH2 - Energy and management ;
Bilal AMGHAR, Khelil SIDI IBRAHIM & Toufik AZIB ;
Smart Charging and V2G Solutions : Optimizing Energy Demand Management with Grid Integration for Evs
ESTACA Lab, France

Session 1B

17h10 Oral presentation ; Paper 4 ; TH2 - Energy and management ;
Jérôme FILS ;
Energy production with fusion: comparison of electro-magnetic confinement and laser-driven inertial compression methods
ECAM-EPMI, France

17h30 Oral presentation ; Paper 28 ; TH4 - Water management ;
Ahmedou MEMOUNE DAH , Hitoshi TANAKA , Abdoul DIA & Rafik ABSI ;
Impact of Climate Change on Coastline Evolution: Case of the West African Coastal Areas Quelles solutions pour la protection du littoral ouest Africain ?
Université de Nouakchott, Mauritanie; ECAM-EPMI France & Tohoku University, Japon

17h50 Oral and Poster presentation ; Paper 5 ; TH6 - Professions of the future and related training courses ;
G DI PALO, M UZUNOVA, A VOTO, S HAMACI, R ABSI ;
A survey of Open Innovation ecosystems and practices within 6 countries for regional policy recommendations
ECAM-EPMI, France & Foundation IFEL Campania, Institute for Finance and Local Economy of Campania Napoli, Italy

18h10 Oral presentation ; Paper 10 ; TH7- Materials & Physics ;
Amira M'HADBI, Khalid CHTAIBI, Mohammed EL GANAOUI, Haîkel BEN HAMED & Amenallah GUIZANI ;
Analysis of mixed convection in a square ventilated cavity containing a nonNewtonian fluid and a heat-generating square block
Lorraine University, IUT, LERMAB, Longwy, France ; University of Tunis El Manar, Tunis, Tunisia ; Cadi Ayyad University, Marrakesh, Morocco & Picardie Jules Verne University, Amiens, France

Session 2A

15h30 Oral presentation ; Paper 23 ; TH1 - City and buildings of the future ;
Atsou Fiefonou AKOUETE, Prifin Bogardi MAYAYA NKOKOLO ;
Vers une Mobilité Urbaine Durable à Lomé : Innovations et Défis pour la Ville du Futur

15h50 Oral presentation ; Paper 16 ; TH1 - City and buildings of the future ;
Abderrahmane JOUHAR, Driss EL HACHMI, Raja MOUSSAOUI, Takarli MOKHFI, Fatima ALLOU ;
Acoustic wave assessment of compressed earth blocks in seismic zones : Application village Tirknit provinces Chichaoua Taroudant (Morocco)

16h10 Oral presentation ; Paper 1 ; TH2 - Energy and management ;
Ali KOUBAYSSI, Mohammad ARNAOUT, Mohammad ABOU CHAHINE, Rafik ABSI ;
Power Compensation of Shunt Capacitors for Hybrid Multi-Source Systems: Improving Voltage Stability and Reducing Losses

16h50 Oral presentation ; Paper 38 ; TH1 - City and buildings of the future ;
Qiong YE ; Giao T.M. NGUYEN ; Rafik ABSI ; Béatrice LEDESERT & Ronan HEBERT ;
Thermal performance of building envelopes incorporating solid-solid phase change materials
CY Cergy Paris Université & ECAM-EPMI, France

Session 2B

17h10 Oral presentation ; Paper 14 ; TH2 - Energy and management ;
Hamza BENZZINE, Hicham LABRIM, Aouatif SAAD, Driss ZEJLI, Rachid EL BOUAYADI
Optimization of Greenhouse Production : Energy Simulation and Strategic Planning for Off-Peak Market Periods

17h30 Oral presentation ; Paper 32 ; TH2 - Energy and management ;
Mohamed-Amine BABAY ; Mustapha ADAR ; Ahmed CHEBAK ; Mustapha MABROUKI
Design and Optimization of Hybrid PV-Hydrogen Systems for Efficient Energy Storage and Balancing
University of Sultan Moulay Slimane, Beni Mellal, Morocco

17h50 Oral presentation ; Paper 33 ; TH2 - Energy and management ;
Mustapha ADAR, Mohamed-Amine BABAY, Mustapha MABROUKI
Three PV systems production forecasting using deep learning and statistical techniques
University of Sultan Moulay Slimane, Beni Mellal, Morocco

18h10 Oral presentation ; Paper 13 ; TH2 - Energy and management ;
Aabla EL HJAJBI, H. LABRIM, A. FADDOULI, B. HARTITI, D. ZEJLI, M. MALKI, R. ELBOUAYADI
A Computational investigation of a new hybrid system of a flat-plate solar collector with phase-change material and concentrator

Paper 3 ; Poster presentation TH6 - Professions of the future and related training courses ;
Raphaël SASPORTAS
Extraction of linearly independent rows and dependency coefficients in datasets
ECAM-EPMI, France

18h30 : Coffee and Posters

Friday November 22, 2024

8h30 **Reception and welcome coffee on CHIMM site**

9h00 **Special Session and Round Table:**
Architecture, urbanisme et ville de demain
Architecture, urban planning and the city of tomorrow

Plenary Conference
Maysoun SAWAAN
Architect and international expert in urban planning, Nouakchott, Mauritanie
Urban master plan developement for cities in developing countries
Paper 44 : TH1 - City and buildings of the future

Round Table
Participants : Marie-Gabrielle MERY, Maysoun SAWAAN, Mohammed EL GANAOUI, Jean-Michel BRUCKER, Ali AL RAOUF

10h00 **Special Session and Round Table**
TH5 - E-Health

Plenary Conferences

- Yahya BARBARA
  La santé en progression
- Moncef BENKHERRAT, Carlos ALARIO HOYOS, Doru CANTEMIR, Carlos DELGADO KLOOS, Adriana TOFANESCU, Valerio ALESSANDRONI, Pablo J. ALHAMA BLANCO, Rafik ABSI
  EUCare4.0 Health 4.0 training to boost digital transformation of EU
  Paper 27: TH5 – E-HEALTH

Round Table
Focus : EUCare4.0

Plenary Conferences

11h30 Elias Fouad MAMI
Université de Tlemcen, Algérie
La maintenance industrielle au service de l'usine du futur
Paper 21 : TH4 - Factories of the futur

12h00 K. MATHEW
Accelirate Inc, India
Transforming Energy Systems with AI and Automation for the City of the Future
Paper 29 : TH1 - City and buildings of the future

Session 3A

14h00 Oral presentation ; Paper 17 ; TH3 - Water management ;
Mohammed EL HABNOUNY, O Salma, Menchafou YOUSSEF , Driss ZEJLI & Aouatif SAAD
Experience with desalination plants for irrigation in Morocco: example of Dakhla Public-Private Partnership projects
Ibn Tofail University, Kenitra, Maroc

14h20 Oral presentation ; Paper 31 ; TH3 - Water management ;
Mohammed KHATTAOUI, Said ZAMOUM, Demelash GOSHIME, Djillali HAMES, Chahinaz LOUCIF & Rafik ABSI ;
Evaluation des débits ruisselés à un exutoire d'un bassin versant à partir des données pluviométriques à l'aide du logiciel HEC-HMS
Mouloud Mammeri University. Tizi-Ouzou. Algeria, ECAM-EPMI, France & Arba Minch University, Ethiopie

14h40 Oral presentation ; Paper 34 ; TH3 - Water management;
Noureddine BENSAFI, Mourad LAZRI, Rafik ABSI, Karim LABADI, Soltane AMEUR ;
Combining Classifiers for Delineation of Raining Cloud over North Algeria and Mediterranean Sea
ECAM-EPMI, France & Université Mouloud Mammeri Tizi Ouzou, Tizi Ouzou, Algérie

15h00 Oral presentation ; Paper 40 ; TH3 - Water management ;
Sadjia HAMDAD, Mourad LAZRI, Karim LABADI, Rafik ABSI, Soltane AMEUR
Évaluation du phénomène sec/humide pour une gestion durable de l'eau à l'aide des chaînes de Markov
ECAM-EPMI, France & Université Mouloud Mammeri Tizi Ouzou, Tizi Ouzou, Algérie

15h20 Oral presentation : Paper 7 ; TH3 - Water management ;
Taki-Eddine ABBASSI, Abdelhakim SAHOUR, Moncef BENKHERRAT, Saddam BRAI, Islem BOUTIOUTA, Farouk BOUHAMREZ ;
Machine Learning-Based Soil Moisture Prediction Using Meteorological Data for Enhanced Irrigation Management
Abbes Laghrour University, Khenchela, Algeria ; ECAM-EPMI, France ; Badji Mokhtar-Annaba University, Algeria & 8 Mai 1945 – Guelma University, Guelma, Algeria

Session 3B

15h40 Oral presentation : Paper 2 ; TH3 - Water management ;
Amira YOUBI, Amira AFRI, Taki-eddine YAHI, Ahmed HOUILIA, Hadj Ahmed ABBASSI, Moncef BENKHERRAT ;
Developing an Innovative Artificial Ecosystem in the Wetlands of El Rym Annaba (Northeast Algeria)
ECAM-EPMI, France & Environmental Research Center (CRE), Annaba, Algeria, Public Establishment of Health of proximity EPSP- Dréan, Algeria

16h00 Oral presentation ; Paper 24 ; TH5 - E-Health ;
Abdelhakim SAHOUR, Mohamed LAMRI, Farouk BOUMEHREZ, Abdelaali BEK-HOUCHE ;
Explainable AI for Diabetes Diagnosis
Abbes Laghrour University, Khenchela & 8 Mai 1945 – Guelma University, Guelma, Algeria

16h20 Oral presentation ; Paper 12 ; TH4 - Waste management ;
Khaoula EL MAJDOUB, Salah SOUABI, Safaa KHATTABI RIFI, Abdelaziz MADINZI
Traitement des eaux usées des huileries d'olive avec le pois chiche (Cicer arietinum) comme coagulant naturel
Faculté des Sciences et Techniques de Mohammedia, Maroc

16h40 Oral presentation ; Paper 42 ; ; TH2 - Energy and management ;
Yassine BOUDGHENE STAMBOULI, Samir HAMACI ;
Modélisation du Temps de Cycle d'un AS/RS pour Optimiser les Coûts de Fonctionnement, accent mis sur les coûts énergétiques
ECAM-EPMI & University Centre of Maghnia, Algeria

Session 4A

14h00 Oral presentation ; Paper 8 ; TH7- Materials & Physics ;
Liqiang GONG, Hanguang FU, Rafik ABSI
Microstructure and properties of Cu-bearing hypereutectic high chromium cast iron
ECAM-EPMI & Beijing University of Technology, Chine

14h20 Oral presentation ; Paper 15 ; TH7- Materials & Physics ;
Ibtissam EL AOUNI, Hicham LABRIM, Rachid EL BOUAYADI, Driss ZEJLI, Mohammed EL GANAOUI, Aouatif SAAD ;
Optimization of an Evaporation System: A Comparative Analysis of ADMM and Quadratic Programming
Ibn Tofail University, Kenitra, Maroc

14h40 Oral presentation ; Paper 18 ; TH7- Materials & Physics ;
Salwa BOUHAMIDI ALAOUI ; Hicham LABRIM, Ahmed AL SHAMI, Mohammed BENAISSA, Redouane MGHAIOUINI, Rachid EL BOUAYADI
Structural, Electronic, Optical, and Thermoelectric Properties of FrSnI3-xFx (x=0, 1, 2, 3) Perovskites Using the TB-mBJ Approach
Ibn Tofail University Kenitra & Mohammed V University Rabat, Maroc

15h00 Oral presentation ; Paper 19 ; TH2 - Energy and management ;
Mohammed Islam BOUTIOUTA ; Taki Eddine ABBASSI ; Aya SAKHRI ; Nourreddine DOGHMANE ;
Experimental Energy Consumption Analysis and Optimization of ESP32-Based Wireless Sensor Nodes for Forest Fire Monitoring in Mechrouha, Northeastern
Badji Mokhtar-Annaba University, Algérie

15h20 Oral presentation ; Paper 20 ; TH1 - City and buildings of the future
Feriel AOUISSI, Farouk BOUMEHREZ, Abdelhakim SAHOUR, Abdelali BEKHOUCHE, Fouzia MAAMRI, Hiba Ines BITAT ;
Smart Greenhouse Monitoring and Management Using a LoRa-Based IoT System
Abbes LAGHROUR University Khanchela,Algerie ; 8 Mai 1945 – Guelma University, Guelma, Algeria & ECAM-EPMI, France

Session 4B

15h40 Oral presentation ; Paper 22 ; TH7- Materials & Physics ;
Ines ABDELAZIZ, Farouk BOUMEHREZ, Abdelhakim SAHOUR, Abdelali BEKHOUCHE, Fouzia MAAMRI, Hanane DJELLAB ;
Detection of wheat diseases with deep learning
Abbes Laghrour Khenchela University, Algeria ; Université 8 Mai 1945 Guelma, Algeria ; ECAM-EPMI, France & University of Echahid Larbi Tebessi, Tebessa Algeria

16h00 Oral presentation ; Paper 25 ; TH7- Materials & Physics ;
Yunjie LI, Jean-Michel NUNZI ;
An investigation of CO2 laser pattern creation on Polydimethylsiloxane thin film surface in daytime passive radiative cooling
Queens University, Kingston, Canada

16h20 Oral presentation ; Paper 26 ; TH7- Materials & Physics ;
Monica AYACHIT, Jean-Michel NUNZI ;
Advancements in PMMA Nanoparticle Synthesis for Drug Delivery Applications
Queens University, Kingston, Canada

16h40 Oral presentation ; Paper 35 ; TH7- Materials & Physics ;
Ali HAMROUN, LABADI Karim, LAZRI Mourad, Fethi OUALOUCHE ;
Simulation and performance evaluation of a stochastic discrete-event model of car sharing networks
ECAM-EPMI, France & Université Mouloud Mammeri Tizi Ouzou, Tizi Ouzou, Algérie

17h00 End of sessions and conference conclusion

Plenary Conferences

Invited Plenary Conference: Geoffrey LEVERMORE (Nobel price and EVF Series Godfather)

Emeritus Prof, University of Manchester, UK

Climate change and the urban heat island

Climate change and the urban heat island

Geoff LEVERMORE [1]

[1] Emeritus Prof, University of Manchester, UK

*Corresponding Author: geoff.levermore@manchester.ac.uk

Abstract. The paper examines the origins of climate change showing the measure of mankind's emissions of carbon dioxide directly from the burning of fossil fuels as evidenced by the carbon 13 isotope. The fact that the 1.5C rise in temperature will be exceeded is discussed. The need for direct air capture as well as mitigation to limit the carbon emissions is considered. The city environment is examined, especially as the urban heat island (UHI) will add to the global warming in the future to an extent of 10K. Extensive measurements in the UK city of Manchester are discussed, which show that the UHI effect is greater at night. Future city developments with suggested ways of combatting the UHI and adapting to climate change are examined. Climate justice is also briefly discussed.

Keywords: Climate change; urban heat island (UHI) ; carbon emissions ; city developments

Plenary Conferences Program

Kamil GRECKI
Founder at Archiverse.io, Poland
Digital twin and technology in AEC industry
Paper 37 : TH7 : Factories of the futur

Nidam ABDI
Territorial Challenges, Les Mesnuls, France
Bonnes pratiques mondiales en matière de transitions numériques et énergétiques des territoires
Paper 30 : TH1 - City and buildings of the future

Pierre-Olivier LOGERAIS
Univ Paris Est Créteil, CERTES, IUT de Sénart-Fontainebleau, Lieusaint, France
Durabilité des centrales photovoltaïques en milieux désertiques : de la conception aux stratégies de maintenance
Paper 41 ; TH2 - Energy and management

Djaffar OULD ABDESLAM ;
Université de Haute Alsace, IUT de Mulhouse, Institut IRIMAS, Mulhouse, France
L'IA au service de la gestion de l'énergie. Le cas du projet INTERREG ASIMUTE : Autoconsommation Intelligente de l'Energie
Paper 45 ; TH2 - Energy and management

K. MATHEW
Accelirate Inc, India
Transforming Energy Systems with AI and Automation for the City of the Future
Paper 29 : TH1 - City and buildings of the future

Maysoun SAWAAN
Architect and international expert in urban planning, Nouakchott, Mauritanie
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Paper 44 : TH1 - City and buildings of the future

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EUCare4.0 Health 4.0 training to boost digital transformation of EU
Paper 27 ; TH5 - E-Health

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La maintenance industrielle au service de l'usine du futur
Paper 21 : TH7 - Factories of the futur

Digital twin and technology in AEC industry

Kamil GRECKI [1]

[1] Founder at Archiverse.io, Poland

*Corresponding Author: kamilgrecki@archiverse.io

Abstract. The conference will cover how advanced technologies like digital twins, IoT, artificial intelligence, and automation are transforming each phase of a smart building's lifecycle—from design and construction to operation and maintenance. We'll discuss how these technologies contribute to energy efficiency, sustainability, and enhanced building management. Case studies will illustrate real-world applications, showing how construction practices are evolving to meet the demands of modern, resilient smart cities.

Keywords: Digital twin, AEC industry, new technologies, lifecycle, smart buildings

Bonnes pratiques mondiales en matière de transitions numériques et énergétiques des territoires

Nidam ABDI [1]

[1] Territorial Challenges, 29, rue Neuve, 78490 Les Mesnuls,

*Corresponding Author: ni.abdi@territorialchallenges.com

Abstract. CONTEXTE : Animée par Nidam ABDI, cette conférence a pour objectif de mettre en lumière des initiatives exemplaires portées par des collectivités territoriales du monde entier, incarnant la convergence des transitions numérique et énergétique pour façonner les territoires de demain. Fort de plus de 13 ans d'expérience en veille stratégique via Territorial Challenges, Nidam ABDI s'appuie sur une expertise internationale pour identifier et partager des innovations transformatrices.

INTRODUCTION: Présentation de _Territorial Challenges_, publication numérique pionnière dans la veille stratégique mondiale, spécialisée dans la détection et l'analyse des tendances en matière de transformation numérique des territoires. Je rappellerai mon parcours, de journaliste à expert influent dans les transitions numérique et énergétique, et introduirai les quatre grands axes thématiques qui guident mon travail : Territoires intelligents, Transition énergétique, Industrie 4.0 et Données/Objets connectés.

PARTIE 1 : TERRITOIRES INTELLIGENTS ET TRANSITION ÉNERGÉTIQUE Dans cette première partie, je présenterai des exemples de villes et collectivités locales à l'avant-garde des villes intelligentes, qui allient gestion numérique et efficacité énergétique. J'évoquerai des projets concrets réalisés dans des villes européennes (Amsterdam, Barcelone, Helsinki), asiatiques (Singapour, Séoul) et américaines (Boston), ayant réussi à développer des solutions intelligentes pour gérer les infrastructures urbaines et réduire l'empreinte énergétique à travers des systèmes de capteurs, des réseaux énergétiques décentralisés et des technologies de l'Internet des objets (IoT).

PARTIE 2 : INNOVATIONS DANS L'INDUSTRIE 4.0 ET LA TRANSITION ÉNERGÉTIQUE L'accent sera ensuite mis sur la convergence entre l'industrie 4.0 et la transition énergétique. Des projets internationaux seront mis en lumière, notamment l'utilisation de l'intelligence artificielle et de la robotique dans la gestion prédictive de la maintenance. Seront également abordés les partenariats entre collectivités territoriales, pôles universitaires et entreprises pour la réalisation de projets dans le domaine de l'industrie 4.0.

PARTIE 3 : LES DONNÉES ET LES OBJETS CONNECTÉS DANS LES TERRITOIRES URBAINS Enfin, je discuterai de l'utilisation des données collectées via les objets connectés, et de la manière dont ces informations sont transformées en outils innovants pour la gestion urbaine. J'évoquerai des exemples de collectivités ayant réussi à utiliser ces technologies pour améliorer les services publics et la qualité de vie, comme le cas de Toronto avec ses capteurs intelligents pour la gestion de l'eau et de l'énergie. Je mentionnerai également les enjeux juridiques liés à la confidentialité et à la protection de la vie privée des citoyens.

CONCLUSION La conférence se conclura par un appel à la cooperation internationale et à l'innovation collective. Je soulignerai le role essentiel des collectivités locales dans ces transitions et la nécessité de multiplier les échanges de bonnes pratiques entre territoires à l'échelle mondiale.

Durability of photovoltaic power plants in desert environments: from design to maintenance strategies

Pierre-Olivier LOGERAIS [1]

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Abstract. Deserts are large and empty spaces where renewable energy production can be deployed over vast areas. Large-scale photovoltaic (PV) farms are currently being deployed or studied in various desert regions around the world, enabling these regions to develop economically, addressing climate change issues and substantially increasing global PV capacity. The main advantage for solar panels lies in maximizing their energy production when exposed to high levels of sunlight. However, desert environments raise a number of challenges due to extreme temperatures, sandstorms and dust accumulation, which can significantly impact the efficiency of PV modules, accelerate their ageing and make maintenance operations more complicated. To meet these challenges, it is necessary to study the durability of PV panels upstream in laboratory conditions or using outdoor platforms in order to design high-performance systems and select the most robust technologies, and to set up downstream instrumented devices for the supervision and the maintenance of these installations. These issues are covered here by presenting the results of research studies carried out with instrumented PV platforms in various deserts, an example of accelerated laboratory testing and a multi-criteria analysis, and a diagnostic protocol that can be used in the maintenance of photovoltaic power plants operating in this kind of environment.

Keywords: photovoltaic systems; desert environment; performance; ageing

Artificial Intelligence for Energy Consumption Reduction: The case of the Upper Rhine Region

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Abstract. Buildings energy saving is one of the most important energy issues of our time. Buildings represent the largest energy-consuming sector in the economy as reported by the International Energy Agency (IEA) in 2013. In 2015, the JRC (Joint Research Center) of the European Commission published a study that shows that domestic and commercial buildings consume approximately 40% of the total electrical energy in Europe and more than a third of the power demand at peak times. A similar study was conducted in the United States by the U.S. Energy Information Administration's (EIA).

For a good energy management and consumption reduction in a prosumer building, it's important to know in real time the different parameters of electrical signals. The nature and characteristics of these electrical signals, often related to the morphology of the signal or its frequency content, have led to the use of artificial intelligence techniques. Methods such as ADALINE or Machine Learning open new possibilities for the identification of electrical power parameters.

The European projects ASIMUTE (www.asimute.uha.com) will be discussed. The ASIMUTE project came to fruition in this peculiar context and aims at proposing long-lasting solutions that align with sustainable development and energy efficiency policies. The project focuses on 4 main areas of research:

Sociology: Conducting societal studies that analyze household consumption habits and facilitating communication between public authorities and civil society. This line of research requires the involvement of Upper Rhine citizens.
Law: Securing the data smart meters emit, while paying close attention to the harmonization of existing legal differences in the Upper Rhine region.
Mobility: Developing technological, ecological and viable solutions for the deployment and reinforcement of electric mobility.
Artificial intelligence: Studying artificial intelligence and its outcomes on energy consumption to optimize regional energy use.

Keywords: Artificial Intelligence, Adaptive Filters, Energy Reduction, Self-Consumption, Building Management.

Transforming Energy Systems with AI and Automation for the City of the Future

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Abstract. The transformation of energy systems is pivotal to building sustainable and efficient cities of the future. Artificial Intelligence (AI) and Robotic Process Automation (RPA), augmented by Agentic Process Automation (APA), are driving this revolution by integrating innovative technologies into energy production, distribution, and consumption processes. AI-powered solutions enable predictive analytics, real-time decision-making, and enhanced efficiency across energy systems. Smart grids utilize AI to manage decentralized energy sources, balance power loads, and integrate renewable energy, while virtual power plants leverage machine learning algorithms to optimize electricity trading and distribution.

RPA, coupled with AI, automates repetitive administrative tasks in energy operations, such as billing, compliance monitoring, and grid maintenance scheduling, freeing human resources for strategic initiatives. Additionally, AI-driven automation in energy consumption, such as smart meters and connected devices, empowers consumers to optimize usage patterns, reducing costs and environmental footprints. These technologies collectively facilitate the integration of electric vehicles, renewable energy sources, and sector coupling, ensuring the resilience and adaptability of urban energy networks.

Despite its potential, the widespread adoption of AI and RPA faces challenges, including data privacy concerns, cybersecurity risks, and the high energy consumption of AI systems. Overcoming these obstacles requires robust ethical frameworks, transparent data usage policies, and energy-efficient infrastructure. By leveraging AI and RPA, cities can accelerate their transition toward sustainable energy systems, fostering economic growth, environmental conservation, and enhanced quality of life. This paper explores these transformative technologies role in shaping the energy systems of tomorrow's smart cities.

Keywords: Artificial Intelligence, Agentic Process Automation (APA), Robotics Process Automation (RPA), Smart Cities, Energy System

Urban Master Plan Development for Cities in Developing Countries: Application to Nouakchott

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Abstract. The world recently entered an unprecedented period of urbanization due to the formation of dozens of super and hyper-cities (Muggah 2016). By 2050 city-dwellers are expected to account for two-thirds of the global population, or an estimated 6.4 billion people (Bosetti, Ivanovic, Munshey 2016). While a number of the world's largest cities still reside in North America and Western Europe, most future population growth will occur in sprawling cities and slums of developing countries in Africa and Asia. Urbanization brings with it possibilities of improved access to jobs, goods and services for poor people in developing countries. However, there are tremendous challenges and threats, with major implications for the humanitarian and development sector (Muggah 2012). As the world continues to urbanize, natural disasters, economic shocks, climate changes and other factors will increasingly affect populations in cities, potentially making it more fragile. Sitting on the frontline of global emergencies, cities are actively searching for ways to cope, adapt, and bounce back.

Nouakchott is one of the largest cities in the Sahara. Located on the Atlantic coast and it lies on the west coast of Africa. It is the capital and largest city of Mauritania which serves as the administrative and economic center. Since the establishment in 1960 this city has known an exponential growth. According to the statistics by the National Statistical Office (OSN) of Mauritania the population has grown from around 2,000 in 1957 to 558,195 in 2000, and to number now over a million, encompassing around a third of the national population. This rapid growth of the city was driven not only by the "pull factors" such as commercial and economic center of the country, but also by some "push factors" such as serious poverty and scarcity of foods in the inland and rural areas caused by droughts and sandstorms took place in 1970's. Ever since, Nouakchott has spread in an uncontrolled, anarchic way until its star-formation covers about 30km in diameter. The site of the city presents a number of risks, among which: the shifting dunes surrounding the city, the fragile western costal cordon in the midst of salt-water wells. This city thus threatened by sand, salt, and water, all at once. Water is the foremost threat: recurring inundation and freshwater droughts are two major issues. This paper aims to issue a preliminary overview of the urban dilemma in Nouakchott and to highlight the most important risk factors that contribute to fragility of this city. In 2020 the Mauritanian government issued a new master plan for Nouakchott city made by JICA expert team. This master plan come up with three basic orientations in order to improve the city. The research aims to understand how these orientations will participate in minimizing the risks and solving the urban problems of Nouakchott, and how the city will be in 2040. Mauritanian institutions responsible for urban development are implementing fundamental changes, including new urban and housing policies in addition to the development of their legal frameworks. The research aims to understand how these changes will support the developing he Mauritanian cities in the future.

EUcare4.0: Health 4.0 training to boost digital transformation of EU

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Abstract. The main objective of the EUcare4.0 project is to support the digital transformation of EU healthcare by contributing to the development of the digital skills, competencies, and knowledge necessary to effectively apply and use the principles of Health 4.0 and the underlying technologies in the mental health sector.

The project will also help develop skills that are useful in the event of disasters and pandemics. Indeed, in the current health situation due to the coronavirus crisis, we can even more clearly see the need for skills and the rapid adaptation of healthcare services in various types of situations. To achieve the project's goal and meet the needs identified through the context analysis, the EUcare4.0 partnership will produce an innovative vocational training program and corresponding course content, training guidelines, evaluation and certification tools, as well as an online learning space that will provide free and open access to training materials and relevant case studies on Health 4.0 technologies.

The main target groups of the EUcare4.0 project are VET (Vocational Education and Training) trainers who provide various training programs to mental health specialists. They will directly benefit from the project's outcomes and activities and will be able to acquire or enhance their knowledge and skills related to Health 4.0. The secondary target group includes mental health specialists such as psychiatrists, psychiatric nurses, psychologists, social workers, and counselors. The project addresses the needs of the target groups by providing them with the necessary training materials and tools. It also meets the needs of the partner organizations, which aim to provide updated services, training, and guidance in the field of mental health.

The EUcare 4.0 website (https://eucare40.eu/) consists of three main sections:

1. Introduction to Health 4.0 for Mental Health Specialists: A publication designed to provide teachers, trainers, VET professionals, and mental health specialists with relevant knowledge about Health 4.0 and its underlying technologies applicable to the mental health sector.
2. EUcare4.0 Modular Training Components: An innovative program and relevant course content focused on Health 4.0 and its underlying technologies applicable to the mental health sector.
3. EUcare4.0 Online Learning Space is an innovative learning environment that offers flexible access to the developed training resources. It includes:
   a) Introduction to Health 4.0 for mental health specialists.
   b) A series of case studies on Health 4.0.
   c) EUcare4.0 modular training modules.
   d) Guidelines for EUcare4.0 modular trainers.
   e) Evaluation and certification tools.

Keywords: Digital Health, Smart Healthcare, Artificial Intelligence (AI), Internet of Medical Things (IoMT), Telemedicine, Remote Patient Monitoring, Wearable Technology, Big Data Analytics, Health Data Security, Health 4.0, Machine Learning in Healthcare, Smart Diagnostics, Cloud Computing in Healthcare, Patient-Centered Care, Health Informatics, Augmented Reality in Medicine, Medical Device Integration, Mobile Health (mHealth), Cybersecurity in Healthcare, Robotics in Healthcare, Digital Therapeutics, Personalized Medicine

La maintenance industrielle au service de l'usine du futur

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Abstract. La maintenance industrielle, une fonction stratégique de l'entreprise, est en constante évolution. Sous-estimée dans le passé, elle est devenue de nos jours un centre de profit, un facteur de qualité et une source de productivité dans les usines de production. Aujourd'hui, elle se retrouve directement concernée par le concept d'industrie du futur qui a pour mission de rendre l'usine intelligente et flexible. D'autre part, les machines connectées sont devenues le cœur de cette usine intelligente futuriste. Parce qu'elles peuvent transmettre la bonne information en temps réel et au bon moment, on entre dans l'ère du Lean Manufacturing , de la digitalisation des procédures et de la maintenance 4.0. Cette dernière est une approche industrielle qui exploite les technologies qui gravitent autour de l'industrie 4.0. Grâce à l'intelligence artificielle et aux nouvelles technologies, elle est le stade le plus avancé en termes de management de la maintenance industrielle. En s'appuyant sur les technologies avancées et les méthodes complémentaires, cette nouvelle forme de maintenance permet à l'usine d'atteindre des performances exceptionnelles.

La conférence proposée explore les principales briques technologiques pour la mise en œuvre de l'industrie du futur. Elle permet aussi de dégager une vision sur la maintenance4.0 et d'indiquer les procédures de sa digitalisation et de sa mise en place. Ce travail présente également l'impact de la maintenance 4.0 sur l'efficacité opérationnelle de l'usine. Naturellement , le projet ambitieux de mise en œuvre de l'usine du futur ne peut être réalisable avec succès sans la prise en compte de la normalisation, de la cybersécurité de la culture d'entreprise, du facteur humain et de l'environnement.

Keywords: Maintenance 4.0 , usine intelligente, digitalisation, machines connectées, intelligence artificielle, briques technologiques, cybersécurité

Oral Presentations

TH1 - City and buildings of the future

Optimizing Hygrothermal Performance of Building Envelopes with Dynamic PCM-Biomaterial Concrete Configurations

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Abstract.

Integrating phase change material (PCM) into the building envelope has been a promising solution for enhancing the building's thermal performance in recent years, as the PCM can dramatically increase the thermal inertia and energy storage ability of the wall. Meanwhile, biobased concrete is an environment-friendly material that enables indoor humidity regulation and heat insulation. However, the traditional passive combination method limited the thermal performance of the PCM and the bio-based concrete, due to the thermal resistance of the bio-based material, which restricted the thermal response of the PCM. This study proposed a novel dynamic method of combining the PCM with a bio-based concrete wall to enhance indoor hydrothermal performance. The simulation results show that, compared to the traditional static PCM integration method, the dynamic method accelerated the phase transition process and improved the energy, thermal, and indoor hydroelectric performance. Compared to the traditional passive configuration, the dynamic PCM combined with bio-based concrete generated reductions of 18.2%, 66.3%, and 40.7% for heat load, temperature fluctuation, and partial water vapor pressure fluctuation, respectively.

Keywords: Dynamic strategy, Building, Phase change materials (PCMs), Energy efficiency

Thermal performance of building envelopes incorporating solid-solid phase change materials

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Abstract:

This research focuses on the thermal performance of building envelope structures incorporating a patented solid-solid phase change material (SS-PCM), designated as PUX-1500-20, a cross-linked polyurethane. This SS-PCM is capable of storing and releasing thermal energy via phase transitions within the human comfort temperature range, facilitating the temporal and spatial transfer of solar energy for optimizing energy efficiency. The primary aim of this study is to integrate the SS-PCM into hollow bricks and evaluate their thermal inertia through both experimental testing and numerical simulation. The results presented herein provide a comprehensive analysis of the thermal performance of these structures and assess their potential in contributing to energy consumption reduction.

Keywords: Patented phase change material, solid-solid transition, latent heat storage, cross-linked polyurethane, building integrated, passive thermal storage system, model testing ,numerical simulation.

Enhancing Indoor Air Quality: A Comparative Study of Air Age and CO_2 Levels Across Various Ventilation Scenarios

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Abstract. This study evaluates the effectiveness of various ventilation strategies-natural, mechanical, and mixed-by analyzing their impact on air age and CO_2 concentration distribution within a simulated indoor environment. Air age, defined as the average time that air spends in a specific area, serves as a vital indicator for assessing ventilation efficiency and pollutant dispersion. Through a comparative analysis of air age and CO_2 gradients along the X, Y, and Z axes, the research identifies areas with inadequate airflow, which may lead to pollutant accumulation. The results reveal that while natural ventilation offers basic air renewal, it frequently results in uneven CO_2 distribution, particularly in the central and lower regions of the room. In contrast, mechanical and mixed ventilation strategies exhibit superior pollutant control, more uniform CO_2 distribution, and reduced air age, making them more effective in maintaining optimal indoor air quality over extended periods. As urban areas evolve into smarter, more sustainable cities, this study highlights the significance of evaluating both air age and pollutant concentration gradients. By optimizing ventilation efficiency, we can promote healthier indoor environments that contribute to the well-being of residents in future cities. Effective ventilation strategies will be crucial for ensuring clean air and enhancing the overall quality of life in increasingly populated urban landscapes.

Keywords: Ventilation Strategies, CO_2 Concentration, Indoor Air Quality, Air Age, Airflow Patterns, Pollutant Dispersion, Ventilation Efficiency, Pollution Control, Sustainable Cities.

Towards Sustainable Urban Mobility in Lomé: Innovations and Challenges for the City of the Future

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Abstract. This article examines the challenges of urban mobility in Lomé, Togo, in the face of rapid urbanization and pressure on infrastructure. With nearly 70% of the country's urban population, Lomé suffers from traffic congestion, high transport prices, pollution and a deteriorating quality of life. The article will present existing transport infrastructure and highlight sustainable solutions, such as electric motorcycles and integrated public transport systems. By presenting case studies of innovative initiatives, it will offer recommendations to improve the efficiency of the urban transport system and strengthen the quality of life of residents.

Keywords: Sustainable urban mobility, Lomé, challenges, innovation.

Acoustic wave assessment of compressed earth blocks in seismic zones : Application village Tirknit provinces Chichaoua Taroudant (Morocco)

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Abstract

Compressed earth blocks, commonly known as btc, are a traditional building material used everywhere due to their durability and energy efficiency. However, in Morocco, on 8 September, nearly 3,000 people were killed in an earthquake. Provinces seriously affected include Al-Haouz, Chichaoua and Taroudant; for about 40 municipalities, classes have been suspended. In this framework, raw soil samples were taken from the village of Tirknit, which belongs to the disaster area province Chichaoua-Taroudant, with the aim of better understanding the performance of local materials when seismic tremors occur.

The specimens were utilized to prepare one brick of unstabilised compacted earth. Then, waves were excited in two x//y directions in order to measure pulse speed and time of flight. From these data, the (SNR) for every signal was obtained. Elastcity module according to the test results is 1679.91 MPa, while Poisson's ratio measured using a Pundit pl200 Proceq instrument in a totally non-destructive material test amounts to 0.31.

These results provide for the better understanding of the mechanical properties of earth-compressed blocks in seismic contexts that help in evaluating traditional construction methods in risk areas.

Keywords: compressed earth blocks, ultrasound, mechanical characteristics, energy efficiency, post-seismic.

Smart Greenhouse Monitoring and Management Using a LoRa-Based IoT System

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Abstract. Innovative solutions in greenhouse management have become essential to enhance productivity while conserving water and energy. Advances in Wireless Sensor Networks (WSN) offer sustainable approaches through Low Power Wide Area Networks (LPWAN). LoRaWAN is one of the most widely adopted technologies due to its long-range, low-power wireless communication capabilities.

This paper focuses on developing a system for monitoring environmental parameters inside and outside three agricultural greenhouses, using LoRa technology to ensure efficient data transmission. The system will collect data related to the environment, such as temperature, humidity, and light levels, helping to assess the surrounding conditions of each greenhouse individually. By leveraging Internet of Things (IoT) technologies, the system will allow users to monitor these parameters in real-time through a dedicated mobile application or website.

The proposed in this paper are the formulation and advancement of an intelligent Internet of Things (IoT) infrastructure for three greenhouse environments utilizing a Long Range (LoRa) wireless communication module to facilitate extensive-range data transmission and reception while ensuring minimal energy consumption.

In greenhouse management, the Internet of Things (IoT) significantly contributes to enhancing agricultural practices, crop quality, and overall productivity by supplying precise data regarding the environmental parameters pertinent to these crops. Such data empowers agricultural practitioners to render informed decisions aimed at modifying the internal climate of greenhouses in alignment with the specific requirements of plant growth and development. The advent of LORA technology is positioning itself as a highly effective mechanism for data transmission across extensive distances while maintaining low energy expenditure, rendering it particularly suitable for agricultural implementations. This

technology facilitates the establishment of a network comprising interconnected devices capable of transmitting data to gateways over distances that may extend to several kilometers. The amalgamation of IoT and LORA within greenhouse environments significantly augments the capacity to diligently monitor and regulate environmental conditions, thereby fostering increased productivity and enhancing the quality of crops.

We have designed an advanced greenhouse monitoring system that leverages the IoT and LoRa technology to gather real-time environmental parameters, including temperature, humidity, solar radiation, and CO2 concentrations both within and outside the greenhouses. The acquired data is relayed through the LoRa network to a central gateway, subsequently directing the information to a network server for visualization on an online dashboard accessible via web browsers on laptops, tablets, and similar devices, thereby facilitating remote oversight and management of greenhouse conditions. This system significantly enhances agricultural efficiency and sustainability while concurrently optimizing productivity levels.

Moreover, the system integrates a web application and a database that grant users the opportunity for remote access to the data, consequently supporting real-time observation of the greenhouse ecosystem. This interface equips greenhouse managers with the ability to engage in informed, data-centric decision-making processes that enhance crop development and augment yield. The comprehensive system architecture, inclusive of its various components and the flow of data,

In conclusion, LoRa-based WSNs present an optimal framework for the development of an intelligent agricultural monitoring system that exhibits a high degree of energy efficiency and the capability to facilitate long-distance data transmission. This system allows for precise real-time monitoring of various environmental parameters, with the functionality to transmit data wirelessly through a Wi-Fi module. The cloud-based platform empowers users to access and analyze data at any time and from any location, thereby offering a sophisticated solution for environmental monitoring. By leveraging these contemporary technologies, agricultural practitioners can effectively address daily challenges and substantially enhance their productivity and profitability.

Keywords: - Smart Greenhouse - Internet of Things (IoT) - LoRaWAN Networks - Automation in Agriculture - Real-time Monitoring – Sensors - Climate Control Systems - Smart Farming Solutions.

TH2 - Energy and management

Analysis of Digital Twins Applications in Energy Efficiency: Systematic Review

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Abstract. This article provides a comprehensive exploration of how Digital Twins are revolutionizing energy efficiency and promoting industrial sustainability, emphasizing their transformative potential. Digital Twins offer precise virtual models of physical systems, allowing for real-time tracking, predictive maintenance, and resource optimization—all crucial for addressing today's energy challenges. Drawing from a systematic review of academic sources such as Google Scholar and IEEE Xplore, the article outlines the varied applications of this technology, spanning sectors from manufacturing to urban infrastructure and smart building management. Key advantages include lower operational costs, enhanced safety, and increased efficiency, although challenges persist, particularly concerning implementation costs and data management. The case studies included demonstrate tangible examples of how Digital Twins can reduce energy consumption and enhance the overall performance of industrial operations. In conclusion, the article underscores the significance and benefits of Digital Twins and offers strategies for overcoming adoption hurdles, aiming to maximize their impact on sustainability and industrial efficiency.

Keywords: Digital Twin, Energy Efficiency, BIM, Industry 4.0, sustainability, optimization

Smart Charging and V2G Solutions: Optimal Energy Management for EVs with Grid Integration

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In a global context of energy transition and the fight against climate change, the evolution of electricity grids towards more intelligent and efficient infrastructures is essential. The concept of Smart Grid is emerging as a key solution to meet these challenges. A Smart Grid allows more dynamic, interactive and efficient management of electricity production, distribution and consumption. At the same time, the development of electric vehicles (EVs) represents a significant step forward in reducing greenhouse gas emissions and dependence on fossil fuels. However, the massive integration of EVs poses new challenges to the electricity grid, particularly in terms of demand management and charging capacity. This is where Smart Charging comes in, optimizing EV charging processes to minimize impacts on the grid and maximize the use of renewable energy. In this research work we were interested in the modeling and optimal management of a smart grid equipped with intelligent charging stations. We explored in depth and analyzed how the different elements constituting the electricity grids of tomorrow interact to create a more sustainable, resilient and efficient energy system. We have developed intelligent supervising strategy to predict, analyze and control the interactions between the different components of the Smart Grid and EV charging systems. The simulation results demonstrated that the use of AI (Artificial intelligence) for optimization makes it possible to design management strategies that balance supply and demand, ensure grid stability and optimize the use of renewable energy resources.

Energy production with controlled fusion: comparison of electro-magnetic confinement and laser-driven inertial compression methods

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Abstract. The demand for a clean, in wide range available and safe energy source has become an urgent research goal in the last decades in order to cover the always increasing energy needs of humanity and in parallel to avoid the destructive contribution of hydrocarbon products to climate change.

Nuclear fusion plants have more attractive arguments than fission ones: not only the nuclear fuel, deuterium and tritium, are not dependent on extraction mines which often cause geopolitical tensions, but also produce considerably less nuclear wastes whose storage provokes tricky ecological challenges for millennia. Moreover, past accidents in nuclear plants show the inherent risk of fission energy, even if controls and preventive actions are particularly strict.

Fusion technology override these obstacles. Nuclear fuel is comparatively very easy to obtain. On the other hand, side dangerous waste products are considerably reduced in comparison to fission while green-house gases are almost inexistent.

Scientist and engineers are investigated two different ways to reach a plant-driven, industry –scaled controllable fusion. One is based on electro-magnetic confinement of hot and dense plasma, like the ITER or the Stellarator projects respectively in France and Germany. The other one is the laser-driven fusion facility like the LaseMegaJoule project in France.

We compare in this article the two methods, explaining their expected objectives and results.

Keywords: Controlled fusion – Electro-magnetic confinement – Laser-driven inertial fusion – clean energy production

Power Compensation of Shunt Capacitors for Hybrid Multi-Source Systems: Improving Voltage Stability and Reducing Losses

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Abstract. Radial distribution systems provide as inexpensive and straightforward interfaces between the power grid and customers. Unfortunately, these systems frequently experience significant power losses and voltage reductions, particularly as they get farther away from substations. This is mostly because the system doesn't provide enough reactive power. The placement and sizing of these capacitors present a problem. In this paper, a genetic algorithm (GA) method for solving the capacitor placement problem is presented. Finding the effective places and sizes for capacitors in distribution networks is the goal in order to reduce power losses and improve voltage profiles. Because it efficiently finds near-global solutions with little computational effort, the GA approach is used. Extensive case studies on IEEE 25, 35, 50, 70, and 120 bus systems are used to confirm the effectiveness of the proposed method and demonstrate its robustness and efficiency at different degrees of distribution system complexity. The outcomes show that capacitor placement can significantly increase both cost-effectiveness and energy efficiency. In the end, this research presents a GA-based method for resolving the capacitor placement issue, offering helpful advice and solutions to raise the efficiency and dependability of radial distribution systems.

Keywords: Radial distribution systems, Power Grid, Voltage Stability, Genetic Algorithm, Shunt Capacitor, Capacitor Placement IEEE Bus, Cost Effectiveness, and Energy Efficiency.

The Impact of Increasing the Number of Undulations of Undulatory Shape Distributed Along the Concave Surface of Savonius Wind Turbine Blade inspired by The Flower of Life Concept

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Abstract. This research aimed to quantitatively investigate the impact of increasing the number of undulation of a novel approach, known as the undulatory form inspired by the flower of life concept, on the performance of conventional SWT. This approach involves increasing the replaced concave surface of the conventional SWT with a series of small blades (distributed in convex and concave positions) positioned in an undulating pattern along the concave surface. ANSYS Fluent software is used to solve the unsteady Reynolds-Averaged Navier-Stokes (RANS) and the SST K-omega turbulence model equations. The experimental and the previous numerical data validated the innovative methodology, aiming to visualize its enhancement on both the moment and power coefficients of the wind turbine in a TSR range from 0.5 to 1, while maintaining a 15% OR relative to the rotor diameter and an inlet velocity of 7 m/s.

Keywords: CFD, power coefficient, Savonious, undulations, wind turbine.

Validation of the numerical model of a concentrated photovoltaic-thermal hybrid collector using TRYSYS

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Abstract. In a global climate context, an agreement has been reached to triple the world's renewable energy capacity and double energy efficiency by 2030. Solar energy is playing a key role in this process.In fact, solar systems, especially concentrated photovoltaic thermal (CPVT) systems, have received particular attention due to their efficiency and the diversity of their applications. The aim of the presentwork is to validate a numerical model for a CPVT hybrid collector, using TRNSYS simulations based on experimental results. Different simulations have been carried out for various solar irradiances, ambient temperatures, temperatures and flow rates of the heat transfer fluid in the collector. Thermal and electrical powers, considered as validation variables, were obtained. The results show good agreement between the model developed and the experimental results, with mean errors of 4.10% and 6.74% for electrical and thermal power, respectively. We conclude that the CPVT collector model on TRNSYS generates realistic results.

Keywords: Solar energy, Hybrid systems, Thermal systems, Concentrated Photovoltaic Thermal collector (CPVT), TRNSYS, Energy performance.

Optimization of Greenhouse Production: Energy Simulation and Strategic Planning for Off-Peak Market Periods

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Abstract. This study presents the optimization of strawberry, pepper, and tomato production in a greenhouse located in the region of Kenitra, Morocco. The objective is to reduce energy needs and increase revenues through better planning of production periods. A simulation was conducted using the TRNSYS software to estimate the heating and cooling needs of the greenhouse, and heatmaps were developed to identify the optimal production periods.

The results show that total energy needs can be reduced from 180,000 kWh to 63,000 kWh by optimizing the cultivation periods. The heatmaps helped identify the periods when crops can be produced with minimal energy costs while maximizing sales prices.

These optimization strategies have demonstrated their potential to reduce energy costs while increasing revenues. The combination of energy simulation, heatmaps, and precise planning allows for more efficient resource use and a significant improvement in profitability.

Keywords: Greenhouse production, Energy optimization, TRNSYS simulation, Heatmap, Kenitra, Production strategies, Profitability

Design and Optimization of Hybrid PV-Hydrogen Systems for Efficient Energy Storage and Balancing

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Abstract.

This work presents a methodology for designing a hybrid PV-H2 system by integrating weather data and electrical variables to balance energy between subsystems and evaluate their performance in terms of capacity and operation. The study focuses on Beni Mellal, Morocco, to identify optimal trade-offs between efficiency and component sizing. In directly connected systems, the electrolyzer (EL) operates at intersection points between PV output and EL input curves for different solar irradiance levels. The findings suggest that operating the EL at a fixed rate results in large PV and battery sizes and energy imbalances in winter and summer. A proposed solution is to operate the EL at a minimal load at night and adjust daytime operations to balance energy seasonally. The study highlights the potential of using solar energy to produce hydrogen for remote areas, offering an efficient energy storage solution in the form of hydrogen.

Keywords: Hybrid PV-Hydrogen System - Electrolyzer Operation - Solar Energy - Hydrogen Production- Energy Storage - Meteorological Data Integration - Green Hydrogen - Electrolysis

Three PV systems production forecasting using deep learning and statistical techniques

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Abstract. This study investigates the seasonal performance production and predicts the future performance of three silicon-based PV module technologies - polycrystalline, monocrystalline, and amorphous - using a seven-year production time series.

The primary objective is to compare the performance of these technologies and provide insights into their respective production degradation rates. The study employs SARIMA, Facebook Prophet, MLP, and LSTM time series forecasting tools to analyze and forecast the production performance of these technologies. Results indicate that the polycrystalline silicon PV system exhibits the lowest production performance degradation trend, while the amorphous silicon PV module technology shows significant annual production performance degradation trend. Evaluation of performance metrics suggests that the LSTM and MLP models may offer better performance based on the RMSE and MAE metrics.

Overall, this study provides valuable insights into the performance of different silicon-based PV module technologies and offers a framework for predicting future production performance trends using advanced time series forecasting tools.

Keywords: Performance Indicators, Facebook Prophet, SARIMA, MLP, LSTM, Silicon PV Technology.

A Computational investigation of a new hybrid system of a flat-plate solar collector with phase-change material and concentrator

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Abstract. This research presents an innovative method to improve hot water storage efficiency by integrating different types of Phase Change Materials (PCMs) into a solar collector with added solar concentration. The study examines five PCM variants: Paraffin 44, Paraffin 52-54, Paraffin wax, RT 70 HC, and hydrated salt (Barium Hydroxide Octahydrate). A theoretical model, based on energy equations and utilizing a one-dimensional approach, was developed to assess the thermal behavior of each component. This model was analytically solved and numerically calibrated to address the differential equations governing heat transfer. The finite-difference method (FDM) for numerical simulations discretized the system. The analytical results emphasized the critical role of PCM type, thickness, and the number of solar concentrations in boosting hot water storage, showing an increase of 2392 L/day compared to a concentrated collector without PCM. These findings highlight the significant potential of integrating PCMs with solar collectors to enhance hot water production efficiency.

Keywords: Phase Change Material, Solar water heater, Concentrator, hot water storage.

Modélisation du Temps de Cycle d'un AS/RS pour Optimiser les Coûts de Fonctionnement, accent mis sur les coûts énergétiques

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Abstract. Dans ce travail nous nous intéressons à l'évaluation de performances d'un système automatisé de stockage/déstockage AS/RS. Cette évaluation est basée sur deux paramètres très important : le temps de cycle et le débit. Nous avons pour but d'effectuer une modélisation du temps de cycle de la machine utilisée dans un tel système, sous conditions aléatoires, afin d'estimer différents temps de cycle moyens, particulièrement le temps de cycle multiple où la machine peut effectuer plusieurs taches et ainsi emprunter différents chemins possibles. Chacun de ces chemins représentant des distances parcourues avec une vitesse et chacun aura un coût de fonctionnement en termes de temps et implicitement de taux de rendement et surtout de coût énergétique, connaissant l'importance vitale de ce genre de systèmes dans la vie économique et logistique de nos villes et futures villes.

Pour un tel système, considéré comme un système à événements discrets (SED), notre idée consiste à modéliser le temps de cycle de la machine en utilisant un outil robuste et formel, celui des RdP temporisés (RdPT), afin de représenter les différentes distances parcourues et exprimer les temps consommés, les formules obtenues permettront de connaître le coût énergétique respectif et ainsi effectuer une optimisation du chemin afin d'optimiser les différents coûts particulièrement énergétique avec toutes les conséquences que cela aura sur les performances globales du système, notamment en termes d'efficacité et de productivité, mais aussi en termes d'amélioration de la conception c'est-à-dire l'espace et l'argent investis.

Notre travail est appliqué à un AS/RS à Racks Mobiles mais nous visons aussi à l'étendre à d'autres classes et configurations d'AS/RS.

Keywords: AS/RS à racks mobiles, évaluation des performances, réseaux de Petri temporisés, temps de cycle, optimisation, coûts énergétiques.

Experimental Energy Consumption Analysis and Optimization of ESP32-Based Wireless Sensor Nodes for Forest Fire Monitoring in Mechrouha, Northeastern Algeria

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Abstract. An innovative solution for forest fire monitoring is proposed, leveraging a wireless sensonetwork (WSN) based on ESP32 nodes equipped with cameras, BME680 gas sensors, and carbon monoxide (CO) sensors. The main objective of this system is to extend the operational lifespan ofthe sensor nodes by optimizing their energy consumption while maintaining a high level of reliability in fire detection. This approach is critical in large-scale monitoring applications where energy efficiency and node durability play a key role. The sensor network is composed of four primary nodes strategically placed on elevated points, designed with dual wireless communication technologies. For long-range communication, LoRa is utilized to connect these nodes, which are several kilometers apart. Meanwhile, NRF communication is used for short-range interactions, allowing each node to communicate with others within its local area of coverage. This hybrid communication architecture offers the advantage of covering large forested areas while reducing energy usage, as it selectively employs the most efficient communication protocol based on the node's distance from its peers. An experimental case study was conducted in the Mechrouha forest, located in Souk-Ahras, in northeastern Algeria, to validate the efficiency of this setup. The chosen test area is prone to wildfires, making it an ideal real-world scenario for the implementation of such a system. This context allowed us to propose a sensor network topology consisting of four groups of basic sensor nodes, each covering a surface area of one square kilometer, with each group controlled by a sink node installed on a mountaintop. The sensor nodes can operate in several modes, each having distinct energy consumption characteristics: Data acquisition: capturing images and/or collecting climate data (temperature, humidity, gas levels), Data processing: performing local computations on the acquired data, Data transmission and reception: sending and receiving information between nodes or to a central base station, Sleep mode: reducing power consumption when the node is not actively processing or transmitting data. Given these varied modes of operation, the energy consumption differs significantly across the modes, and it was crucial to accurately measure the power usage in each scenario. To achieve this, an experimental setup was designed consisting of the sensor node (ESP32 with camera, BME680 gas sensor, and CO sensor), connected to a digital

oscilloscope and a precision milliammeter. A precision resistor was placed between the power supply and the sensor node to convert the current drawn by the node into a measurable voltage, which could then be visualized on the oscilloscope. This setup enabled precise real-time measurement of the energy consumption during various node activities. A series of experiments were carried out to evaluate the node's power consumption in different scenarios: Image capture and transmission, Climate and CO data collection and transmission, Varying transmission data rates (to assess the impact of bandwidth on energy consumption), Activation and deactivation of the data integrity mechanism (CRC : cyclic redundancy check) to study its effect on power usage. These tests provided valuable insights into the energy requirements of each mode and led to the identification of optimal parameters for energy efficiency. The results demonstrated that power consumption can be significantly reduced by adjusting the operating parameters while maintaining the systems overall effectiveness in monitoring. In parallel to the optimization of node operation, the study also explored the potential for integrating environmental energy sources through Energy Harvesting to further extend the lifespan of the sensor nodes. These sources include: Solar energy, which can be harvested using small solar panels, Electromagnetic energy, collected from ambient electromagnetic fields and/or Vibrational energy, harnessed through mechanical vibrations in the environment. By incorporating these renewable energy sources, the nodes can be powered continuously, even in remote or hard-to-access locations, thus extending the duration of the monitoring system without frequent battery replacements. Additionally, the CO sensor presents a particular challenge in terms of energy consumption. This sensor relies on a heated sensing element, which draws a relatively high current even in standby mode. To mitigate this issue, a CMOS transistor-based circuit was added to control the sensor's power usage. The circuit allows the sensor to be powered on only when a CO measurement is needed, effectively reducing its overall energy consumption and further enhancing the nodes energy efficiency. The data captured by the sensor nodes, including climate measurements and images, are processed to detect early signs of wildfires. An image processing algorithm based on the HSV (hue, saturation, value) color model is used to analyze the captured images, detecting changes in color patterns that could indicate fire or smoke. In parallel, the Fire Weather Index (FWI), a widely used metric for assessing wildfire risk, is calculated using the environmental data gathered by the sensors (temperature, humidity, wind speed, and gas concentrations). The combination of image analysis and FWI calculations enables the system to provide real-time, accurate forest fire risk assessments. This dual-layer approach, combining real-time image-based fire detection with data-driven fire risk prediction, offers a robust solution for forest fire monitoring in high-risk areas such as Mechrouha. The system is designed to provide early warnings, potentially minimizing the devastating impacts of wildfires by enabling swift and informed decision-making by authorities.

Keywords: Forest - Internet Of things (IoT) - Wireless Sensor Networks (WSN) - ESP32 - BME680 - HSV colour - FWI Environmental Monitoring - Low Power Devices - energy efficiency - Long Range Communication (LoRa) - Fire Risk Management.

TH3 - Water management

Impact of Climate Change on Coastline Evolution: Case of the West African Coastal Areas

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Abstract. The aim of this study is to understand and quantify the impact of climate change on the coastline evolution. The case study is the southern Mauritanian coastline, which extends for approximately 300 kilometers, on the coastline between the port of Tanit and the port of N'diago, at the limit of the border between Mauritania and Senegal. It is a contrasting environment, characterized by great geological, geomorphological, climatic and biological diversity. The first step of the study was conducted within a 2 years WACA project (West Africa Coastal Areas Management Program) funded by the World Bank. The study allowed observations using Geodesic terminals and Pictures from satellite and drones. This second step is now conducted within a new collaboration between Mauritania, Japan and France and expect to include other actors, institutions in social, economic studies … The target is to extend the project beyond observations toward quantifications using adequate models. The project is therefore an academic research project towards practical solutions. The aim is the quantification of longshore sediment transport rates. The input data are wave conditions, direction, height, period. The expected outputs are longshore sediment transport volume / year. The study is using similar methods related to shoreline change, which demonstrated their effectiveness for other cases Benin-Ghana, Vietnam: Recent publications dealing with the sandy coast along the Bight of Benin and one related to shoreline change due to jetty construction, which is quite similar to our situation in Mauritania.

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https://www.worldbank.org/en/programs/west-africa-coastal-areas-management-program

https://www.wacaprogram.org/

Keywords: climate change, coastline evolution, southern Mauritanian coastline, WACA project, World Bank, Geodesic terminals, satellite, drones, quantification, models. longshore sediment transport rates, wave conditions.

Experience with desalination plants coupled with renewable energy for irrigation in Morocco: example of Dakhla Public-Private Partnership project

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Abstract. This paper presents a brief analysis of the experience of Morocco's Ministry of Agriculture in the field of seawater desalination, with particular emphasis on the Dakhla desalination plant, a major project in the region. The Dakhla desalination project is an innovative initiative aimed at integrating renewable energies into the desalination process through public private partnerships. It includes the construction of a 60 MW wind farm, which will provide the energy required for the reverse osmosis desalination process for the irrigation of 5200 hectares of a newly created perimeter. This approach will significantly reduce the carbon footprint of desalination, while ensuring a reliable water supply for the Dakhla region with a very favourable price. The article details the technical features of the project, including wind farm specifications, desalination and irrigation infrastructures and expected environmental benefits. These developments are essential to meet the growing need for water in Morocco's arid regions, while contributing to the transition to a more sustainable economy.

Keywords: Desalinations plants, Morocco, Dakhla, wind farm, renewable energy, public private partnerships, irrigation water, drinking water.

Evaluation des débits à l'exutoire d'un bassin versant à partir des données pluviométriques à l'aide du logiciel HEC-HMS

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Abstract. La sécheresse qui sévit en Afrique du nord, notamment dans la wilaya de Tizi-Ouzou en Grande Kabylie (Algérie), a des répercussions considérables sur l'écosystème, l'agriculture, l'économie et la vie quotidienne des populations. Face à ces défis, il est impératif de mettre en place des stratégies efficaces pour la gestion de l'eau depuis les précipitations sur les bassins versants. Il s'agit en premier de transformer les données climatiques d'un bassin versant donné en séries de débit, fournissant ainsi une sortie hydrologique ; c'est ce qu'on appelle une modélisation hydrologique.

Plusieurs modèles hydrologiques sont proposés dans la littérature et sont classés selon l'approche mathématique utilisée (déterministe et stochastique), selon le mécanisme (empirique, conceptuel et physique) et selon la variabilité spatiale à l'intérieur du bassin versant (global, semi-distribué et distribué).

Parmi les modèles les plus puissants, nous citons le HEC-HMS (Hydrologic Engineering Center-Hydrologic Modeling System), développé par le « hydrologic Engineering centre (HEC) » du corps de l'armée américaine des ingénieurs. Le HEC-HMS est un modèle déterministe, conceptuel et semi-distribué. A partir des évènements pluvieux, le modèle permet de faire un bilan hydrologique et de déterminer des hydrogrammes de crues nécessaires aux études de drainage urbain, de prévision des crues et de leurs impacts, de la conception des réservoirs ainsi que de la réduction des effets des inondations. Pour son calage, le logiciel nécessite des mesures de débit à l'exutoire du bassin versant. La qualité d'une simulation est lié au nombre de Nash.

L'objectif final est d'appliqué le logiciel HEC-HMS au bassin versant de Taksebt, situé en grande Kabylie (Algérie), dénué de station hydrométrique pour la mesure de débits, indispensables pour le calage du modèle. On s'est proposé alors d'appliquer le dit logiciel à de petits bassin versants, situés dans la même région et doté chacun de station hydrométrique à son exutoire, et de déterminer les paramètres optimaux, de production, de transfère et de routage, permettant les meilleurs calages des modèles, puis d'extrapoler ces paramètres au bassin versant de Taksebt sans se soucier du calage.

Nos résultats confirment que le logiciel HEC-HMS est délicat mais performant. Après calage des simulations, nous avons opté pour 'specified hyetograph' pour les données de précipitations, 'SCS Curve Number' pour l'estimation des pertes par infiltration, 'SCS unit hydrograph' comme fonction de transfère et 'Muskingum' comme fonction de routage. Enfin, plusieurs autres conclusions ont été tirées.

Keywords: HEC-HMS, bilan hydrologique, bassin versant, pluviométrie, infiltration, ruissellement, débit.

Combining Classifiers for Delineation of Raining Cloud over North Algeria and Mediterranean Sea

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Abstract. In this paper, we presented the application of the classifier combination technique to classify cloud systems, namely stratiform and convective systems. The data used come from the SEVIRI (Spinning Enhanced Visible and Infra-Red Imager) radiometric imager on board the MSG (Meteosat Second Generation) satellite. The methods were trained and evaluated with satellite and radar data of the rain event of October 10, 2018 in the south of France provided by Météo-France. This allowed us to evaluate and compare the performances for cloud identification of two methods frequently used in combination of classifiers.

Keywords: Machine Learning, Combining Classifiers, Bagging, Boosting, Stacking, Cloud Identification, Delineation Raining Cloud, SEVIRI, MSG, Radar.

Évaluation du phénomène sec/humide pour une gestion durable de l'eau à l'aide des chaînes de Markov

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Résumé. Le travail présenté dans cet article propose une évaluation spatio-temporelle du phénomène sec/humide durant la période des pluies dans le nord de l'Algérie, dans le but de fournir des prévisions de sécheresse pour une gestion durable de l'eau.

Nous avons utilisé les chaînes de Markov (CM) afin de modéliser le comportement du phénomène sec/humide, qui est catégorisé en neuf classes selon les valeurs de l'indice SPI (Standard Precipitation Index). Les données d'entrée proviennent d'estimations satellitaires des précipitations annuelles sur la période 1985-2021. La méthode a été validée par des prévisions à court terme, qui ont montré une bonne concordance avec les données réelles.

Mots-clés: Sécheresse, Chaîne de Markov, Prédiction.

Machine Learning-Based Soil Moisture Prediction Using Meteorological Data for Enhanced Irrigation Management

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Abstract. Effective irrigation management is crucial in modern agriculture to maximize crop yields and conserve water resources. Accurate estimation of soil moisture levels enables farmers to determine optimal irrigation schedules, which is essential for sustainable farming practices. Traditionally, soil moisture sensors have been employed to obtain precise measurements necessary for informed decision-making. However, these sensors can be unreliable due to malfunctions, high costs, maintenance challenges, or may not be installed at all in certain agricultural settings.

This study proposes a machine learning-based predictive system designed to estimate soil moisture levels using meteorological data, providing an alternative to physical soil moisture sensors. By leveraging readily available weather data, farmers can obtain accurate soil moisture estimates to inform irrigation practices without the need for extensive sensor networks.

We utilized a dataset sourced from Kaggle, which includes global meteorological parameters collected over several years. The dataset encompasses a range of weather variables such as temperature, precipitation, humidity, wind speed, and atmospheric pressure. Our methodology involved training several machine learning algorithms to predict soil moisture content based on these meteorological inputs. The algorithms used include:

- Decision Trees: Selected for their simplicity and interpretability, allowing for clear insights into which variables most significantly influence soil moisture levels.
- Random Forests: An ensemble learning method that enhances prediction accuracy by combining multiple decision trees and reducing the risk of overfitting.
- Artificial Neural Networks**: Employed for their ability to capture complex, nonlinear relationships between input variables and soil moisture levels.

The models were trained and validated using a portion of the dataset, with performance evaluated based on metrics such as mean squared error (MSE) and the coefficient of determination (R^2). The results indicate that these machine learning models can predict soil moisture levels with a high degree of accuracy. Among the models tested, the random forest algorithm demonstrated superior performance in balancing prediction accuracy and computational efficiency.

The proposed predictive system offers several advantages:

Cost-Effectiveness: Eliminates the need for expensive soil moisture sensors and associated maintenance costs.

- Scalability: Can be applied to large agricultural areas without the logistical challenges of deploying physical sensors.
- Accessibility: Utilizes readily available meteorological data, making the system accessible to farmers worldwide.
- Timeliness: Provides real-time or near-real-time soil moisture estimates based on current weather data.
- Sustainability: Promotes water conservation by enabling precise irrigation scheduling, aligning with environmentally sustainable farming practices.

By implementing this system, farmers can make informed irrigation decisions that optimize water usage and enhance crop yields, addressing challenges such as water scarcity and the impacts of climate change.

In conclusion, integrating machine learning techniques with meteorological data presents a viable and innovative solution for soil moisture estimation in agriculture. This approach has the potential to supplement or replace physical soil moisture sensors, offering a practical tool for improving irrigation management. Future work will focus on enhancing the model's accuracy and generalizability by incorporating larger and more diverse datasets, as well as exploring additional machine learning algorithms. Collaboration with agricultural experts and stakeholders will also be pursued to tailor the system to the specific needs of different crops and regions, further contributing to sustainable agricultural development.

Keywords: Soil moisture estimation - Machine learning in agriculture - Irrigation management- Meteorological data - smart farming -Water conservation- Decision Trees- Random Forests- Artificial Neural Networks- Predictive modeling Agricultural technology- Precision agriculture- Weather-based irrigation Crop yield optimization- Water efficiency

Developing an Innovative Artificial Ecosystem in the Wetlands of El Rym Annaba (Northeast Algeria)

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Abstract. The El Rym wetland, located in Annaba (Northeast Algeria), is a crucial ecosystem for local biodiversity. Facing increasing anthropogenic pressure and the effects of climate change, this wetland has experienced significant degradation in recent years.

As part of a sustainable development strategy, our study proposes to restore this site through an innovative approach focused on creating an artificial ecosystem. These artificial ecosystems consist of various vegetated basins and specific substrates, using local plants and integrating green energy. They not only treat wastewater and rainwater through phytotechnological solutions but also help valorize water, enhance biodiversity, and create an educational green space for local communities.

The objectives of this approach are multiple:

- Ecological Restoration: Restore the natural functions of the wetland, including hydrological regulation, water purification, and biodiversity conservation.
- Water Quality Improvement: Treat wastewater and rainwater using phytoremediation and natural filtration techniques.
- Creation of a Green Space: Develop a recreational and environmental education area for the local population.
- Flood Protection: Mitigate flood risks by increasing the site's water retention capacity.
- Enhancement of Natural Heritage: Highlight the biological and landscape richness of the region.

The creation of an innovative artificial ecosystem at El Rym presents a unique opportunity to combine sustainable development, environmental protection, and improvement of living conditions for local populations.

Keywords: TH1 - El Rym wetland, TH2 - Artificial ecosystem, TH3 - Wastewater and rainwater treatment, TH4 - Phytotechnology, TH5 - Green energy, TH6 - Sustainable development.

TH4 - Waste management

Traitement des eaux usées des huileries d'olive avec le pois chiche (cicer areitinum) comme coagulant naturel

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Résumé. Les effluents provenant des moulins à huile d'olive (OMW) posent un sérieux problème environnemental en raison de leur teneur élevée en composés toxiques et résistants, accompagnés d'une teneur en charge organique très élevée.

L'objectif de cette étude est d'examiner l'efficacité d'un traitement des OMW par flottation naturelle et coagulation-floculation, avec l'utilisation du pois chiche (Cicer arietinum) comme agent coagulant. Les résultats de l'analyse physico-chimique ont montré une demande chimique en oxygène (DCO) initiale de 201,6 g/L, ainsi qu'une turbidité de 10432,5 NTU, des polyphénols avec une concentration de 4,49 g/L. Après une phase de flottation naturelle, les taux de réductions de la pollution observés ont été de 66,33 % pour les polyphénols, 33,41 % pour la turbidité et 28,57 % pour la DCO.

Lorsque la flottation a été associée à la coagulation floculation avec le pois chiche, les résultats ont montré des réductions très remarquables, avec une élimination de 94 % de la turbidité, 60 % des phosphates, 86,67 % de la DCO, 82,42 % des polyphénols et 96,70 % des nitrates. Cette technique, utilisant le pois chiche comme coagulant, présente l'avantage d'être à la fois moins coûteuse et respectueuse de l'environnement., Elle peut être facilement mise en œuvre dans de nombreuses industries pour le traitement des effluents, tout en offrant une solution durable et économique aux défis liés à la gestion des eaux usées.

Mots clés : OMW, Traitement, Flottation, Coagulation-Floculation

TH5 - E-Health

Explainable AI for Diabetes Diagnosis

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Abstract. Whether young, old, type 1, type 2, gestational, newly diagnosed, long-time sufferer, caretaker or loved one, millions of people are afflicted and affected by diabetes. The World Health Organization (WHO) predicts that by 2030, diabetes will be the 7th leading cause of death in the world and estimated more than 422 million adults of the population in Worldwide, were living with diabetes, with millions more with prediabetes. Machine learning models have shown promising results in correctly identifying the presence of diabetes, which is essential for providing efficient treatment. However, their decision-making process is often considered a "black box" that lacks transparency and interpretability. In this project, we explore the use of SHAP and LIME, two popular explainable AI techniques, to generate local and global explanations for ML learning models. All the datasets used for the study is gathered from Kaggle, and split it into training and test sets, by using different kinds of machine learning algorithms, which would boost the success rate of therapy. Along with CatBoost, XGBoost, SVM, Random Forest, AdaBoost, Logistic Regression, LightGBM, and Decision Trees are a well-known model for predicting diabetes and managing the therapy. We then applied explainable AI techniques to generate explanations for the model's predictions on the test sets. Our results demonstrate that SHAP and LIME can effectively identify patterns in the symptoms of the patients and suggest a potential diagnosis or it can recommend further courses of action. In addition, this study also presents a comparative study of these algorithms based on various performance metrics like accuracy, recall, AUC-ROC, and F1 score, achieving the highest values on the test set, indicating the potential of combining ML and explainable AI for improving diabetes diagnosis and treatment.

Keywords: Machine Learning, Diabetes Prediction, SHAP, LIME, XAI.

TH6 - Professions of the future and related training courses

A survey of Open Innovation ecosystems and practices within 6 countries for regional policy recommendations

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Abstract. Open innovation is a consequence of globalization. Companies that wish to prosper can no longer do everything within them. The challenges of today and those of tomorrow are becoming more and more complex and the same company cannot do everything alone. Yes, open innovation is now daily; it is present in schools, large groups and start-ups. This is how we progress better today, by helping each other. Conversely, closed innovation consists of keeping your project confidential, which limits the possibilities of development but also the risk of project theft. In this paper, we discuss some analysis and we propose a survey of open innovation ecosystems and practices within six European countries, which will have an impact on regional level as regional policy recommendations. Open innovation consists of de-compartmentalizing the company's innovation process, by opening up some or all of the phases of its innovation process to other company departments or even other companies (suppliers, customers or other partners).

20 years ago, the open innovation concept appeared. This term was popularized by innovation researcher Henry Chesbrough in his book: The New Imperative for Creating and Profiting from Technology. Open innovation consists, for a company, in thinking about its innovation and its R&D, no longer from a closed point of view, but by integrating collaborations outside the department dedicated to innovation among employees or even with other companies or partners. Contests, hackathons, start-up incubators…

The objective of open innovation is to do business together, in order to make the value proposition even more relevant.

In this meaning, to take advantage of our strengths and build the future, it is no longer enough to invest; it is imperative to change the approach, to change the view of innovation. From the point of view of companies and their leaders, (...) innovation is the result of a global process in which R&D is only one ingredient among others, to be integrated into a complex organizational approach. Many of the innovations, that have transformed their market in recent years, are not mainly technological innovations. No innovation relies on creation or improvement to create value and differentiate itself from the competition. On the other hand, the different examples of agile innovation share a common point: the national and European innovation support systems would not have, until now, retained them, at least not for the core of their activity!

Keywords: close and open innovation, policy recommendation, innovation in learning, externalization and globalization

Extraction of linearly independent rows and dependency coefficients in datasets

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Abstract. This paper introduces a method for extracting all linearly independent rows from a dataset. The method isolates the rows that cannot be expressed as linear combinations of others, providing a systematic approach to identifying the truly independent rows within a dataset. Additionally, it computes the linear dependency coefficients for dependent rows, offering a clear representation of the relationships inside the set of dependent rows. This technique is valuable for simplifying datasets, reducing dimensionality, and gaining deeper insights into the underlying structure of linear dependencies in complex datasets. Ultimately, it aids in enhancing data analysis, improving model performance, and facilitating clearer interpretations in various fields, including statistics, machine learning, and data science.

Keywords: Linear Independence - Dimensionality Reduction- Matrix Algebra - Dependency Relationships

TH7 – Factories of the future, Materials & Physics

Analysis of mixed convection in a square ventilated cavity containing a non-Newtonian fluid and a heat-generating square block

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Abstract. Over the last few decades, the phenomenon of cooling heat-generating components by mixed convection has attracted a great deal of interest due to its wide implications in various engineering and industrial applications, particularly in energy-efficient cooling systems for smart grids, electric vehicles, data centers, nuclear reactors, and heat exchangers. In the present study, mixed convection in a ventilated square cavity containing a non-Newtonian fluid and a heat-generating block has been numerically investigated. The block, which is square in shape, is placed concentrically in the center of the cavity (see Fig. 1). Moreover, all cavity walls are kept adiabatic. The fluid inlet and outlet have a length equivalent to 10% of the cavity length. The physical control parameters are Reynolds number ($100 \leq Re \leq 500$) and power law index ($0.6 \leq n \leq 1.4$). The results show that the thermal and dynamic characteristics of the flow are modified considerably as the control parameters are varied. Also, increasing the Reynolds number leads to an intensification of the maximum flow intensity, and to better thermal management of the heat generated by the block. For a given Reynolds number, thermal management is more effective with a shear-thinning fluid than with a Newtonian or shear-thickening fluid.

Keywords: Mixed convection, non-Newtonian fluid, Heat generation block, ventilated Cavity.

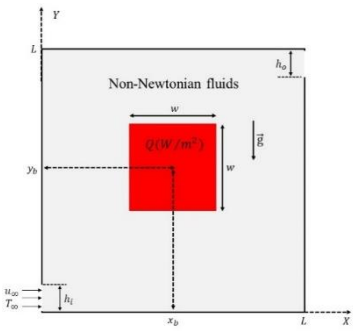

Fig. 1. Schematic of the physical model.

Microstructure and properties of Cu-bearing hypereutectic high chromium cast iron

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Abstract：In order to further improve the wear resistance of Hypereutectic High Chromium Cast iron (HHCCI), the effects of different Cu contents on the microstructure and properties of HHCCI were systematically studied. It was found that with the increase of Cu content, the carbide size was refined, and the increase of Cu content led to the increase of austenite and the decrease of hardness in as-cast HHCCI. After heat treatment at 1050 °C, the hardness of HHCCI increased significantly compared with as-cast. And with the increase of Cu content, the hardness of HHCCI increased first and then decreased, and the hardness was the highest when 0.5 wt.% Cu was added. The increase of copper content promotes the precipitation of secondary carbides and makes the interface between α-Fe and $M_{23}C_6$-type secondary carbides a semi-coherent boundary. With the increase of Cu content, the wear loss of HHCCI decreased after heat treatment at 1050 °C, and the wear resistance improved. When the Cu content increased to 1.0 wt.%, the wear resistance of HHCCI was the best, which was 2.6 times that of copper-free HHCCI. The continued increase of copper content has no obvious effect on the wear resistance of HHCCI. In addition, a small amount of Cu tends to adsorb on the (0001) preferential growth surface of M_7C_3-type carbides, thereby refining the carbides. From the First-principles calculations, the solid solution strengthening effect of Cu on the matrix and the adsorption and refinement of carbides were revealed, and the influence mechanism on the wear resistance of HHCCI was characterized.

Key words: Hypereutectic high chromium cast iron; Cu alloying; Carbides; Wear resistance; First-principles calculations

Optimization of an Evaporation System: A Comparative Analysis of ADMM and Quadratic Programming

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Abstract. This paper explores the optimization of an evaporation system by comparing two methods: the Alternating Direction Method of Multipliers (ADMM) and Quadratic Programming (QP), along with the analytical approach.

The study aims to evaluate the performance of each method in terms of accuracy, convergence, and computational efficiency. The results show that QP provides solutions closely aligned with those from the analytical method, exhibiting only minor differences. However, ADMM yields slightly divergent results, particularly for certain system parameters, offering an alternative approach with more flexibility in handling constraints. The comparative analysis underscores the strengths of QP for straightforward, smaller-scale problems, while ADMM demonstrates its potential in handling more complex optimization scenarios. This study provides key insights into the practical application of these optimization methods for enhancing the performance of evaporation systems.

Keywords: Evaporative system, optimization, ADMM, Quadratic programming

Structural, electronic, optical and thermoelectric properties of $FrSnI_{3-x}F_x$(X=0, 1, 2, 3) perovskites using the TB-mBJ approach

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Abstract.

In this study, we investigate the structural, optical, electronic, and thermoelectric properties of $FrSnI_{3-x}F_x$ (x = 0, 1, 2, 3) perovskites using density functional theory with the modified Becke-Johnson method (TB-mBJ) for exchange correlation functions. This research is the first theoretical investigation of these promising materials. Our results show that each variant of the perovskite exhibits p-type semiconductor behavior, and that the energy gap of FrSnI3 can be tuned by substituting an iodine atom with fluorine. This substitution causes a significant variation in the energy gap, ranging from 1.169 eV to 2.951 eV. In particular, the FrSnI2F compound stands out with a direct gap of 1.539 eV, making it an ideal candidate for solar cell applications. Optical properties, including real and imaginary dielectric function components, absorption and refractive indices, highlight the performance of these materials. Their high absorption capabilities suggest that these perovskites can be tailored and integrated into optical and optoelectronic devices in a variety of spectral ranges.

Furthermore, thermoelectric property calculations using BoltzTrap software show that $FrSnI_{3-x}F_x$ (x = 0, 1, 2, 3) has a promising Seebeck coefficient and an impressive figure of merit approaching unity at high temperatures. These results underscore the immense potential of these materials in thermoelectric applications, opening the door to new possibilities in energy conversion technology.

Keywords: TH1 - TB-mBJ, TH2 - Band gaps, TH3 - Dielectric function, TH4 - Seebeck coefficient, TH5 - Thermal conductivity, TH6 - BoltzTraP code

Detection of wheat diseases with deep learning

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Abstract. Wheat constitutes an essential agricultural commodity on a global scale, playing a pivotal role in ensuring food security and enhancing human nutrition. With an annual production surpassing 750 million metric tonnes, it represents approximately 20% of the total caloric intake worldwide. Principal challenges encompass yield stagnation, repercussions of climate change, and the imperative for enhanced disease resistance.
Wheat, a fundamental alimentary crop, experiences yield reductions specifically attributable to three distinct species of rust fungi, namely leaf rust, stem rust, and yellow rust. All these contribute to significant reductions in agricultural yields. The detection of these pathological conditions is predominantly conducted through manual inspection by human observers; however, when implemented on a larger scale, this methodology becomes labor-intensive, temporally demanding, and susceptible to human inaccuracies. Consequently, there exists a pressing requirement for a robust and efficient system that facilitates the early-stage identification and classification of these diseases.

This paper aims to develop a robust deep learning-based model for real-time detection of wheat rust diseases. Given the critical importance of accurate and timely disease identification, for enhancing agricultural productivity and food security. To address this challenge, we explore the performance of YOLOv5 models for plant disease detection using a high-quality dataset. Our focus is on evaluating the model's ability to accurately detect rust diseases under various conditions, including different variations in size, color, position, and lighting.

For this purpose, a dataset including the specific disease, brown rust, was obtained. The cross-platform tool Google Colab was used for data analysis and the Python programming language was implemented. The acquired data was used for both training and evaluation of the models. We sourced our dataset from Kaggle. The images in the dataset have diverse characteristics, including various colors, orientations, quality levels, and resolutions. The dataset contains two classes: wheat brown rust disease (leaf rust)

and healthy wheat leaves. The labeling tool was used to annotate ground truth boxes around each instance of wheat leaf disease in the training dataset.

In this step, a model is built to detect infected wheat leaves using the YOLOv5 algorithm. YOLOv5 is a version of YOLO known for its high detection accuracy and fast inference speed, making it suitable for real-time detection on embedded devices. Compared to other YOLO versions, YOLOv5 offers higher detection accuracy, lightweight characteristics, and faster detection speed. The YOLOv5 architecture is particularly effective for plant disease detection, especially in identifying diseases on wheat leaves.

To improve the model's generalization, data augmentation was used to enhance the training data, maintain diversity, and adjust the distribution of images. Moreover,, by applying the selected YOLO model to the preprocessed dataset, the model will be trained to detect infected wheat leaves. To optimize the model's performance, several parameters will need to be adjusted for the specific dataset of infected wheat leaves. These parameters include the optimizer, learning rate, epochs, image size, batch size, and loss function.

In conclusion, this work introduces an innovative methodology for the detection of plant diseases via the application of a deep learning framework. Advanced deep learning techniques, such as Convolutional Neural Networks (CNNs) and YOLO algorithms to achieve high accuracy and efficiency in disease detection.are essential for distinguishing healthy and diseased wheat leaves.
The efficiency and precision associated with the detection and identification of these diseases are notably elevated with this system.

Keywords: - Food security - Plant disease detection - Wheat rust disease - Deep learning - Convolutional neural networks - Yolov5.

An investigation of CO2 laser pattern creation on Polydimethylsiloxane thin film surface in daytime passive radiative cooling

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Abstract.

Passive daytime radiate cooling (PDRC) has been driving people's attention in recent years, which aims to let objects radiate energy to the cooler outer space and cool down without any energy input during direct sunlight. It takes advantage of certain materials that reflect in the UV-visible spectrum region or emit in the infrared region. The thermal radiation is selectively emitted through the atmospheric transparent window, where the atmosphere has minimal absorption to the energy emitted at 8-13 μm. With these kinds of materials covered on the building, the building can cool down during the daytime. Polydimethylsiloxane (PDMS) is a commonly used organo-silicon polymer that has great flexibility, transparency, and non-toxicity. It also has a strong emission at the atmospheric transparent window. The average emissivity of PDMS in 8-13 μm is about 0.95, and to obtain an even higher emissivity, creating micron-meter scale patterns on the PDMS surface can enhance the emissivity to 0.99. However, the creation of the patterns needs non-green solvents and mold, and a large amount of waste can be produced if massive production of patterned PDMS film is needed. Here, we proposed a potential mold-free and solvent-free pattern creation method by sending a CO2 laser at an appropriate intensity to an uncured PDMS surface, and the surface responds to having a self-forming pattern. Two types of patterns are observed on the surface: one grows around the CO2 beam contact area, and the other grows inside it. We are also able to selectively cure PDMS thin film by manipulating the laser intensity and distance between the laser and the film.

Advancements in PMMA Nanoparticle Synthesis for Drug Delivery Applications

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Abstract. The development of effective drug delivery systems remains a cornerstone of modern pharmaceutical research, with a significant focus on enhancing the precision and efficacy of therapeutic interventions. Among various strategies, the use of polymer-based nanoparticles has shown considerable promise in achieving controlled and targeted drug delivery. Polymethyl Methacrylate (PMMA) nanoparticles offer a versatile platform for drug encapsulation due to their biocompatibility and tunable properties.

This study explores the synthesis of PMMA nanoparticles utilizing the nanoprecipitation technique, a method renowned for its ability to produce nanoparticles with controlled size and distribution. Our research involves the optimization of synthesis parameters to enhance encapsulation efficiency and stability of therapeutic agents. Comprehensive characterization of the nanoparticles is conducted, including size distribution, morphology, and release kinetics, to assess their potential for targeted drug delivery applications.

The findings from this study provide valuable insights into the practical applications of PMMA nanoparticles in drug delivery, highlighting their potential to improve therapeutic outcomes through precise delivery and controlled release of active pharmaceutical ingredients.

Simulation and performance evaluation of a stochastic discrete-event model of car sharing networks

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Abstract. In recent years, car-sharing systems have gained worldwide attention as a new solution to mobility problems such as pollution reduction and congestion. The operation of these transport systems needs a rigorous control and a suitable management strategy to have a high quality of service.In this paper, we develop an original discrete-event approach for modeling and analyzing the performance of car-sharing systems using stochastic Petri nets, taking into account their dynamic behavior under constraints such as battery charging and car maintenance.


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