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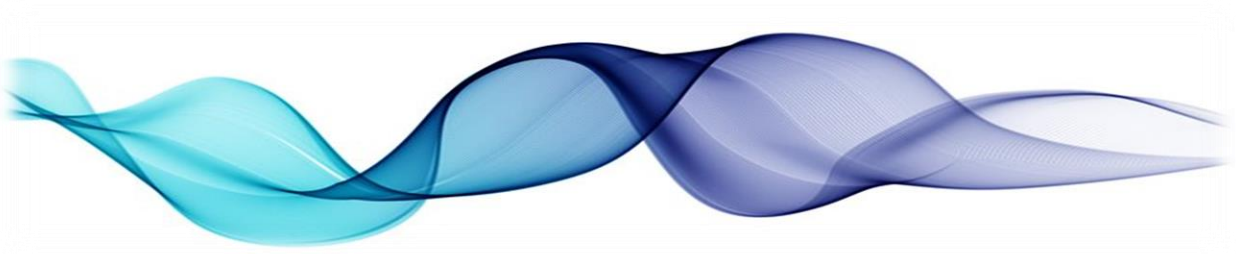

Welcome To CISTEM 2022 !

The International Conference on Electrical Sciences and Technologies in Maghreb (CISTEM), is a federative event that brings together the Maghrebian electrical specialists. It is also a performant exchange channel aiming to increase inter-Maghreb interactions and international visibility.

The first three editions in Tunis, Marrakech and Algiers (CISTEM 2014, CISTEM 2016 and CISTEM 2018) were successful and CISTEM is becoming a regular biennial event that aims to organize a wide number of plenary conferences, round tables, as well as special workshops dealing with the wide fields of Electric Engineering related topics.

The 4th edition of CISTEM, IEEE CISTEM 2022, is held in Tunis from October 26th to 28th, 2022, at INSAT, University of Carthage. It foresees the participation of maghrebian and international exhibitors, as well as round tables to exchange experiences about cooperation between Industry and University. Furthermore, CISTEM 2022 aims to reinforce maghrebian networks for research in Electrical Sciences and Technologies and extend them to European ones. A particular focus is addressed on Socio-Economic challenges of Energetic and Technological transition in these regions.

Welcome to CISTEM 22 where you can share experiences and ideas in the Electrical Sciences and Technology field and discover (or rediscover) the beauty of the cultural, geographical, and historical riches of Tunis!

Afef BEN ABDELGHANI-BENNANI,
Manef BOUROGAOUI,
and Jamel BELHADJ
CISTEM 2022 General Chairs

Ilhem SLAMA-BELKHODJA
CISTEM 2022 Honorific Chair

CISTEM 2022 is hosted by:

جامعة قرطاج
Université de Carthage

INSAT
المعهد الوطني للعلوم التطبيقية و التكنولوجيا
Institut National des Sciences Appliquées et de Technologie
1996

CISTEM PERMANENT COMMITTEE

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Abdelouaheb	MEKHALDI	Ecole Nationale Polytechnique, Algiers, Algeria
Ilhem	SLAMA-BELKHODJA	University of Tunis El Manar, Tunis, Tunisia

4th IEEE INTERNATIONAL CONFERENCE ON ELECTRICAL SCIENCES AND TECHNOLOGIES IN MAGHREB

FOR MORE INFO
cistem2022.sciencesconf.org

26-27-28 OCTOBER 2022

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ALSTOM

Leading societies to a low carbon future, Alstom develops and markets mobility solutions that provide sustainable foundations for the future of transportation. From high-speed trains, metros, monorails, trams, to turnkey systems, services, infrastructure, signalling and digital mobility, Alstom offers its diverse customers the broadest portfolio in the industry. 150,000 vehicles in commercial service worldwide attest to the company's proven expertise in project management, innovation, design and technology. In 2021, the company was included in the Dow Jones Sustainability Indices, World and Europe, for the 11th consecutive time. Headquartered in France and present in 70 countries, Alstom employs more than 74,000 people. The Group posted revenues of €15.5 billion for the fiscal year ending on 31 March 2022.
Log onto www.alstom.com for more information..

MEDREC

The Mediterranean Renewable Energy Centre - MEDREC- is a think-tank and an operational platform for regional cooperation. Its core mission is to support and boost collaboration for Sustainable Development and energy transition in the Mediterranean region mainly through the design and the implementation of projects with support from different funding agencies

STEG

The Tunisian Electricity and Gas Company was created in 1962, its mission is the production, transportation and distribution of electricity and natural gas on Tunisian territory. Specific STEG electrification policy enabled Tunisia to reach, urban electrification rate of nearly 100% and the rural electrification rate of 99%

IMPERIX

Imperix develops high-end control equipment and prototyping hardware for power electronics, drives, smart grids, and related topics. Its products are designed to enable cutting-edge innovation in corporate and academic environments. They are especially valued for their ability to accelerate the implementation of laboratory-scale power converters and facilitate the derivation of high-quality experimental results. T he company also offers various levels of integration services, intended to assist its customers in their prototyping activities. As such, its offering ranges from the delivery of plug-and-play hardware and software, to that of fully customized systems involving specialized control software algorithms.

CISTEM 22 SPONSORS

BYD

Founded in February 1995, BYD is a high-tech company devoted to leveraging technological innovations for a better life. After more than 27 years of high-speed growth, BYD has established over 30 industrial parks across 6 continents and played a significant role in industries related to electronics, auto, renewable energy and rail transit. With a focus on energy acquisition, storage, and application, BYD offers comprehensive new energy solutions with zero-emission.

PV-NeTE

PV-NeTE is a PAQ-COLLABORA Project. Its main target is the development of research and training environment to look for New Energy Technologies (NeTE) using an innovative platform according to the PHIL principle (Power Hardware-In-the-Loop). The first Unit is a Renewable Energy Storage System prototype, based on power electronics and advanced controls, that can connect and disconnect from an electrical distribution network integrating photovoltaics. The second Unit is a Smart Transformer digital prototype. The 3rd Unit is a PHIL Platform PHIL that studies different scenarios of integration rate of solar roofs in Tunisia

IFT

L'Institut Français de Tunisie is the tool allowing the reception of the public around many aspects of the cooperation between France and Tunisia: educational and linguistic, academic, scientific, cultural and audiovisual cooperation between Tunisia and France.

Tunisie Telecom

Tunisie Telecom is the incumbent telecom operator in Tunisia. It has more than 6 million subscribers in the fixed and mobile telephony, in Tunisia and abroad. It also plays an important role in improving the rate of internet penetration in Tunisia, which allowed it to eventually have 140,000 subscribers at the end of April 2008.

PLENARY SPEAKERS-CISTEM 2022

PLENARY 1: Wednesday, 26 October 2022, 09:00-09:45

Chairman: Mohamed GABSI

Défis et Enjeux de la Mobilité Electrique 3D pour le Transport de Charges Lourdes

Sylvain Allano

FLYING WHALES, France

Résumé:

Il existe dans le monde et plus particulièrement dans des régions difficilement accessibles des besoins considérables de transport de charges lourdes. Tous les domaines d'activité sont concernés, notamment les énergies renouvelables, les productions agricoles et agroforestières, la logistique et les interventions médicales et humanitaires. Depuis dix ans, une équipe de pionniers a décidé de concevoir et de fabriquer une flotte de grands dirigeables, en revisitant l'impressionnant savoir-faire technique développé dans les premières décennies du siècle dernier et en y intégrant des technologies nouvelles et des concepts innovants. Les dirigeables de FLYING WHALES bénéficieront d'une portance hélium et seront pourvus d'un système de propulsion électrique d'une puissance crête de 4 MW, qui sera d'abord hybride (biocarburant-turbogénérateur-distribution électrique) puis hydrogène-électrique"

Biographie:

Sylvain Allano, ancien élève de l'ENSET et agrégé de physique appliquée, a été chercheur au CNRS, professeur à l'ENS de Cachan et directeur scientifique adjoint en charge de la section 08 au département STIC du CNRS devenu désormais INSIS. Il a été directeur scientifique du groupe automobile PSA devenu STELLANTIS, et est actuellement directeur scientifique de la compagnie FLYING WHALES. Il a créé plusieurs entreprises dont une basée au Maroc sur l'innovation dans le domaine de la mobilité 3D.Il intervient également comme conseil en propriété industrielle auprès de start-up et d'organisations de recherche.

PLENARY 2: Wednesday, 26 October 2022, 09:45-10:30

Chairman: Mahmoud HAMMOUDA

Ouassim Aidi

ALSTOM Tunisia

Leadership Portrait in Energy Transition

Biography:

Post Graduate Diploma (PGD) holder from University of Roehampton, with 12 years' experience in multicultural environments in Middle East and Europe.

Coming from Real Estate & Construction Industry, Ouassim AIDI has a progressive path in Alstom since 2015 until recently being nominated Alstom Tunisia and MENAT (Middle East, North Africa and Turkey) HR Business Partner.

In current capacity Ouassim works with businesses in 13 countries on the realization of organization goals as well as supporting local HR teams. At cluster level, Ouassim works on HR transversal projects and initiatives.

PLENARY 3-a: Wednesday, 26 October 2022, 09:45-10:05

Chairwoman: Ilhem SLAMA-BELKHODJA

Radhouane Dakhli

STEG, Tunisia

Programme SMART GRID de la STEG : un Appui à l'Amélioration des Performances des Réseaux Electriques

Résumé:

Le 'Programme Smart Grid de la STEG' est présenté en tant que vecteur d'innovation technologique et un appui à l'amélioration des performances dans la gestion du système électrique tunisien. En effet, eu égard à la forte dimension technologique amenée par le concept, les solutions et infrastructures Smart Grid seront de nature à permettre:

- La contribution à l'atteinte des objectifs stratégiques de la STEG
- Une évolution dans les processus Métiers et l'efficience du Système Electrique
- L'appui à la transformation digitale de l'entreprise
- Un support à la Recherche et Développement et à l'Innovation via les projets collaboratifs.

Les grandes lignes de la présentation:

- Présentation du programme Smart Grid et de ses enjeux
- Méthodologie STEG / Feuille de Route
- Solutions Technologiques / Projets en cours et Perspectives
- Impacts sur les Métiers/ Appui à la Transformation Digitale
- Opportunités de Recherche et Innovation et Projets Collaboratifs

Biographie:

Diplômé en Génie Electrique de l'Ecole Normale Supérieure de l'Enseignement Technique (ENSET de Tunis, 1995), Radhouane DAKHLI est actuellement Chargé du Département Réseaux du Futur à la Direction de Maîtrise de la Technologie à la STEG.

PLENARY 3-b: Wednesday, 26 October 2022, 10:05-10:30

Chairwoman: Ilhem SLAMA-BELKHODJA

Moez JOMAA,

SINTEF, Norway

SOFEM: Solar Fueled Maritime Mobility in Tunisia Project

Abstract:

The project "Solar Fuelled Electric Maritime Mobility" by SINTEF seeks to demonstrate the feasibility and the social, economic and environmental benefits of solar-fuelled electric boat transport in Tunisia and the wider region. The overall objectives of the project are:

-Build a demonstration case of solar fueled electric ferry.

-Perform cost-benefit analysis and feasibility assessment of renewable energy based maritime public transport.

-Organize capacity building workshops for relevant stakeholders and influencers.

Biography:

Graduated with PhD and MSc degrees from Sorbonne University, Moez Jomaa had 15+ years of experience as a Senior Scientist at SINTEF, the largest research organization in Scandinavia. He is specialist in solar technology and industry 4.0. He is an invited speaker and panellist at several United Nations conferences on the sustainable development goals and in particular SDG7.

PLENARY 4: Thursday, 27 October 2022, 09:00-9:45

Chairwoman: Ilhem SLAMA-BELKHODJA

Sami SIALA

GE Power Conversion

Architectures De Puissance Dans les bateaux à propulsions électriques et économies d'énergie : Défis et Tendances

Résumé:

La présentation traitera de l'évolution des architecture électriques dans les bateaux à propulsions électriques, et les méthodes pour les économies d'énergie par augmentation du rendement en navigation et les solution d'alimentation à quai.

Biography:

Sami was born in Tunisia. He attended Sfax Technical and Sciences University and received The Electrical Engineering degree in 1987, The M.S. Degree in Electrical Engineering in 1988 from the Institut National Polytechnique of Toulouse, France, and the Ph.D in Electrical Engineering in 1992. Sami began his career in 1992 as an Assistant professor with the Engineering School Saint Nazaire (ESAIGELEC). In 2000 He joined Alstom Power Conversion as R&D Senior Engineer. In 2004, he became the Head of the R&D Electrical Power System department. Then, in 2006 Power Conversion left ALSTOM for Converteam LMBO, he moved to the subsea O&G team as The Technical Manager of the Ormen Lange subsea Compression station. In 2008, Sami was appointed at the Converteam Engineering Design Center in India as R&D Director, where he built the R&D team in Chennai. Following that, in 2012 after integration of Converteam in GEPC, he joined the Chief Engineering office as Chief Application SW Architect. Recently he is appointed Consulting Engineer. He is author and co-author of more than 70 Scientific papers and Holds 5 patents, in the area of Medium Voltage System, Design and Control. Since February 2019, He is Leading the Electrical System Engineering and Technology, in the role of Technical Director of General Electric Power conversion France.

ALSTOM

• mobility by nature •

PLENARY 5: Thursday, 27 October 2022, 09:00-9:45

Chairman: Mohamed BOUDOUR

Iyad Dayoub

Université Polytechnique Hauts-de-France

Technologies Émergentes Pour La 5G et au-delà: Applications et Défis dans les transports intelligents

Résumé:

Dans cette conférence, nous présenterons les technologies récentes et émergentes pour les communications cellulaires futures 5G/6G. En particulier, nous dressons un bilan sur les avancées dans les différentes technologies actuellement discutées pour ces systèmes futurs telles que l'IoT, les communications M2M, MIMO massif et les communications millimétriques ainsi que l'accès non-orthogonale NOMA.
En outre, les applications de ces technologies dans les systèmes de transport intelligents (ITS) seront discutées d'abord dans le contexte des systèmes existants. Ensuite, nous discutons les défis et les futures orientations de recherche en Europe visant le développement de futurs systèmes européens de transport terrestre (ferroviaire et véhiculaire).

Biographie:

Iyad Dayoub est Professeur à l'Université Polytechnique Hauts-de-France (UPHF) et à l'Institut National des Sciences Appliquées/Hauts-de-France (INSA-H-d-F). Il a reçu les diplômes de Master et Doctorat de l'Institut National Polytechnique de Lorraine (INPL) en 1997 et de l'Université de Valenciennes en 2001. Ses activités de recherche actuelles sont développées à l'Institut d'Électronique, de Microélectronique et de Nanotechnologie (IEMN CNRS UMR 8520), où il est le responsable du groupe COMUM. Il est membre senior de l'IEEE et membre de plusieurs comités consultatifs de conférences internationales, de comités de programmes techniques et de comités d'organisation tels que VTC, GLOBECOM, ICC, PIMRC, WWC, etc. Il est lauréat de plusieurs prix, dont le prix de Outstanding IEEE Publication Award (2018).

PLENARY 6 : Th

Chairman: Hamid BEN AHMED

Towards Greener Aircrafts: Multidisciplinary Design Optimization of Hybrid Electric Propulsion System

Xavier ROBOAM

LAPLACE, University of Toulouse

Abstract:

The aviation sector currently accounts for around 2-3% of global CO2 emissions and a “flight shame” feeling is asserting itself in a portion of the population, especially among young people. Thus, Electrification is a key driver in this direction especially with hybrid and full electric architectures. Three main directions are on the road of hybrid electric aircrafts: Thermal engine optimization, aerodynamic optimization and Energy management optimization that will be the main focus of this keynote. But “more embedded weight in devices and systems means an increased wing surface also involving more fuel burn”. In that context, the “hunt for kilos” is opened and huge level of power integration and energy efficiency is required to make electric solutions competitive. But if a high level of integration is required at technological device level, the “system integration’’ optimizing main couplings at powertrain or if possible at aircraft level is a second major driver to lower the whole embedded weight. So, multidisciplinary design optimization (MDO) involving integrated devices through surrogate models is appropriate. In order to emphasize these issues, this keynote will describe a MDO process of the powertrain system for a series hybrid electric architecture applied to a regional flight mission.

Biography:

Xavier Roboam received the Ph.D. Degree of ‘Université de Toulouse’, France in 1991. He is full-time CNRS researcher (Directeur de Recherches) in the Laboratory of Plasma and Conversion of electrical Energy (LAPLACE) of Université de Toulouse since 1992. He is currently the deputy Director of LAPLACE. He has been consultant expert for Airbus in the framework of “new architectures and integrated design of electrical networks and systems” during 10 years until 2016. He has published more than 300 references with 12 edited books. His current research interests include integrated optimal design of multi-field systems for transport and embedded networks (more electrical aircraft) or smart microgrids.

PLENARY 7: Thursday 27 October 2022, 09:45-10:30

Chairman: Sami HLIOUI

Yacine AMARA

University of le Havre, France

Improving Power Density and Torque Density of Synchronous Machines

Abstract:

This contribution discusses the degrees of freedom that could be advantageously exploited in the conception of synchronous machines in order to improve their power density and/or torque density. The aim is to inventory degrees of freedom identified in scientific and technical literatures. Identifying these additional degrees of freedom will help positively respond to highly constrained design problems, which are appearing due to the higher usage of electrical energy in many industrial and consumer products. The goal is also to stimulate new ideas in the design of synchronous machines.

Biography:

Yacine Amara (S'00–M'03–SM'18) was born in Algiers, Algeria, in 1975. He received the Ingénieur d'Etat degree from the Ecole Nationale Polytechnique, Algiers, in 1997 and the Ph.D. degree in electri-cal and electronic engineering from the University of Paris South XI, Paris, France, in 2001. From 1998 to 2001, he worked toward the Ph.D. degree with the Laboratoire d'Electricité Signaux et Robot-ique (LESiR), Ecole Normale Supérieure de Cachan, Cachan, France. From 2003 to 2004, he was a Research Associate with the Department of Electronic and Electrical Engineering, University of Sheffield, Sheffield, U.K. From 2004 to 2007, he was a Lecturer with the Department of Electrical Engineering, Technical University of Belfort-Montbéliard, Belfort, France. Since 2008, he has been with the Groupe de Recherche en Electrotechnique et Automatique du Havre (GREAH), University of Le Havre, Le Havre, France, where is currently a Full Professor. His research interests include the design, modeling, and control of rotating and linear permanent-magnet machines for automotive and renewable energies applications.

PLENARY 8 : Friday 28 October 2022, 09:00-9:45

Chairman: Férid KOURDA

Bernardo Cougo

IRT Saint Exupéry, France

Next Generation Of Power With Sic And Gan Components

Abstract:

Wide bandgap devices, such as SiC and GaN, increase power converter's efficiency and power density but they significantly affect Electromagnetic Interference and Partial Discharge issues in power electronic systems. This tutorial starts with introduction about modern Power Electronics issues and the gain on using WBG technologies. State of the art concerning the research, production and commercialization of GaN and SiC transistors is then presented.in order to precisely design high density converters, accurate dynamic characterization of such components is necessary. A more accurate characterization method is described, which gives precise information on switching energy, speed and voltage overshoot during commutation for many different parameter variations. They are important data used to calculate filtering devices to reduce EMI issues and overvoltage on cables and loads connected to the converter applications using WBG components is presented. Details on the impact of SiC components in power drive systems will be addressed as well as some solutions to reduce overvoltage and EMI filtering in this system.

Biography:

Bernardo Cougo worked as a post-doctorate fellow at the PES Laboratory, at ETH-Zurich, in Switzerland and also at LAAS and LAPLACE laboratories in Toulouse, France. His is currently working as a Senior Power Electronics Expert at the French Institute of Research IRT Saint-Exupery.He has taught in different universities in Brazil and France, and he is currently a lecturer at ENSEEIHT/INP on subjects related to power electronics integration and Wide Bandgap semiconductors. He advises several Ph.D. students and Post-doctorate fellows on research projects related to SiC module design and SiC converters, mainly for aircraft applications. He has more than 60 publications since 2008 about power electronics integration and WBG semiconductor characterization and applications.

PLENARY 9: Friday 28 October 2022, 09:00-9:45

Chairman: Georges BARAKAT

Sami HLIOUI

CY Cergy Paris Université-SATIE

Optimisation Des Machines Électriques pour les Applications à Forte Compacité: Problématiques et Méthodologies

Abstract:

Les attendus des systèmes de conversion électromécanique ont considérablement évolué et se sont largement complexifiés : cycles de fonctionnement complexes intermittents, voire stochastiques, fonctionnalités accrues, performances massiques et volumiques sévères, intégration, environnement contraignant, durabilité et recyclabilité, etc. Ces attendus ont engendré, soit de nouvelles contraintes devant être prise en compte dès la phase de conception, soit l'exigence de recherche de nouvelles architectures et topologies de conversion, soit encore l'élaboration de modèles et de méthodes avancés. La machine électrique, organe central, de ces chaines de conversion, a alors subi ces nouvelles contraintes et exigences et de nouvelles stratégies de dimensionnement doivent être établies.. À travers la présentation de différentes problématiques et méthodologies de dimensionnement par optimisation de machines électriques, des méthodologies spécifiques de réduction de temps de calcul seront également détaillées.

Biography:

Sami Hlioui est professeur des universités à Cergy Paris Université (CYU) - France et chercheur au laboratoire SATIE de l'école Normale Supérieure Paris-Saclay (ENS-PS) - France. Il a obtenu son grade de Master recherche de l'école Normale Supérieure de Cachan - France, son doctorat de l'université de technologie de Belfort Montbéliard – France en 2008 et son habilitation à diriger des recherches (HDR) en 2018 de l'école normale supérieure Paris-Saclay, France. Ses axes de recherche portent sur la modélisation multi-physiques des transducteurs électromagnétiques (modélisation électromagnétique BF (0..10kHz) et HF (100kHz..10MHz), thermique et mécanique) ainsi que l'établissement de méthodologies de dimensionnement et d'optimisation des machines électriques pour les applications embarquées (automobile et avionique).

PLENARY 10: Friday 28 October 2022, 09:45-10:30

Chairman: Sami SIALA

Alben CARDENAS

Université du Québec à Trois-Rivières, Canada

Systèmes De Recharge et Électrification des Transports

Résumé:

L'électrification des transports est une nécessité pour la réduction des émissions de gaz à effet de serre. Nous assistons à un bouleversement technologique et économique autour des nouvelles technologies pour le transport de marchandises et de personnes. Les véhicules électriques, hybrides rechargeables et à pile à combustible devront prendre une grande part du marché d'ici quelques années. Toutefois, pour utiliser ces nouveaux véhicules nous devons avoir des infrastructures de recharge adaptées, disponibles et efficientes. Nous abordons donc le sujet des « Systèmes de recharge et Électrifiacation des transports » pour donner, du point de vue technologique, un aperçu de la situation actuelle, les perspectives et les défis.

Biography:

Alben Cardenas (Member, IEEE) received the B.S. degree in electronic engineering from Antonio Nariño University, Villavicencio, Colombia, in 2003, and the M.A.Sc. and Ph.D. degrees in electrical engineering from the University of Quebec at Trois-Rivières (UQTR), Canada, in 2008 and 2012, respectively. He was a Researcher with the Hydrogen Research Institute (HRI), UQTR, where he was also a Lecturer with the Electrical and Computer Engineering Department, from 2011 to 2019. He is currently a Professor at the Electrical Engineering Department of UQTR. He is a member of the Research Group on Industrial Electronics (GREI), and the Hydrogen Research Institute (HRI) of UQTR. His research interests include control, embedded systems, and artificial intelligence applications for smarts grids, renewable energy, distributed generation, power electronics, and VLSI technologies for energy conversion and power quality applications. In 2009, he joined the Ordre des Ingénieurs du Quebec, where he received the engineer's permit, in 2013. He is also a member of the IEEE Power & Energy Society, the IEEE Industry Applications, and the IEEE Industrial Electronics Society.

PLENARY 11: Friday 28 October 2022, 09:45-10:30

المركز المتوسطي للطاقات المتجددة

MEDREC

MEDITERRANEAN RENEWABLE ENERGY CENTRE

SPECIAL SESSIONS

Special Session 1: Wednesday 26 October 2022, 14:00-16:00 and 16:30-17:30

Title: **Mobility**

Organized by: **IFP Energies Nouvelles**

Description:

IFP Energies Nouvelles (IFPEN) is a major player in research and education in the fields of energy, transport, and the environment. From scientific concepts in fundamental research to technological solutions in applied research, innovation is at the heart of its activities, which are structured around four strategic orientations: climate, environment, and circular economy; renewable energies; sustainable mobility; responsible hydrocarbons. As part of the public interest mission assigned by the public authorities, IFPEN focuses its efforts on providing solutions to the societal and industrial challenges of energy and the climate, in support of the ecological transition. IFPEN's engineering school, IFP School, is an integral part of IFPEN and prepares future generations to meet these challenges.

To accompany the electrification of the transport sector, IFPEN's work covers the development of innovative, efficient, high power density electrical machines and their power electronics. To be in line with research and industrial needs, IFP School regularly adapts its educational programs to train engineers who are immediately operational in the sustainable mobility sector. The main objective of this session is to share our know-how in terms of research and teaching to achieve sustainable, clean and accessible mobility for all.

Special Session Chair: **Ouafaé El Ganaoui-Mourlan**

SPECIAL SESSIONS

Special Session 2: Thursday 27 October 2022, 14:00-16:00 and 16:30-17:30

Titre: **Défis Socio-économiques de la Transition Energétique**

Organisé par: **Le Centre d'Etudes et de Recherches Economiques et Sociales, CERES**

Description:

La session a pour but d'évoquer les freins socio-économiques actuels rencontrés par les pays dans leur transition écologique et énergétique, de discuter aussi des atouts et des spécifiés du Maghreb, étudier la nécessité ou non de constituer des lieux d'échanges entre les spécialistes des Sciences Humaines et Sociales et ceux des sciences exactes et la manière d'introduire les aspects socio-économiques et la transition énergétique dans les programmes universitaires ?

Participants :

M. Mounir MAJDOUB : Expert international en transition énergétique et développement durable, ex-Secrétaire d'État de l'environnement.

Mme Mariem LAZAAR : Maître de Conférences au Laboratoire des Procédés Thermiques, LPT du Centre de Recherches et des Technologies de l'Energie (CRTEn), Technopole de Borj Cedria.

M. Ali ABDALLAH, Enseignant-Chercheur, CERES.

M. Abderrahmen MERSANI Enseignant - Chercheur, CERES.

Professeur Youssef BEN OTHMAN Directeur général du CERES.

ROUND TABLES

ROUND TABLE : Thursday 27 October 2022, 17:30-18:30

Titre: Apports de la diaspora dans l'enseignement/ recherche pour faire face à la transition énergétique dans les pays du Maghreb..

Chairwoman : Walfa CHOUKI, Directrice Générale de Alstom Tunisie et Vice-Présidente RH Alstom AMECA Region

Walfa Chouki, Vice-Présidente des Ressources Humaines pour l'Afrique, le Moyen-Orient et l'Asie centrale (AMECA), dirige et coordonne plus de 16 pays. Elle est notamment en charge de la stratégie des RH de la région AMECA afin de soutenir la croissance interne et externe.

De formation marketing et management international, Walfa est aussi accréditée coach par le Coaching Training Institute (CTI).

Forte d'une expérience multinationale de 20 ans en Ressources Humaines et en gestion d'entreprise, Walfa a fait ses preuves dans la gestion d'équipes multiculturelles dans des environnements hautement matriciels et en évolution rapide. En effet, Walfa a conçu et déployé un programme de changement d'entreprise mondial et des initiatives de développement organisationnel pour un groupe comptant plus de 90 000 employés dans plus de 70 pays (chiffre d'affaires annuel de plus de 23 milliards d'euros).

En 2021, passionnée par le développement du leadership, elle obtient un Diplôme International Board Director par la prestigieuse INSEAD Business School.

En 13 juillet 2022, Alstom lui confie la direction générale d'Alstom Tunisie ; elle est responsable de la partie commerciale et du développement industriel dans le pays.

TECHNICAL TRACKS

Special Session SS 1	Mobility
Special Session SS 2	Socio-Economic aspects of Energy Transition
TT 1-1; TT 1-2	Power Electronics
TT 2	Optimization in Electrical Systems
TT 3	Renewable Energy Integration
TT 4	Power Systems & Electrical Grid
TT 5-1; TT 5-2; TT 5-3	Microgrids
TT 6-1; TT 6-2; TT 6-3	Photovoltaic Systems: Characterization and Diagnosis
TT 7	Automatics & Robotics
TT 8	Image Processing
TT 9	Robotics & Telecommunication
TT 10-1; TT 10-2	Electrical Machines Diagnosis & Control
TT 11	Electrical Grid: Power Quality and Stability
TT 12	Electromagnetics in Electrical Systems
TT 13	Energy Management in Electrical Systems
TT 14	Electrical Machines Design
TT 15	Energy Transition
TT 16	Energy Storage Systems
TT 17	Applied Physics in Electrical Systems
TT 18	Electric Vehicle

CISTEM 22 Scientific Program - Overview

	Tuesday 25 October	Wednesdsday 26 october	Thursday 27 october	Friday 28 October
08:00- 08:30		Registration @Welcome Desk		
08:30-9:00		Opening Session @Auditoirum	Registration @Welcome Desk	Registration @Welcome Desk
09:00-09:45		Plenary 1 Sylvain ALLANO (45')@Auditorium	Plenary 4 Sami SIALA (45')@Conference Room1 / Plenary 5 Iyad DAYOUB (45')@Conference Room2	Plenary 8 Bernardo COUGO (45')@Conference Room1 / Plenary 9 Sami HLIOUI (45')@Conference Room2
09:45-10:30		Plenary 2 Ouassim AIDI (45')@Conference Room1 / Plenary 3 Radhouane DAKHLI Moez JEMAA (45')@C.R.2	Plenary 6 Xavier ROBOAM (45')@Conference Room3 / Plenary 7 Yacine AMARA (45')@Conference Room4	Plenary 10 Alben CARDENAS (45')@Conference Room3 / Plenary 11 BYD (45')@Conference Room4
10:30-11:00		Coffee Break	Coffee Break	Coffee Break
11:00-12:40		TT 1-1 @C.R.1 / TT 2 @C.R.2 / TT 3 @C.R.3 / TT 4 @C.R.4	TT 6-2 @C.R.1 / TT 11 @C.R.2 / TT 12 @C.R.3 / TT 5-3 @C.R.4	TT 16 @C.R.1 / TT 10-2 @C.R.2 / TT 17 @C.R.3 / TT 18 @C.R.4
12:40-14:00		Lunch	Lunch	Lunch
14:00-16:00		SS1-1 @Auditorium / TT 5-1 @C.R.1 / TT 6-1 @C.R.2 / TT 7 @C.R.3	SS2-1 @Auditorium / TT 1-2 @C.R.1 / TT 13 @C.R.2 / TT 10-1 @C.R.3	Closing Session @Auditoirum
15:00-18:30	Registration @welcome desk			
16:00-16:30		Tea Break	Tea Break	
16:30-17:30		SS1-2 @Auditorium / TT 5-2 @C.R.1 / TT 8 @C.R.2 / TT 9 @C.R.3	SS2-2 @Auditorium / TT 14 @C.R.1 / TT 6-3 @C.R.2 / TT 15 @C.R.3	
17:30-18:30		Round Table 1 @Auditorium	Round Table 2 @Auditorium	

PRESENTATION INSTRUCTIONS

FOR ALL ORAL CONFERENCES

As the schedule of presentation sessions is tight, it is of utmost importance that all presenters are ready and in time for their presentations. The introduction of each presenter will be kept brief when introduced by the chairman's.

1. **Your presentation must be in English or French**
2. **Your presentation must be saved as PowerPoint or PDF format on a USB key**
3. **Your presentation should be uploaded on the computer located in the conference room before the beginning of your session**

PLENARY SESSIONS

You will have 45 minutes: 35 minutes for presentation and 10 minutes for questions.

TECHNICAL TRACKS

You will have 20 minutes: 15 minutes for presentation and 5 minutes for questions.

CISTEM 2022: SPECIAL SESSIONS

SS1 • Special Session: Mobility

SS 1-1		WEDNESDAY 26 October (14:00 AM – 16:00 PM) @Auditorium Chair: Ouafae El Ganaoui-Mourlan
2656 **14:00**	30’	Adan Reyes Reyes, Andre Nasr, Delphine Sinoquet and Sami Hlioui. *“Robust design optimization taking into account manufacturing uncertainties of a permanent magnet assisted synchronous reluctance motor”* ***Abstract*** In this paper, a robust design optimization of a permanent magnet assisted synchronous reluctance machine was performed to increase its mean torque while reducing torque ripple. This optimization was carried out using a surrogate model based on 2-D finite element simulations. The results of the robust optimization which took into account manufacturing uncertainties were compared to a deterministic optimization using 2-D finite element simulations. The robust designs have shown not only good mean torque and torque ripple performances, but they have also shown improved robustness.
7793 **14:30**	30’	Abdelli Abdenour, Ralph Sindjui, Baptiste Chareyron and Adrien Gilson. “*Analysis of the impact of end effect and power cable length on the power – speed characteristics of six phase PM-SynRel”* ***Abstract*** This paper deals with the investigation of the influence of different parameters such as end effect and power cable length on the machine performances. This influence is highlighted for the extra low voltage applications (< 60 V DC) using six-phase permanent magnet assisted synchronous-reluctance machines. The investigation presented in this work combines different methods such as 3D finite elements, experimental tests, and information from technical data sheets. Firstly, the machine is designed using 2D finite element analysis, and then tested using two test benches, the first one with long cables and the second with short cables. The experimental power- speed characteristics obtained by these tests are compared to those obtained with simulations. The impact of the real modulation index, end effect and power cable length on the power speed characteristics is evaluated.
6143 **15:00**	30’	Rebecca Mazloum, Sami Hlioui, Luc Laurent, M'Hamed Belhadi, Guillaume Mermaz-Rollet and Mohamed Gabsi. “*On the use of surrogate models for drive cycle automotive electrical machine design”* ***Abstract*** Surrogate models have become a widely used solution for reducing computation times along design processes. In this work, a Gaussian Process surrogate model is built and used to predict the performance and losses of an electrical machine in a fast manner. This approach is relevant, especially for drive cycle calculations that rapidly generate rising computation costs if they are computed using physical models, especially finite elements analysis. We present in detail the established method and a comparison of the obtained results with finite elements results.
8213 **15:30**	30’	El Hadj Miliani, Ouafae El Ganaoui-Mourlan, Yacine Amara and Peter Janas. *“Teaching of Thermal Behavior of Electrical Machines and Batteries at IFP School, France”* ***Abstract*** In this contribution, the authors present the academic experience of teaching the thermal behavior of electrical machines and batteries at IFP School (France) for master’s degree students. The evolution of teaching programs at IFP School in relation with the energetic transition, experienced all around the word, will be first introduced. The focus will be then placed on the description of the course dedicated to the study of the thermal behavior of electrical machines and batteries. More precisely, it is the modeling of thermal behavior which is discussed.

SS 1-2		WEDNESDAY 26 October (16:30 AM – 17:30 PM) @Auditorium Chairs: Ouafae El Ganaoui-Mourlan
2589 **16:30**	20’	Arthur Piat, Pierre-Etienne Lévy, Sami Hlioui, François Costa and Sébastien Serpaud. “*AC motor impedance HF modeling for designing with winding variability*” Abstract ***Abstract*** This paper presents a unified predictive modeling for common-mode (CM) and differential-mode (DM) impedance estimation of a Permanent Magnet Synchronous Motor (PMSM). This methodology combines 2D Finite Element modeling and generated lumped parameter circuit in Spice environment. It is then used to determine the consequences of design choices and evaluate the importance of controlling the winding process in the PMSM fabrication. By doing so and by changing parts of the PMSM design, the overall high frequency response of the system with regards to input parameters can help in satisfying EMC high frequency constraints (between 1 kHz and 10 MHz)
9563 **16:50**	20’	Théodore Cherrière, Sami Hlioui, Mohamed Gabsi, Luc Laurent, François Louf and Hamid Ben Ahmed. “*Topology Optimization of Flux Switching Machine Rotors”* ***Abstract*** This paper investigates the topology optimization of the rotor of a 3-phase flux switching machine with 12 permanent magnets located within the stator. The objective is to find the steel distribution within the rotor, maximizing the average torque for a given stator, permanent magnets, and electrical currents. The optimization algorithm relies on density methods based on gradient descent. The adjoint variable method is used to compute the sensitivities efficiently. Since the rotor topology depends on the current feedings, this approach is tested on several electrical periods. The obtained structures are then analyzed and classified.
8026 **17:10**	20’	Chaima Zammali, Lahoucine Idkhajine, Sami Hlioui, Thach Ngoc Dinh, Gilles Rostaing and Hamid Ahmed. “*PDC control strategy for a synchronous machine subject to magnetic saturations”* Abstract ***Abstract*** This paper presents a Parallel-Distributed-Compensation (PDC) control strategy for a highly saturated synchronous machine, represented by a continuous-time Takagi-Sugeno (T-S) model. The proposed control law is provided to guarantee the stability of the closed-loop system as well as trajectory tracking. Based on Lyapunov's theory and the α-stability concept, new conditions are formulated and solved using a finite set of Linear Matrix Inequalities (LMIs). Finally, a numerical example is introduced to illustrate the relevance of the proposed approach.

SS2 • Special Session: Socio-Economic Aspects of Energy Transition

SS 2-1		Thursday 27 October (14:00 AM – 16:00 PM) @Auditorium Chair: Naoufel Ziadi
14:00	2h	CERES
SS 2-2		**Thursday 27 October (16:30 AM – 17:30 PM) @Auditorium Chair: Naoufel Ziadi**
16:30	1h	CERES

CISTEM 2022: TECHNICAL TRACKS

TT1 • Technical Track: Power Electronics

TT 1-1		WEDNESDAY 26 October (11:00 AM – 12:40 PM) @C.R.1 Chairs: Othman Hasnaoui, Khoukha Imarazene
6426 **11:00**	20’	Lotfi Saidi, Adla Ismail, Mounir Sayadi and Mohamed Benbouzid. “*PHM of Power Electronic Converters in Renewable Energy Systems: A Review With Some Applications*” ***Abstract*** A great number of research works have been devoted to both the advances in electronic power converters and renewable energy sources, either connected to the grid or isolated. The combination of these two important research subjects is quite important, as the urgency of facing the challenge of replacing fossil energy with renewable energy becomes paramount. There has been a growing and an unprecedented number of technical problems and challenges in the last few years stemming from this pursuit. The purpose of this study is to highlight approaches for predicting electronic power converters’ future behavior and estimating their remaining useful life (RUL) to define an effective maintenance schedule.
7335 **11:20**	20’	Ahmad Ammar Naassani, Mohamed Wissem Naouar, Ahmad Deya Sukary, Mohamad Assi and Eric Monmasson. “*Analysis, Synthesis and Implementation of a Direct Current Control Strategy for Three-Phase Grid Connected Converter”* ***Abstract*** This work presents the analysis, synthesis and implementation of a direct current control strategy for a three-phase Grid connected Converter (GcC). The considered control strategy is aimed to control the grid current vector in the d-q reference frame. For that, two switching functions linked to the d-q components of the grid current vector were defined. These switching functions were utilized to deduce rules that allow an appropriate selection of the GcC voltage vector for the control of the grid current vector components during full and low loads, during transients and steady-state operation. In order to show the performances of the developed control strategy, simulation tests were carried out and compared with the results of two direct current control strategies: A three-Hysteresis Controllers (3HC), and a two- Hysteresis Controllers using six-Sectors Switching Table (2HC-6SST). The obtained results confirmed that the proposed control strategy decreases the switching frequency while maintaining a good value of the Total Harmonic Distortion factor (THD) of the grid currents. Also, the DC-link voltage fluctuations during severe and sudden change of the transferred active power are reduced.
3939 **11:40**	20’	Khoukha Imarazene, Yacine Bouali and El Madjid Berkouk. “*Three-Level Space Vector PWM Implementation for Neutral Point Clamped Inverter using a Hardware Description Language”* ***Abstract*** The development of digital hardware technology has caused the rapid growth of complex algorithms implementation used in power electronics. The work carried out in this paper is about the study of the structure of the three-phase three-level Neutral Point Clamped inverter. Its mathematical model as well as its control by space vector modulation. Moreover, this modulation technique was implemented using VHDL, the developed design was verified using simulation under ModelSim software.

6842 **12:00**	20’	Kawther Ezzeddine, Manel Merchaoui, Mahmoud Hamouda, Hadi Youssef Kanaan and Kamal Al-Haddad. “*A PSO-Based MPPT Algorithm for Grid-Connected Photovoltaic Current Source Inverter”* ***Abstract*** Maximum power point tracking (MPPT) controllers are a key element in photovoltaic (PV) energy conversion systems since they allow extracting the maximum power from PV generators. Metaheuristic algorithms such as the particle swarm optimization (PSO) are nowadays widely adopted and have shown their superiority to many other techniques. In this paper, a PSO-based MPPT algorithm is implemented to extract the maximum power from a grid-connected current source inverter (CSI)-based PV system. CSIs are, inherently, single-stage boost-type topologies, which allow the injection of high-quality sinusoidal AC currents with controllable power factor into the grid with a DC-link voltage level lower than the grid voltage. A space vector with pulse width modulation (SVPWM) technique is developed to, properly, control the CSI’s power switches and an appropriate proportional integral (PI) DC-link current controller is designed to ensure that the real power injected into the grid is equal to the maximum power that can be extracted from the PV panel under all conditions. A numerical co-simulation of the overall PV system is realized using Matlab/Simulink and PLECS and the obtained results show the effectiveness of the proposed techniques for grid-connected PV applications.
5106 **12:20**	20’	Merabet Hichem, Bedoud Khouloud, Bahi Tahar and Drici Djalel. “*Short-Circuit Fault Diagnosis in PWM Inverter Based on Fuzzy Logic Approach of photovoltaic system connected to Grid”* ***Abstract*** this work presents a novel procedure for detection and localization fault in PV systems connected to grid. Aiming at the short-circuit fault (SCF) detection in the tow level inverter, using conventional fault diagnosis method based on the normalized current average of absolute value of currents (AAVC), last that used as input to fuzzy inference system (FIS), This method can address the reliability problem of multilevel inverters in renewable electrical generation systems and can dramatically reduce the number of required sensors. The global model of the system is built using MATLAB/Simulink. Simulation results are presented showing the diagnosis approach performance under distinct operating conditions
TT1-2		**THURSDAY 27 October (14:00 AM – 16:00 PM) @C.R.1** **Chairs: Férid Kourda , Nesrine Belhaj Youssef, Abdelli Abdenour**
7712 **14:00**	20’	Cheikh Abdel Kader, Nadia Ait-Ahmed, Azeddine Houari, Mourad Ait-Ahmed, Menny El Bah and Ali Djerioui. “*A Robust Voltage Control based on Intelligent PI Controller for Grid Forming Inverters”* ***Abstract*** In this paper, a robust free-model control is proposed in order to ensure power quality enhancement of grid forming inverter. The proposed controller is based an intelligent proportional-integral controller with an adaptive gain to enforce the disturbance rejection ability. The design steps of the adaptive controller are presented. The effectiveness of the proposed control is verified by extensive simulation tests under MATLAB/Simulink and a comparison study a conventional PI controller is provided to highlight the performances of the proposed controller.
8798 **14:20**	20’	Ibtissem Abari, Mahmoud Hamouda, Mohammad Sleiman, Jaleleddine Ben Hadj Slama, Hadi Y. Kanaan and Kamal Al-Haddad. “Fault Diagnosis of Single-Phase Five-Level Packed U-cell Inverter under Different Load and Variable Working Conditions” ***Abstract*** Open-circuit fault under different load and variable working conditions is the most severe issue that affects the robustness of fault diagnosis algorithms. Considering this, this research work proposes a high-frequency fault diagnosis approach that is capable to detect and isolate a single open-switch fault in a single-phase five-level Packed U-Cell (PUC5) inverter, not only under stable conditions but also under different load and variable working conditions. Firstly, a high frequency model of the PUC5 inverter is proposed. Then, the conducted emissions, measured

		across the electromagnetic interferences filter resistor, are employed as a fault signature. Finally, simulation results are considered to verify the effectiveness of the proposed fault diagnosis method.
9043 **14:40**	20’	Manel Jebali Ben Ghorbal and Moamed Wissem Naouar. “*A systematic design methodology for power MOSFET gate drivers”* ***Abstract*** Gate driver circuits are a key element for reliable turn on and turn off of power MOSFETs. The gate drive circuits are composed of relevant elements like gate drive IC, gate resistor, bypass capacitor, isolated power supply, etc. These elements as well as their features should be accurately selected and analyzed to ensure safe switching process of power MOSFETs. For this purpose, this paper presents a step-by-step methodology for the design of a basic gate driver circuit for power MOSFETs. The interest of the proposed design methodology is demonstrated by applying it to a case study. Also, several simulation results are presented to show the effectiveness of the proposed design methodology.
2848 **15:00**	20’	Imen Abdennabi, Nathalie Batut, Ambroise Schellmanns, Lionel Jaouen, Fabrice Roqueta, Arnaud Yvon and Sophie Ngo. “*Modeling of carrier lifetime based on deep-Level transient spectroscopy for power PIN diodes*” ***Abstract*** The dynamic performances of PIN diodes are very difficult to predict with Technology Computer-Aided Design (TCAD) simulation tools, especially when the carrier lifetime is adjusted. The standard simulation model used in TCAD tools is based on Shockley-Read-Hall (SRH) recombination theory. This model is not sufficient as it considers the presence of only one deep energy level located at the material mid-gap. Used as a lifetime killer, Platinum doping introduces several deep energy levels facilitating the minority carrier recombination. Thus, a new approach based on trap physical description is performed using Deep Level Transient Spectroscopy (DLTS) measurement technique. This approach has significantly reduced the big mismatch observed between the PIN diode turn-off measurements and the standard simulation model results.
1724 **15:20**	20’	Khalil Wali, Manel Jebali Ben Ghorbal, Mohamed Wissem Naouar and Houssem Ouali. “*Effect of parasitic inductances on the switching responses of eGaN HEMTs*” ***Abstract*** Compared to Silicon (Si) transistors, Gallium Nitride (GaN) transistors offer superior features and advantages. In fact, GaN transistors have better performances in terms of thermal capacity, switching frequency range, switching losses, power rating, etc. Therefore, they can be considered as an appropriate solution for high power density energy conversion systems. In return, they are subjected to several challenges like the necessity to reduce parasitic inductances resulting from the layout of power converters. With the addition of the inherent GaN inductances, a non optimized power converter layout can lead to important voltage ringing and increased power losses. This is mainly due to the high dv/dt across GaN transistors during the switching process. In this context, this paper studies the effect of parasitic inductances on the switching responses of a half bridge converter. The considered converter is built using enhancement mode GaN based High Electron Mobility Transistors (eGaN-HEMTs) and is tested through a Double Pulse Test (DPT) under LTspice software. To show the great effect of parasitic inductances, two model levels were simulated and compared. The first one does not include any parasitic inductances while the second one is a complete model that includes the internal eGaN-HEMTs parasitic inductances in addition to the external ones related to the half bridge converter layout. Simulation tests considering the cases of optimized and non-optimized layouts were analyzed and compared to demonstrate the need for a layout optimization in order to minimize external parasitic inductances.
8146 **15:40**	20’	Hanen Messaoudi, Manef Bourogaoui and Afef Bennani Ben Abdelghani. “*Design of a smart and fast charger for Electric Vehicles”* ***Abstract*** Electric vehicles (EVs) have proven to be a perfect short-term solution to reduce gas emissions and air pollution worldwide. However, the widespread accessibility of EVs is limited by diverse economic, technical, and policy restrictions. The battery's short lifetime and the long charging time are among the most critical EV issues. Therefore, there are extensive research works that deal with the EV battery charger design. In this paper, the design and simulation of a smart and fast EV battery charger based on a Vienna Rectifier (VR) and an isolated Dual Active Bridge (DAB) converter is presented. The

		designed charger is based on the CHAdeMO charging protocol allowing a smart data transfer between the battery and the charger. Simulation tests performed on Matlab/Simulink prove the efficiency and the rapidity of the proposed charger.

TT2 • Technical Track: Optimization in Electrical Systems

TT 2		WEDNESDAY 26 October (11:00 AM – 12:40 PM) @C.R.2 Chairs: Mahmoud Hammouda, Sami Hlioui
6526 **11:00**	20’	Gherbi Yamina Ahlem and Lakdja Fatiha. “Dynamic economic emission dispatch concidering valve point effect and variale active losse using new optimization method” ***Abstract*** Nowadays, the problems related to the operation of the transport networks and the production of electrical energy have taken on considerable importance. Faced with ever-increasing electricity consumption and very restrictive environmental conditions, electrical energy networks tend to grow and become more and more meshed and interconnected.The main role of any company responsible for the production of electrical energy is to ensure, at any time and in any place, the coverage of user demands for active and reactive power. The company must also guarantee an acceptable quality of power with a reduced operating cost. Our article deals with multi-criteria optimization by metaheuristics. These criteria are oriented towards dynamic economic/environmental dispatch (DEED) that treats the impact of the cost of production and the emission of toxic gases as competing objectives. Which requires some form of conflict resolution to reach a solution. This is why we need efficient optimization algorithms. Firefly Algorithm (FA) and Bat Algorithm (BA) are two nature-inspired metaheuristics. These two methods have been studied and adapted to solve our multi-objective optimization problem while respecting the constraints. At the end of this work, the hybridization of FA and BA was proposed. The purpose of this hybridization is to combine the advantages of both methods, and thus improve their performance. The effectiveness of this new method has been demonstrated by applying it to 5 units test system.
5598 **11:20**	20’	Ndeye Khady Diop Dieng, Oumar Ba, Niang Boubacar, Thiaw Lamine, Gueye Samba and Ndiaye El Hadji Mbaye. “*Improvement of convergence speed of particle swarm optimization algorithm: application to Maximum PowerPoint Tracking control of a photovoltaic generator”* ***Abstract*** The photovoltaic system (PVS) studied in this article consists of a photovoltaic generator (PVG) supplying a battery through a step-down chopper. The objective of the work is to speed up the convergence of the particle swarm algorithm in order to find the maximum power point of the photovoltaic generator. For this, a modified version of the Particle Swarm Optimization (PSO) algorithm suitable for our PVS is applied to the control of the DC-DC converter in order to accelerate de maximum power point of the generator. The developed algorithm is simulated in Matlab-Simulink for uniform dynamic irradiation and temperature on the PVG. The obtained results show that for an estimated MPPT control efficiency of at least 99.7 %, the improved PSO algorithm converges to near MPP with a smaller number of iterations than the PSO without improvement in all test cases.
4819 **11:40**	20’	Ahmed Jridi, Jaouher Chrouta, Hachmi Khaterchi, Abdelrrahmen Zaafouri and Ramzi Ramzi Ben Messaoud. “*Optimization of a Peltier influence cooling system for photovoltaic cells”* ***Abstract*** Temperature rise is one of the most crucial challenges for sun-concentrating photovoltaic systems, since it affects cell performance and promotes cell breakdown. To solve this issue, a novel cooling technique based on the Peltier effect is devised and studied. To cool the PV cell, a Peltier module is placed beneath it in this setup. These measures are combined to generate a hybrid photovoltaic-thermoelectric (PV-TE) module that uses both the photovoltaic and Peltier effects. When the Peltier module is turned on, the cell returns to normal functioning at ambient temperature, with a

		maximum power of 2.0488W
4358 **12:00**	20’	Amal Haj Slama, Lotfi Saidi and Majdi Saidi. “*Optimal Sizing for Renewable Hybrid Energy Systems: A Review With Some Applications”* ***Abstract*** This paper reviews the recent classification, evaluation criteria, and sizing methods dedicated to hybrid renewable energy systems.Artificial intelligence is the most promising sizing method compared to traditional sizing methods. Indeed, a Multi-objective application dedicated to the dilemma of financial-energy security cost is presented.
5116 **15:00**	20’	Intissar Moussa, Mouna Zerzeri and Adel Khedher. Robust WTE Sensorless “*Design based on Soft-VSI sturcture for Three-Phase IM Drive using Sliding Mode Observer Controller”* ***Abstract*** In this paper, a Sliding Mode Observer (SMO) for flux and then speed-sensorless of three-phase Induction Motor (IM) as robust Wind Turbine Emulator (WTE) design is investigated. A Soft-Voltage Source Inverter (VSI) structure, which is controlled by a specific Space Vector Modulation (SVM), is applied to drive the IM. Hence, appropriate three vectors which synthesize the desired output voltage are selected to allow the proposed system to react as a real turbine considering the wind velocity, static and dynamic behaviors, and parametric variations. Mathematical models of each system part are described to highlight electrical, mechanical, and electromagnetic relations. Simulation results confirm that the presented control method provides good flux and speed estimations despite rotor resistance and load torque variations in terms of trajectory tracking.

TT3 • Technical Track: Renewable Energy Integration

TT 3	**WEDNESDAY 26 October (11:00 AM – 12:40 PM) @C.R.3** **Chairs: Jamel Belhadj, Mohamed Boudour**
1336 **11:00**	20’	Garazi Etxegarai, Irati Zapirain, Haritza Camblong, Juan Hernández, Juan José Ugartemendia and Octavian Curea. “*Photovoltaic power forecast for the next 24 hours with an analytical model and a FFNN model”* ***Abstract*** Photovoltaic (PV) self-consumption installations have increased by 101.84% in Spain, from 2020 to 2021. In this context, developing PV generation forecasting tools can contribute to increase the PV self-consumption ratio, boosting the use of renewable energies. On this matter, this paper presents two PV generation forecasting models for the next 24 hours. These are an analytical model developed in OpenModelica software and a model based on artificial intelligence (AI), specifically a feedforward neural network (FFNN). Both models use measured meteorological data obtained from a weather station 3km from the PV installation. This work analyses how the use of different data as input information affects the prediction of the FFNN. It was found that adding a time vector as an input of the FFNN improves the prediction, thus compensating the fact that it is not a recurrent network. Furthermore, the behaviour of both models has been compared. Both the analytical model and the FFNN obtain a correlation coefficient r of 0.941 and 0.94, respectively. Even so, the MAE and RMSE metrics highlight how the analytical model has a higher error and level of dispersion.
6133 **11:20**	20’	Ahmad Ammar Naassani, Ahmad Deya Sukary and Mohamed Wissem Naouar. “*Economic Feasibility of Grid Connected Wind Energy System in Syria”* ***Abstract*** Recently, a theoretical study estimates the wind potential in Syria by 80000 MW nearly. However, the feasible potential is 5000 to 8000 MW that can be exploited effectively. This paper focuses on

		the economic and financial assessments for wind energy in Syria. For this purpose, an economic feasibility study is conducted for one of the most promising wind sites in Syria; Sindianeh site. The feasibility study finds that the levelized cost of energy of an onshore wind farm is around 0.074$ per kWh including tax credits. This low fee of the produced energy makes high power wind energy systems competitive solutions, which are even cheaper than new traditional fuel plants or others renewable energy systems.
603 **11:40**	20’	Babahammou Hammou Ridha, Merabet Abderrezak, Miles Adel and Settou Belkhir. “Optimal site selection for sitting a solar, hydrogen and gas hybrid power system Using GIS: A case study in Algeria” ***Abstract*** This paper presents a study to evaluate the suitability of gas turbine plants to host a solar, hydrogen and gas hybrid power system, using a geographic information system (GIS). The study area is Algeria.Two criteria have been taken, the first is the best sites of grid-connected solar system in Algeria. The second is potential solar hydrogen production. A reclassification technique was performed for each criterion in order to evaluate its particular suitability. Through the use of the Spatial Analysis Tool in GIS, the degree of suitibility in the final map was calculated. Then the map of Gas turbine power plant (containing 28 stations) was matched with the map of suitability of the areas, to select the appropriate stations to convert them into hybrid stations. The overlay results obtained from the analysis of the resulting maps showed that 17% (346580 km) of the study area was a suitable area that was divided into five areas according to its suitability, 28.8% and 22.8% of them show high and very high, respectively. Six suitable stations were obtained, namely, Hassi Messaoud station, Hassi Rmel station, Telghamt station in Laghouat and Naama station.
2828 **12:00**	20’	Souha Wejhani, Mohamed Elleuch, Slim Tnani, Khadija Ben Kilani and Ghaleb Ennine. “Renewable Energy Integration in Power System: Clarification on Stability Indices” ***Abstract*** The continuing increase of renewable energy integration in power grids presents new challenges for system operators. These challenges emanate from converter-based renewable energy sources (RES), mainly wind and solar photovoltaic, which are asynchronously connected to the grid, and have limited provision of ancillary services. Essential power system services pertainto inertia and strength. Practical methodologies to evaluate and quantify these services are mandatory, and clear requirements ought to be set for secure integration of RES. This paper presents a study on the rotational inertia and strength services of electric power grids integrating RES. The aim is to characterize how these services affect the stability indices, and synthesize requirements for secure RES integration. Methodologically, wind power plants are integrated to the standard IEEE 9-bus test system, with different locations and penetration ratios.Steady state voltage and transient frequency stability indices are evaluated. The results of this paper are twofold: clarifications on stability indices are made, then the inter-relations of these system services as inertia and system strength, are highlighted.The results are further confirmed by two industrial softwares: PSSE and DigSILENT-PowerFactory, used as a test bench for comparison.
4382 **12:20**	20’	Sidi Mohamed Aly, Mouhamadou Falilou Ndiaye, Mohamed Cherif Aidara, Willy Magloire Nkounga and Mamadou Lamine Ndiaye. “*Power Quality Improvement of a Wind Turbine System in Mauritania Using a Fuzzy Logic Controlled Dynamic Voltage Restorer”* ***Abstract*** The problems of power fluctuations, induced by the integration of wind turbines into a power grid, during changes in wind speed are manifested usually by variations in the voltage, current or frequency. Besides affecting the quality of energy, these problems can lead to the dysfunction of sensitive equipment. To solve these disturbances caused by the wind turbines, effective protection of the sensitive loads connected to the grid is required. The purpose of this paper is to improve the quality of the energy produced by a wind power plant. This new approach is then validated in the context of Mauritania. For that, a Dynamic Voltage Restorer (DVR) is proposed to compensate for the voltage drops and harmonic distortions of the voltage supplied by the wind turbine when the

		wind speed changes. In order to boost the performance of the proposed system without using its model, a fuzzy controller is adopted. In addition, to verify the efficiency of the proposed control, a simulation model using MATLAB/Simulink is developed and the behavior analysis of the restorer under different operating conditions is carried out. The obtained results show that the reactive power is reduced by 15% and the harmonic distortion rate of the voltage is limited to 1%. This is fully compatible with the IEEE-519 standard.

TT4 • Technical Track: Power Systems & Electrical Grid

TT 4		WEDNESDAY 26 October (11:00 AM – 12:40 PM) @C.R.4 Chairs: Georges Barakat, Khadija Ben Kilani
1545 **11:00**	20’	Lounis Latiki, Abdallah Medjdoub and Nabil Taib. “*Power Systems Transient Stability Assessment via Direct Method”* ***Abstract*** Transient stability analysis is an essential tool for the design and operation of power systems, These tools provide stability region in which the operating point converge to the postfault equilibrium point. This paper presents power system transient stability assessment of a single machine infinite bus system (SMIB) using transient energy function. The energy function is constructed from SMIB model system of equations, then the transient energy function is obtained and used to determine the system stability region. The obtained simulation results are performed by MATLAB software for transient stability evaluation of single machine infinite bus test system.
852 **11:20**	20’	Sirine Essallah, Israa Ismael Hussein and Adel Khedher. “*Performance Assessement of Double line HVAC circuit versus Bipolar HVDC link in presence of Large-scale Solar plant”* ***Abstract*** This paper presents a comparative study between the bipolar HVDC link and the double line HVAC circuit with the integration of a 1000 MW solar plant. The impact of renewable energy penetration on the power system losses, voltage and transient stability is investigated. The study is conducted on the Iraqi super grid where three types of faults are examined namely the line and the bus disturbances, and the line trip. The simulations were carried out for different transmission line length using the PSS/E software. The results showed that the bipolar HVDC link presents better results compared to the double line HVAC circuit in terms of stability, voltage improvement and power losses minimization.
9983 **11:40**	20’	Imadeddine Abdallah, Mohamed Boudour and Ahmed Amine Ladjici. “Measurement and evaluation of the power systems resilience against extreme events” ***Abstract*** The electrical energy systems are exposed to multiple threats of different magnitudes and different natures, but it remains that the threats that cause the most serious damage are the events of high impact low probability, which are in the majority of the time violent weather events. Their direct impacts on the different strategically important components lead to huge malfunctions that are reflected in the level of resilience of our systems, as they are the first cause that makes the level of resilience fall severely, the fact is currently the focus of much research in the field of electrical energy systems. In this paper, we will be interested in the evaluation of the level of resilience to extreme events under different scenarios, explaining the concept of resilience and its definition, modeling the multiple causes of its degradation as well as Classifying and citing some of these evaluation measures significant for the analysis of electrical networks, an evaluation measure has been proposed in this article and apply on two different scenarios and compare their results with other measures already proposed before.
3346 **12:00**	20’	Toufik Tarif, Ahmed Amine Ladjici, Ahmed Tiguercha and Mohamed Boudour. “*Power System Transient Assessment Using Deep Learning LSTM Algorithm”* ***Abstract*** For the assessment of transient stability in modern power systems, the results of the assessment should be issued as soon as possible to allow sufficient time for preventive control. To this end, this paper develops a new approach for transient stability analysis. The first part treats the estimation of the stability margin and its state. The proposed methodology is based on the LSTM model of the generator internal angle measured by PMU. The second part deals with the location of the critical generator in a power system. The effectiveness of the proposed approach

		is validated for several scenarios implemented in IEEE 39-bus system.
2255 **12:20**	20’	Yassine Boussaa, Khadija Ben Kilani and Mohamed Elleuch. *“Power System Oscillatory Behavior Under High Renewable Integration”* ***Abstract*** A current challenge faced by electric power system operators is to maximize renewable energy integration without compromising the operational reliability of the electric power grid. This paper investigates how high wind power integration affects the dynamic properties of power system oscillations, in particular poorly damped inter-area modes. The oscillatory behavior is analyzed by small signal stability eigen analysis, in terms of modal frequency, stability and mode shapes. This modal decomposition allows to identify the dynamic response of the system under excitations. Various operating parameters are examined: renewable penetration ratios, mode damping and the deployment of synchronous generators in synchronous condenser mode. The mode shapes reveal the variations in coherency between generators, and how these variation topologies are excited by increased wind power integration.

TT5 • Technical Track: Microgrids

TT 5-1		**WEDNESDAY 26 October (14:00 AM – 16:00 PM) @C.R.1** **Chairs: Ilhem Slama Belkhodja, Kassa Idjdarene**
7035 **14:00**	20’	Lotfi Khemissi, Mohamed Abdellatif Khalfa and Anis Sellami. “Control and energy management of Wind/PV/Battery smart microgrid” ***Abstract*** In this paper, a complete model of a grid-connected Wind/PV/Battery microgrid is presented. The system is composed of a 5.45 kW photovoltaic generator (PVG); a 6 kW PMSG-based wind turbine (WT) and 10 kWh lead acid-based battery storage. The hybrid system is connected to the grid through a 20 kVA three-phase voltage source inverter, an LCL filter, and a local load. The LCL filter is designed to attenuate ripple current to 10 % and THD below 5%. A damping resistance is added to the capacitor filter to attenuate resonance phenomena. The extracted power from renewable sources (Wind & PV) is optimized using maximum power point tracking (MPPT) algorithms. The perturb and observe is used for the PVG while the optimal tip speed ratio combined with vector control is used for the WT subsystem. A rule-based energy management system (EMS) is designed to economically dispatch the energy between individual systems of the proposed microgrid. The control and management of the whole system were evaluated through simulations using MATLAB-Simulink software under different climatic conditions.Simulation results prove the effectiveness of the control and management of the hybrid system.
4872 **14:20**	20’	Sonia Moussa and Ilhem Slama-Belkhodja. “*Residential loads modeling and load profile generation for microgrid EMS design in Tunisia”* ***Abstract*** This paper introduces a methodology for residential daily load profile generation considering microgrid energy management system (EMS) design. The envisioned EMS considers power flow exchange and power quality issues. For this purpose, static ZIP load models and equivalent circuit model of residential loads taken from literature are implemented as circuit models. This latter is aggregated and simulated using DSIM software to generate the daily load profile according to the end-user activity. Home appliances are classified before their circuit model are established. Load profile is then generated by switching on/off the established load model circuits according to the user activity. The generated load profile includes information on active and reactive power, as well as harmonic contents for nonlinear loads.

8821 **14:40**	20’	Foued Charaabi, Mehdi Dali, Amine Ben Rhouma and Jamel Belhadj. *“Technical and economic evaluation of remote DC and AC microgrids”* ***Abstract*** Microgrids (MGs) are increasingly deployed around the world as the most suitable solution to expand energy access in energy-poor countries, and even in remote areas of high-income countries. In addition to the previous studies performed on MGs, this paper proposes a framework to evaluate the technical and economic benefits of implementing the AC, DC and hybrid MGs In the first stage, economic analysis has been carried out to determine the optimal size of PV system, wind system connected to each AC or DC MG with an energy storage bank system, according to the meteorological and load profile data of the selected remote area in El Fahs (north of Tunisia). In the second part of work, the power loss, voltage drop and system efficiency has been presented for the AC and DC MGs. Moreover, an experimental validation has been carried out in order to prove the voltage drop and the power loss for the case of a DC MG. This study justifies that DC microgrid is potentially more beneficial than AC MG. But, the stability of the system during short-circuit fault is the main problem in the DC MG. For that reason, it can be concluded that the protection and control of DC MGs should be the crucial areas of future studies.
8277 **15:00**	20’	Mehdi Dali, Foued Charaabi and Jamel Belhadj. “*Short-circuit fault analysis and protection of stand-alone AC and DC microgrids”* ***Abstract*** In recent years, DC microgrid has become an attractive power system due to its inherent ability to interface renewable energy sources, storage systems and various types of electric loads. However, one of the challenging problems on DC microgrids operation is protection. Due to the significant increasing interest on DC microgrid; this paper addresses the impact of short circuit fault in the AC and DC microgrids. In order to demonstrate the current evolution, the fault characteristics have been analyzed in each configuration. On the other hand, a circuit breaker was presented like a solution for this problem with adaptive control. The DC Microgrid and its protection schemes using the proposed circuit breaker are simulated by MATLAB/Simulink platform and the results of the simulation will be analyzed. The results obtained from the output graph shows that the proposed method is effective in protecting the DC Microgrid. This work makes the capability of this breaker to function for each climatic condition and global power produced.
8526 **15:20**	20’	Nidhal Mdini, Sondes Skander-Mustapha and Ilhem Slama-Belkhodja. “*A Critical Inertia of Photovoltaic system with Battery Energy Storage System: experimental microgrid platform study case”* ***Abstract*** Low inertia systems with high penetration of Renewable Energy sources need sophisticated control to ensure frequency stability. Virtual inertia control-based storage systems is used to improve the inertia of the microgrid. However, the selection of the virtual inertia constant will have a crucial contribution in the performance of frequency regulation, more precisely in terms of Rate of change of frequency ROCOF and nadir deviation and even frequency stability of faulty microgrid. To overcome such a problem, this paper proposes a method for determining critical inertia. A limit value of the inertia which makes it possible to operate the microgrid according to the grid code requirements and to avoid the destabilization of the system. For this purpose, a stability analysis, in steady-state and in transient mode according to the variation of inertia, makes it possible to identify the limit values. To verify the efficiency of the proposed algorithm, Simulation under MATLAB environment of the experimental platform Pla-NeTE integrating a BESS system is carried out.
8205 **15:40**	20’	Bekhti Mohammed Abderahim, Ghomri Leila and Larbi Beklaouz Hadj. “*Technical, economical and environmental comparative analysis of a Microgrid using battery and pumped hydro storage for remote area electrification in southern Algeria”* ***Abstract*** The aim of this research is to analyze the technoeconomic and environmental performance of the hybrid energy system (HES) to meet the electricity demand of an off-grid community and the dump

		load in the Indalek village located in the southern of Algeria. Different combinations of HES, such as PV/FC/DG/battery (BESS) and PV/FC/DG/Pumped hydro storage (PHS), are modeled, analyzed and compared using HOMER software. The techno-economic environmental performance analysis is evaluated the net present cost (NPC),cost of energy (COE), excess electricity (EE), fraction of renewable energy (RF) and CO2 emissions of the different combinations of HES. The simulation results show that the hybrid energy system with BESS is the best feasibility technoeconomic performance with the least NPC, COE and the higher EE of $438371, $0.142/KWh, 36222 KW/year, respectively. On the contrary, the HES with PHS has the highest fraction of renewable energy of 87.4% and the most environmentally friendly with 96.43% reduction in CO2 emissions compared to the HES with BESS. Finally, the sensitivity analysis is performed on the hybrid energy system with BESS shows that the improvement of the derating factor with the increase load leads to a lower the COE.
TT 5-2		**WEDNESDAY 26 October (16:30 AM – 17:30 PM) @C.R.1** **Chairs: Férid Kourda, Gherbi Yamina Ahlem**
9815 **16:30**	20’	Mariem Dellaly, Sondes Skander-Mustapha and Ilhem Slama-Belkhodja. “*Data-Driven Emulation of a Peer-to-Peer Energy Exchanged for Interconnected Residential Nanogrids”* ***Abstract*** The new trend for electrical distribution system architectures is to promote the exchange of energy between different prosumers. This paper deals with the management of energy flow between a set of photovoltaic rooftop installations including storage systems. Proposed study aims, as an initial step, to reproduce the operating process of a commercial microgrid platform based on collected data, then as a second step to adapt its operation to Tunisian standards. Theoretical investigations and results for the first step are detailed in this paper. The comparison of the obtained results with the experimental platform data clearly proves the effectiveness of the carried out theoretical study.
6880 **16:50**	20’	Houssam-Eddine Ghadbane, Said Barkat, Azeddine Houari, Ali Djerioui and Tedjani Mesbahi. “*Energy Management Strategy for Hybrid Power System Implemented with Processor in the Loop*” ***Abstract*** The purpose of this study is to propose an energy management strategy (EMS) based on a load following approach for a hybrid power system. The adopted hybrid power system is made up of a lithium-ion battery and supercapacitor, along with two bidirectional DC-DC converters. The proposed EMS algorithm aims not only to provide the necessary power references to the power system but also to extend the power elements lives. The effectiveness of the suggested energy management strategy under load profile process conditions is proven by processor in the loop (PIL) co-simulation results.
113 **17:10**	20’	Mehdi Turki, Wahib Khiari and Jamel Belhadj. “*Integration of an Energy-Water Operating Window for Electrical Power Sharing in a standalone Microgrid-BWRO Desalination Unit”* ***Abstract*** Renewable energy sources are abundant and environmentally friendly and therefore present a promising alternative to power desalination units. This is why the Water-Energy nexus is a crucial step towards sustainable development. Thus, the integration of renewable energy sources (RES) in water desalination processes is very important. The main objective of this paper is to analyse a Brackish Water Reverse Osmosis (BWRO) desalination system powered by a microgrid system without the use of electro-chemical storage devices. Considering the intermittent nature of the renewable energy source and their sensitivity to the Water-Energy nexus, this work proposes to identify the various constraints and operating limits through an experimental BWRO desalination unit with all the elements of water-energy measurement, control and management. The control and management are based on a new technique of "Electrical Power Sharing" through the pressurization systems while using a specific Power Field Oriented Control (PFOC) while respecting the Safe Operating Window (SOW) of the desalination unit.

TT5-3		THURSDAY 27 October (11:00 AM – 12:40 PM) @C.R.4 Chairs: Jean-Christophe Olivier, Mehdi Dali
8925 **11:00**	20’	Mohamed Amine Djema and Mohamed Boudour. “*Load Frequency Control Enhancement for an Islanded Multi-Area AC MicroGrid”* ***Abstract*** This paper presents a new approach to improve the Load Frequency Control (LFC) in a two-area islanded multi-source MicroGrid (MG). The latter operates with conventional generators such as Diesel Engine (DE) and Micro-Turbine (MT), Renewable Energy Generators (REG) such as Photovoltaic (PV) and Wind Turbine (WT), and Storage Systems (SS) such as Fuel Cell (FC), Battery and Flywheel. To meet the load demand and ensure the system’s robustness, Fuzzy Logic (FL) based fine-tuning and Butterfly Optimization Algorithm (BOA) based Proportional–Integral–Derivative (PID) controller are performed in frequency secondary control. Moreover, in order to contribute and enhance the MG’s dynamic performance, this approach is employed in the present work to control the overall SS present in the performed MG test system, compared to the previous work. A comparative study is carried out to demonstrate the ability of the developed control to exhibit a better dynamic response. This enhancement is well observed through the simulation and the presented results.
862 **11:20**	20’	Meriem Belhamidi, Fatiha Lakdja, Larbi Boumediene and Hocine Geuntri. “*Analysis of D-SVC and D-STATCOM in Microgrids with Wind Farm Integration”* ***Abstract*** Over time, Networks are getting complex, and stability issues are more and more likely to arise. Overall, the problem of voltage instability increases as various random energy sources such as solar, wind, etc. are connected to the network. Grid control is the most notable matter. To realize optimal power system performance, it is essential to control the flow of reactive power in the grid. Unbalanced reactive power occurs when a system fails, is extremely loaded, and fluctuates in voltage. Reactive power balance can be restored by connecting a device to the transmission line that can inject or absorb reactive power depending on the system requirements. One of the Use-fullest sources of reactive power is FACTS equipment (Flexible AC Transmission System). Static Var Compensation (SVC) and Static Synchronous Compensation (STATCOM) are the famous compensation ways of the FACTS families. In this paper, we study the difference in the impact of SVC and DSTATCOM on improving the dynamic voltage stability of distribution networks with distributed wind generation and variable load. The dynamic behavior of both devices was observed through simulations performed with MATLAB/Simulink. A comparison of simulation results between grids without FACTS and grids with FACTS was presented in this article.
1607 **11:40**	20’	Mohamed Aymen Aissa, Amine Ben Rhouma and Jamel Belhadj. “*Modeling and experimental characterization of variable-speed centrifugal Pump used As Turbine (PAT) for the flexible generation and storage of electrical energy in a micro-grid*” ***Abstract*** PAT technology has not been well developed and studied. Therefore, the availability of PAT literature is a way to improve its understanding. Since pump manufacturers provide the characteristics of their machines only in pump mode, many correlations are used in several research works for the prediction of their hydraulic behavior to obtain the characteristics in turbine mode. In this paper, the purpose is to study the hydromechanical behavior of a centrifugal pump in order to characterize and assimilate its operation in pump and turbine mode. The study leads to the characterization and quasi-static modeling of the centrifugal pump for the three modes of operation, namely as pump, reverse pump and PAT. Then, the BEP of the PAT is verified by an empirical prediction method. Finally, the electrical behavior of the PAT is evaluated through a passive load.
1838 **12:00**	20’	Hadjkaddour Abdelhak, Benguesmia Hani, Bouchhida Ouahid, Chrifi Alaoui Larbi, Chouder Aissa and Cherifi Abdelhafid. “*Power Flow Control Of Grid Feeding Converter Based On VSG Emulator”* ***Abstract***

		The widespread integration of renewable energy sources with the traditional power systems causes a considerable impact, such as the decrease of total inertia, damping properties and large frequency deviation. In this paper, the virtual synchronous generator (VSG) concept in grid feeding structure is investigated within a week grid in order to bring support capabilities to the frequency and amplitude deviation. The frequency at the point of common cohesion (PCC) can be reduced when more active power is required whereas the voltage amplitude is reduced with reactive power demand. The small signal modeling of the VSG is addressed taking into consideration parameters variation to obtain a smooth power flow transition and then low frequency nadir. In order to validate the theoretical concepts, simulation tests have been carried out using PSIM platform
2471 **12:20**	20’	Béatrice Thomas, Roman Le Goff Latimier, Abdelhafid El Ouardi, Hamid Benahmed and Samir Bouaziz. “*Optimization of a peer-to-peer electricity market resolution on GPU”* ***Abstract*** The increasing integration of distributed energy resources on the electrical grid will complexify its management by overloading the system operator. One solution explored in the literature is to decentralize the grid management with communities or a peer-to-peer market. However, the computational challenge also applies to researchers when they simulate this management on unique hardware. In this work, extensive research has been done to optimize a simulation of an energy market on a Graphic Processing Unit (GPU). This market will be decentralized using an Alternating Direction Method of Multipliers (ADMM). The new optimized version has enhanced the computation time by about 40\% by comparison to the GPU reference method. This allows a resolution of a study case of 2463 agents in 0.15s per hour step or less than one hour for a 3-years simulation.

TT6 • Technical Track: Photovoltaic Systems: Chracterization & Diagnosis

TT6-1		**WEDNESDAY 26 October (14:00 AM – 16:00 PM) @C.R.2** **Chairs: Amine Ben Rhouma, Lotfi Saidi**
4820 **14:00**	20’	Samah Laamami, Mouna Benhamed and Lassaad Sbita. “*Analysis of Photovoltaic Modules’ Parameters under Specific Faulty Conditions with Experimental Illustrations*” ***Abstract*** The reliability of photovoltaic (PV) plants represents a major determinant of cost-effectiveness analysis. This paper presents an experimental and simulation scheme suitable for studying a photovoltaic generator (PVG) under some abnormalities and faulty modes. The operation of a PV cell is typically described by its current-voltage characteristic (I-V), which depends significantly on external conditions and internal parameters such as the photocurrent, the current of saturation, serial and shunt resistance, etc. in the present work, the parametric characterization is developed using the trust region method. The parameters are extracted from measured data (voltage and current). Moreover, MATLAB-based modeling of PVG is used as a tool to study the effects of failure modes patterns on PV modules. The influence of faulty behavior is emphasized in the static characteristic of the PV panel. The simulation study has been experimentally validated and the usefulness of this research is enhanced with the help of several illustrations.
7831 **14:20**	20’	Dhaoui Mehdi, Hatira Bacem and Sbita Lassaad. *New methods for detecting faults in a PV system* ***Abstract*** like all other industrial processes, a photovoltaic system can be subject to various faults. Faults can occur during design, installation, or even during operation, reducing the performance of the PV system. Accurate and consistent performance evaluation of PV systems is crucial for sustainable development as it is considered an essential criterion of energy quality. In this paper, we are specifically interested in the detection of faults in the PV system, the objective of which is to

		propose an algorithm to determine this task. Indeed, the detection algorithm is based on robust statistics and its performance on a variety of defects is evaluated. This algorithm is the first of its kind, which offers an intelligent photovoltaic system to detect faults using statistical methods.
909 **14:40**	20’	Lassaad Brahim, Med Hedi Moulahi and Hechmi Khaterchi. *“Effect of the degradation process via the variation of series and parallel resistances on PV performance”* ***Abstract*** This article presents on the one hand the correlation between the effects of the degradation process and the variation of the series resistance Rs and shunt Rsh which are due to the phenomena of delamination, discoloration of the encapsulant, corrosion and interconnections broken. On the other hand, their impact on the drop in performance of a PV photovoltaic panel. In particular during operation in a harsh working environment. For this reason, we must identify each failure mode and its effect on one of the resistors. However, the degraded state of the module is considered a failure when it exceeds a predefined limit threshold.
1748 **15:00**	20’	Mohamed Bounekhla, Fatiha Habbi, El-Ghalia Boudissa, Mountassar Maamoun and Abderrezak Guessoum. *“Hybrid Firefly Algorithm with Sine Cosine Algorithm for solar photovoltaic parameter estimation”* ***Abstract*** For designing high-performance photovoltaic (PV) systems, parameter determination of solar cell models is very important. In this article, a hybrid method using Firefly Algorithm (FA) with the Sine Cosine Algorithm (SCA) is proposed to identify the unknown electrical parameters of single diode model (SDM) of PV solar cells based on experimental data of I-V characteristic curve. During the optimization process, the main objective is to minimize the root mean square error (RMSE) between the measured data and the calculated data. To demonstrate the efficiency of the suggested HFASCA, a comparison between its numerical results and those of other optimisation methods in the literature, is made. The simulation results reveal a high performance of the HFASCA with an accurate identification of the extracted parameters.
1990 **15:20**	20’	Zied Khammassi, Med Hedi Moulehi, Hechmi Khaterchi and Abderrahmen Zaafouri. *“Efficiency of different control algorithms for a PV panel”* ***Abstract*** This work, presents a comparative study of three intelligent control methods in order to optimize the efficiency of the solar PV system. We have proposed a control law for extract the maximum power point (MPP) based on artificial intelligence algorithms such as artificial neural networks (NNA) or fuzzy logic (FL),the main contribution is to compared them with the classical P&O technique, through simulations, in order to choose the most efficient technique.
9375 **15:40**	20’	Ali Boukerche, Lekhchine Salima and Bahi Tahar. *“Contribution to the fault diagnosis of a photovoltaic system”* ***Abstract*** In this work we have focused on solar photovoltaic energy and the different defects that can negatively affect the performance of photovoltaic systems sometimes causing its total stop. Such defects can be caused by external disturbances, manufacturing defects or lack of maintenance. Regrettably, such situations lead to undesirable consequences to the installation. Taking into account this problematic, this work suggests the study of some possible defects as well as the development of a protocol for the detection and localization of these defects. The effectiveness of the adopted methodology is validated under the MatLab/Simulink environment
TT6-2		**THURSDAY 27 October (11:00 AM – 12:40 PM) @C.R.1** **Chairs: Xavier Roboam, Radhia Garroui**
4253 **11:00**	20’	Lotfi Gafsaoui, Jaouher Chrouta, Hachmi Khaterchi and Abdelrrahmen Zaafouri. “*Sliding mode control of photovoltaic systems*” ***Abstract*** The power generated by the photovoltaic generator varies continuously with the solar illumination

		and the temperature, allowing to continue the maximum power point by interposing one or more controlled static converters between the generator and the receiver. This article presents the modeling and hardware implementation of the MPPT (Maximum Power Point Tracking) algorithm of extremal research by control in slip mode in the conversion chain of a photovoltaic system. To optimize conversion efficiency, the control algorithm is applied directly to the output of the module and connected to the DC-DC conversion step. The selected converter is a DC-DC amplifier converter. We present the control method in sliding mode. An optimal choice of control parameters enables system-wide performance. The simulation results show the efficiency and performance of this proposed system.
1914 **11:20**	20’	Anwer Ghedamsi, Achref Mabrouk, Hamadi Bouaicha and Jamel Belhadj. “*PV plant solution for Cold Ironning at the Goulette port”* ***Abstract*** The maritime transport is responsible for a big portion of the atmospheric pollution. In fact, it is one of the main sources of the polluting gases that increases the greenhouse effect, such as the CO2, NOx, SOx and the particles of matter (PM). Particularly, the port’s pollution is becoming more and more important, because, while being at berth, vessels consume electricity to feed the ship’s hotel load and to power other axillaries equipment which engenders the expel of polluting gases or particles of polluting materials in the air. Moreover, the optimization of the power generation at port has become essential to reduce the pollution level within ports area. Thus, the concept of shore to ship electric connection known as cold ironing should be investigated and improved to respect the environmental standards imposed by the International Maritime Organization (IMO). Therefore, we intended by this paper to investigate the feasibility and the efficiency of having a well-designed and sized PV plant to power merchant ship’s while being at berth at the Tunisian Port La Goulette located in the suburbs of the capitol Tunis.
9866 **11:40**	20’	Fethi Messaoudi, Fethi Farhani and Abderrahmen Zaafouri. “*Control strategy of a single-phase two-stage transformerless grid-connected PV system”* ***Abstract*** Renewable energy which is increasingly in demand. This growth is justified by the limit and the pollution of fossil energy and the increase of the energy deficit. Consequently, several energy strategies that integrate a renewable energy, in order to compensate for the disadvantages of fossil energy and the energy deficit. In particular a photovoltaic energy is one of them. It’s clean and less noisy. It is used as stand-alone or connected to the grid. In this paper, the improvement of the control and the quality of the energy that flows in a photovoltaic system, which connected to the single-phase grid without a transformer, that is well aimed. The two stages configuration are used. Thus, the power line is composed of a photovoltaic generator, a Boost converter, a Half bridge inverter, a passive LCL filter and grid. The basic idea of this paper is to optimize the power quality through a suitable passive filter, a suitable inverter and making a good choice of regulator parameters. In order to verify the proposed control, it is tested under MATLAB.Simulink under different meteorological conditions such as variable irradiation.
4346 **12:00**	20’	Sambalaye Diop, Papa Silly Traore, Boubacar Niang and Mamadou Lamine Ndiaye. “*Using multilayer Neural Network to increase the Prediction Accuracy: application in the Taïba Ndiaye Power Plant”* ***Abstract*** The Taïba power plant is a wind power plant interconnected to the SENELEC network, and its production fills a gap in electricity consumption. Indeed, it represents 150 MW of installed capacity. Like all intermittent power plants, production depends on the environmental parameters of the area where it is located. However, bad weather can cause instability in the electricity grid. It is necessary to use methods to predict its production. This will facilitate the decision making on the amount of energy to be produced to meet the demand. In this sense, this paper aims to predict

		wind generation by dividing the prediction data into 80% for training our model and 20% for testing the prediction efficiency of the model in order to quantify the energy produced and to allow an optimal transition between intermittent and fossil energy sources. The proposed neural network model was tuned by varying the number of hidden layers so as to evaluate the impact of this layers in the efficiency of the prediction. Obtained results show that the variation of the number of hidden layers increase the performance of neural models applied to intermittent energy prediction. The proposed approach gives its best prediction accuracy of 94.57% for the 100 hidden layer network.
3644 **12:20**	20’	Hajer Mannai, Hatem Oueslati and Majdi Hazami. “*Hybrid Wind PV System Risk Assessment”* ***Abstract*** Hybrid Wind–PV power plants are the future of energy generation, this type of system is getting more famous and more attractive in recent years due to its high potential in preserving natural resources, high energy and power generation efficiency, less pollution and stable power output. However, for investors to show more interest, it is important to go through the different aspects of the project including risk analysis. Hence, in this paper we will try to interpret most risks that may face the decision-making process of hybrid wind–solar PV power plants. Firstly, we will identify and classify the risk indicators and divide them to groups following the PESTEL tool. Secondly, we will use the strategic planning technique swot that provides assessment tools to analyze the internal and external environment of this project. Thirdly, to depict any uncertainty and fuzziness we will refer to GE-McKinsey Matrix as a strategy tool that offers a systematic approach for the multi business corporation to prioritize its investments among its business units. Following the identification of risks, specific measures and strategies will be proposed to assist the decision making and limit the risks impact. All along this paper we will use the ISO31000 guidelines as reference to provides principles, a framework, and a process for managing risk.
TT6-3		**THURSDAY 27 October (16:30 AM – 17:30 PM) @C.R.2** **Chairs: Houda Ben Attia Sethom, Ibtissem Abari**
2360 **16:30**	20’	Abdoulaye Sène, Lamine Thiaw and Césaire Ngor Ndiaye. “*Optimisation de l’absorption dans les couches minces optiques nano-structurées: Application aux cellules solaires photovoltaïques”* ***Abstract*** À l’heure actuelle, la recherche d’amplifications géantes du champ électromagnétique dans une structure confinée est un enjeu de taille pour les applications telles que le solaire photovoltaïque, l’optique non linéaire et les microcavités, la microscopie et les capteurs optiques… Dans ce contexte, une méthode de synthèse permettant d’atteindre des exaltations arbitraires dans des structures résonantes plasmoniques ou multi-diélectriques a été élaborée. Le composant est un filtre interférentiel, ou un cristal photonique 1D, dont la géométrie est calculée eu égard à l’exaltation recherchée et à la fréquence de résonance souhaitée ; à chaque valeur de l’amplification du champ (10 ou 104, …) correspond une séquence particulière (3 ou 17 couches, …) de matériaux métalliques/diélectriques sous forme de couches minces optiques.
5032 **16:50**	20’	Sambalaye Diop, Papa Silly Traore and Mamadou Lamine Ndiaye. “*Power and Solar Energy Predictions Based on Neural Networks and Principal Component Analysis with Meteorological Parameters of Two Different Cities: Case of Diass and Taïba Ndiaye”.* ***Abstract*** The overuse of conventional resources based on fossil fuels increases the vulnerability of our environment. Faced with this effect, increasing the penetration rate of intermittent (non-polluting) energies in the electrical networks has become of paramount importance. However, this increase in the penetration rate allows on the one hand to improve the satisfaction of the producers and reduces the consumption of fossil fuels, on the other hand it is a major point of suffering for the non-smart electrical networks. In a dynamic of promoting intermittent energies while ensuring a permanent balance between consumption and production, the forecasting of these energies is an important lever. Hence, this paper studies artificial neural networks to predict the power and energy output of the Diass solar power plant in the short and medium term. Thus, the proposed approach consists in using not only the meteorological data of the city where the power plant is

		located, but also the data of a nearby city with a data acquisition station. The selection of the variables is done by principal component analysis (PCA). Moreover, our results were compared to the literature using only the meteorological data of the plant of implementation. The results obtained are more satisfactory with mean absolute and root mean square errors of 0.0223 KWh and 0.003 KWh respectively and a prediction accuracy of 94.57% in terms of energy and power. In terms of resource, it consumes more with simulation times varying between 1788 seconds and 2201 seconds.
1844 **17:10**	20’	Hamza Nasri, Kamel Sahlaoui, Hatem Oueslati, Hichem Taghouti and Abdelkader Mami. “Experimental Comparative Study between PV Solar Collector and Hybrid PV/T Air Collector” ***Abstract*** The effect of inlet temperature on electrical and thermal efficiency for the photovoltaic thermal collector (PVT) and on electrical efficiency for the photovoltaic collector (PV) form a big problem for the researchers. In this paper, we made an experimental study for a photovoltaic collector and a hybrid thermal photovoltaic collector. The results are obtained from tests for a period of 12 hours in summer. The experimental hypothesis is made through the climatic data of Tunisia on June 2022. The objective of this experimental study is to determine the thermal and electrical efficiencies of photovoltaic thermal collector and the electrical efficiency of photovoltaic collector. To study the effect of the photovoltaic thermal system on overall performance, a mathematical model of photovoltaic thermal has been used .We have examined the effect of adding fins absorbers on improving heat transfer and energy performance of a photovoltaic thermal hybrid solar collector, in order to achieve the objective.

TT7 • Technical Track: Automatic & Robotics

TT 7		**WEDNESDAY 26 October (14:00 AM – 16:00 PM) @C.R.3** **Chairs: Ahmad Hably , Ammar Soukkou**
3886 **14:00**	20’	Wajdi Saad, Jaouher Chrouta and Anis Sellami. “*H ∞ Control of Single-Link Flexible Joint Manipulator: One-Sided Lipschitz Approach”* ***Abstract*** This paper is concerned with the problem of H∞ control for a class of one-sided Lipschitz (OSL) nonlinear systems. The aim is to consider the bounded L2 disturbance attenuation measure, thus ameliorating the performance of the controlled system. At first, a decoupling between Lyapunov and system matrices is used to formulate a less-conservative analysis condition. Then the control gain which ensures the asymptotic stability with H∞ disturbance attenuation performance is derived via linear matrix inequality(LMI). At last, a simulation example is given to prove the feasibility of the proposed approach.
4673 **14:20**	20’	Hmida Hmaied, Hafsi Sami and Bouani Faouzi. “*Real time control of an upper limb orthosis robot for a passive rehabilitation”* ***Abstract*** This study focuses on the design and the position control of a didactic robotic therapy system. This robot is an upper limb device emulating the passive therapy of a human elbow joint. Model Predictive controller (MPC), PI and RST controllers are designed to ensure good closed loop performances. A comparative study between those three controllers is established in a real time environment. This comparison highlights the effectiveness of the model predictive controller. The purpose of this robotic rehabilitation emulation test is to ensure smooth therapy without significant overshoot in order to assist therapists apply their rehabilitation program in good conditions. This test needs to be validated for clinic therapy.

1077 **14:40**	20’	Yassine Soukkou, Ammar Soukkou, Sofiane Haddad, Mohamed Tadjine, Mokhtar Nibouche and Mohamed Benghanem. “*Adaptive Finite Time Command Filtered Backstepping Control for Uncertain Output Constrained Strict-Feedback Nonlinear Systems”* ***Abstract*** In this paper, an adaptive finite time command filtered backstepping control strategy is developed for uncertain output constrained nonlinear systems in strict-feedback form. The adaptive finite time control technique is proposed by integrating the barrier Lyapunov function (BLF) and the finite time control theory into the command filtered backstepping control design. The proposed adaptive control method is introduced to reduce the issue of the explosion of complexity, the compensating signals are designed to avoid the influence of the filtering errors caused by the command filters and the output constraint is not violated. Using the finite time Lyapunov stability theory, the proposed adaptive finite time control approach can guarantees that all the signals in the closed-loop system are practical finite time stable, and the tracking errors converge to a small neighbourhood of the origin in finite time. The effectiveness of the proposed control scheme is verified through numerical simulation.
6026 **15:00**	20’	Ines Mahmoud and Ayachi Errachdi. “*A proposed model reference adaptive neural network controller based on Taylor development of nonlinear discrete system”* ***Abstract*** This paper presents a developed model reference adaptive neural network control. It illustrates how the derivative function affects directly training speed. Indeed, the classical derivative of the sigmoid activation function decreases the learning speed because a large amount of error is not proportionally propagated back to the weights of the output layer. To overcome this difficulty, this paper proposes a Taylor development of the activation function which is capable of speeding up the learning process significantly and it can provide simultaneously stability of the learning process. The results of simulation show that using Taylor development has better effects both on response time and on tracking performance
6564 **15:20**	20’	Wajdi Saad, Jaouher Chrouta and Anis Sellami. “*Adaptive Sliding Mode Control For Systems With Sector And One-Sided Lipschitz Non-Linearities”* ***Abstract*** This paper deals with the problem of adaptive sliding mode control for systems with nonlinear control inputs, one-sided Lipschitz (OSL) nonlinearities, unknown disturbances and parameter uncertainties. At first, a synthesis condition of asymptotic stability is derived in terms of linear matrix inequalities (LMIs). Then, the control law which ensures reaching and occurrence of the sliding mode is designed. Any knowledge of the upper bound on the perturbation is not required and an adaptation law is proposed. At last, a simulation example is given to illustrate the feasibility of the proposed approach.

TT8 • Technical Track: Image Processing

TT 8		**WEDNESDAY 26 October (16:30 AM – 17:30 PM) @C.R.2** **Chairs: Ammar Soukkou, Ala Balti**
6322 **16:30**	20’	Nacir Omran, Amna Maraoui, Imen Werda and Hamdi Belgacem. “*Yolo V5 for Traffic Sign Recognition and Detection Using Transfer Learning”* ***Abstract*** With the advancement in the field of autonomous cars, we are coming closer to reliable integration. However, in order for an autonomous car to function in an urban environment it has to abide by the traffic rules. In this paper we design a vision system based on our trained YOLO v5 models for both classification on the GTSRB dataset and detection on GTSDB dataset using transfer learning from the classification to the detection model to optimize results. Our choice of the YOLO v5 algorithm is justified by its capability to combine accuracy and speed at the same

		time which makes it suitable for real time applications.
4054 **16:50**	20’	Nesrine Boussaada, Zina Boussaada, Alvaro Llaria, Guillaume Terrasson and Octavian Curea. “*Energy Consumption Optimization of a Raspberry Pi-based Image Acquisition Embedded System”* ***Abstract*** The evolution towards the Industry 4.0 concept implies a huge development of the connectivity and the smart automation in all the industrial areas. For the chemical processes, the supervision systems are generally fairly basic, and a number of operations are still conducted by the operators. In order to simplify their daily tasks, expert systems able to discern each stage of the process and any possible drifts can be considered. To be implemented, the expert system needs a knowledge base which, in our case, will contain a set of images representative of the main stages of the process. The embedded system which will make the image capture must be autonomous from an energy point of view. Thus, the energy consumption optimization is necessary to ensure the maximal lifetime for the system. In this frame, this paper presents the energy management solution applied to an image acquisition system, based on a Raspberry Pi, for the chemical industry. The energy saving is achieved by the choice of the physical architecture, together with the application of a duty-cycle strategy.
249 **17:10**	20’	Asma Bahba, Randa Khemiri, Mohamed Amine Zayene and Fatma Ezahra Sayadi. “*Prediction of Response to Chemotherapy of Breast Cancer Tumors based on Deep Learning”* ***Abstract*** Neoadjuvant chemotherapy (NACT) has been defined as a widely treatment approach administered before surgery for women with breast cancer to minimize tumor size and improve outcomes. After NACT, pathological complete response (pCR) indicates the absence of residual tumor in the breast. To enhance the long-term survival outcome and to avoid eventual toxicities by NACT, the prediction of pCR using routine breast imaging is an important step to determine the patient treatment. In this work, we applied deep learning models such as Resnet50 and VGG19 to predict pCR from pre-treatment dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI) scans. The data was obtained using the public database I-SPY1 TRIAL, which is accessible from The Cancer Imaging Archive (TCIA) and encloses 222 patients with breast cancer disease. The dataset was split into 20% for tests and 80% for training. To improve generalization of the model, we also applied data augmentation methods in the training phase as rotating and flipping. Experimental results obtained showed that Resnet50 model outperforms VGG19 in terms of accuracy; where an accuracy of 92.22% and 90.76% are obtained, respectively with data augmentation and axial orientation.

TT9 • Technical Track: Robotics & Telecommunication

TT 9		WEDNESDAY 26 October (16:30 AM – 17:30 PM) @C.R.3 Chairs: Talit Belhoul, Hichem Mrabet
6837 **16:30**	20’	German Monsalve, Nada Belhadj Ltaief, Vageesh Amoriya and Alben Cardenas. “*Kinematic Navigation Control of Differential Drive Agricultural Robot”* ***Abstract*** Agricultural producers must increase food production to fulfill the food demand of the growing population. However, farms must produce more food efficiently and sustainably, reducing greenhouse emissions, soil damage, and water waste. Agricultural robots could become a driving technology in transitioning to more efficient and sustainable farms by reducing their environmental footprint. For agricultural robots, navigation is the backbone for performing other tasks like crop inspection, harvesting, or spraying herbicides. This paper presents an agricultural robot platform with differential steering (skid-steered). A control system for autonomous navigation was implemented using a kinematic model and a PID controller. The results of the simulation and the experiments show that the proposed navigation system allows the robot to follow a predefined trajectory.
6478 **16:50**	20’	Dina Alkama, Sylia Zenadji, Mohamed Amine Ouamri, Abdelkrim Khireddine and Mohamed Azni. “*Performance of Resource Allocation for Downlink Non-Orthogonal Multiple Access Systems in Tri-Sectorial Cell”* ***Abstract*** Non-orthogonal multiple access (NOMA) has recently emerged as a promising candidate for new generation networks. However, the latter face challenges in terms of supporting high data traffic with different Quality of Service (QoS) requirements. This letter proposes a resource allocation in downlink 5G tri-sectorial cell for NOMA systems using Proportional Fair Scheduling (PFS) algorithm, in order to improve network performance in terms of throughput, fairness between users and energy efficiency. Specifically, we study the channel state conditions of users to help those in a critical locations, in order to ensure an optimal distribution of resources among users whatever their position and the load of sectors in the cell. Performances were analyzed with increased number of users in the cell area. Simulation results and discussions on the performance of approach proposed are provided.
2166 **17:10**	20’	Nacir Omran, Imen Werda and Amna Maraoui. “*Real-time pedestrian detection independent of illumination dedicated for automotive applications”* ***Abstract*** With the rising popularity of autonomous cars, research is exploring the boundaries of what is possible with taking in consideration safety. However, with having a vision based detection system, we arrive at the same limitation of the human eye, which is lighting conditions. Taking that in consideration , an expanded vision spectrum from visible to infrared will allow the detection of the thermal signature of the human body even in low light. In this paper, our contribution is establishing a real time detection of pedestrians both on visible and thermal images by training multiple YOLO models with modified KAIST dataset and comparing their performance for real time applications. Out results concluded that YOLO v5 had the best compromise between speed 31 FPS for 640×40 input image and a missrate of 32.5.

TT10 • Technical Track: Electrical Machines Diagnosis & Control

TT10-1		THURSDAY 27 October (14:00 AM – 16:00 PM) @C.R.3 Chairs: Houda Ben Attia Sethom, Mohamed Menaa
8666 **14:00**	20’	Yamina Djouadi, AbdelmounaÏm Tounzi, Kassa Idjdarene, Toufik Rekioua and Djamila Rekioua. “*DTC of a synchronous reluctance machine for an autonomous generator operating”* ***Abstract*** This paper deals with the study of a synchronous reluctance machine using Direct torque Control in the case of an autonomous generator operating to supply remote areas. The diphase model of the machine taking account for the saturation along d-axis is first presented. Thus, the DTC principle in the case of generator operating in introduced. The latter is applied to a synchronous reluctance machine and the simulation results obtained through Matlab-Simulink environment are presented showing the effectiveness of such control in the case of autonomous generator operating.
3280 **14:20**	20’	Chouder Aissa, Bendib Ahmed and Kherbachi Abdelhammid. “*Modeling and Stability Analysis of Virtual Synchronous Generator Control for Single-phase Grid-tied Microgrid”* ***Abstract*** This paper investigates the modeling and control design-based stability analysis of virtual synchronous generator control for a single-phase grid-tied microgrid (MG). First, the designed control scheme of the single-phase VSGs, which integrates an ESOGI-FLL-based power calculation algorithm and ESOGI-FLL for grid frequency and voltage estimation, is proposed. Next, the mathematical model of the VSGs including the dynamics of the frequency and voltage estimation, the droop control, the reactive power controller, and the Swing equation is derived. Using this model, stability analysis of the whole system is assessed taking into consideration the different control parameters variation. Finally, simulations in DSIM are carried out to verify the validity of the designed control scheme-based developed proposal. The obtained results demonstrate the effectiveness of the proposed approach in guaranteeing the control of powers with smooth transient response under power references and load changes.
9196 **14:40**	20’	Safa Aloui Dkhil, Mohamed Taha Bennani and Houda Ben Attia Sethom. “*Permanent magnet synchronous machines multiple failures identification using sequence mining”* ***Abstract*** Permanent Magnet Synchronous Machines (PMSMs) are increasingly used in many industrial fields for their efficiency, robustness, reliability, and low torque inertia. Despite their widespread use, they can operate in severe conditions when faults appear in PMSM drive systems such as inverters, stator windings, sensors, etc. Fault diagnosis and fault-tolerant methods are equipped to improve the stability and robustness of PMSMs. Furthermore, it is much more important to be able to identify how many faults are present in a faulty model. This task is not obvious since one fault can hide another. In this paper, we show the applicability of our fault localization approach based on sequence mining to unveil PMSMs' multiple fault presence.
4830 **15:20**	20’	Azeddine Houari, Ahmed Bouabdallah, Ali Djerioui, Mohamed Machmoum, Mohamed.Fouad Benkhoris and Zoheir Tir. “*Speed Ripples Reduction of PMSM Drives under Low-Speed Working Conditions”* ***Abstract*** The present work deal with the undesired speed ripples caused by parasitic torques at low-speed conditions of Permanent Magnet Synchronous Machine (PMSM) based drives. The proposed speed ripples reduction technique is based on a power harmonic compensator where the damping signals are superposed to the reference current in a Field Oriented Control (FOC) scheme. The design procedure of the torque ripple compensator takes into account the local stability of the system. The practical feasibility and effectiveness of the proposed approach are verified under a small-scale laboratory test bench. Furthermore, the impact of the proposed method on the machine vibration is measured.

6315 **15:40**	20’	Yamina Jouilli, Radhia Garroui, Ben Hamed Mouna and Lassaad Sbita. “*Anti-wind up self-adaptive PI-Fuzzy speed controller for brushless DC motor”* ***Abstract*** this work presents a proposal for an anti-wind up selfadaptive PI-Fuzzy controller with brushless DC motor back calculation method. In order to evaluate the performances of this proposed controller, we will adopt a simulation under various operating conditions such as for example a variable reference speed. The proposed self-adaptive controller is analyzed and compared to the classic proportional-integral (PI) controller, and to the back calculation PI anti wind up controller. Rise time, settling time, recovery time, steady state error, and overshoot are taken into consideration when choosing the parameters of this controller This system is analyzed and simulated by the Matlab/Simulink toolbox and the results obtained show the behavior of the brushless DC motor under the proposed operating conditions and the effect of this self-adaptive anti wind up PI controller on the engine response is already well shown.
TT10-2		**FRIDAY 28 October (11:00 AM – 12:40 PM) @C.R.2** **Chairs: Mohamed Wissem Naouar, Hichem Merabet**
6359 **11:00**	20’	Arezki Chibah, Mohamed Menaa and Krim Yazid. “*Experimental Sensorless Control of DFIG based on Extended Complex Kalman Filter”* ***Abstract*** In wind conversion systems (WECS), the Doubly Fed Induction generators (DFIGs) are generally used. The control of these generators requires the knowledge of rotor position. In doing so, we need to use mechanical sensors placed on the generator shaft to track the rotor position or speed. However, these sensors have many drawbacks that could be alleviated by using a sensorless control. In this paper, we propose to use a novel approach to observe the rotor velocity for sensorless vector control of the Doubly Fed Induction Generator. This method is based on the Extended Complex Kalman Filter (ECKF). The proposed control is experimentally tested under various operating conditions. The experimental tests show that the suggested strategy can estimate with good precision the rotor speed. The developed system can produce excellent control performances.
1961 **11:20**	20’	Oussama Djaidja. “*FTC design based on projection approach applied to DFIG”* ***Abstract*** This paper presents an efficient Fault Tolerant Control (FTC) strategy for the double-fed induction generator that is subject to faults caused by broken rotor bars. A projection-based approach will be used. This research aims to construct an algorithm that can diagnose the presence of a fault in the closed loop system and switch itself between a nominal control (vector control) approach and a robust control (sliding mode control) designed for faulty conditions. The vector control can’t deal with the fault effect, which can achieve gradual system degradation, so we propose a sliding mode control when the faults occur to ensure a ripple-free operation. Moreover, The MRAS (model reference adaptive system) is used to analyze the dynamic of the residual vector (estimation error), this will serve as an indication of which control law should be used for such fault. The obtained results confirm that the suggested FTC has better robustness against the faults where the DFIG operates with acceptable performance in both active and reactive power.
6347 **11:40**	20’	Nadia Tadrist and Hocine Zeroug. “*Speed controller performance investigations into e-bike using Brushless DC motor with sensorless control*” ***Abstract*** With ever-increasing concerns on our environment, there is a fast growing interest in electric bike with a motor mounted either at the front and at the rear wheel. In addition, there it is a pressing need for researchers to develop advanced electric-drive systems. This paper investigates and describes an e-bike for transportation which uses a Brushless DC motor with an outer rotor mounted at the front wheel with a nominal torque of 10Nm and 250W with planetary gear. The

		controller uses an outer speed and inner current control loop using sensorless technique, back-emf based. The performances are highlighted in terms of torque –speed characteristics of the motor combined to various control techniques over a wide speed range. It is shown that the e-bike is able to start and run at convenient speed estimated with average minimum speed of 2Km/h and high speed up 25 Km/h with a battery autonomy lasting up to 2h under semi flat and hilly distance less than 7%. We show that this speed control from low and high speed can be well tuned and adapted to various paths that fits the cyclist own comfort and desired acceleration**.** Also, the findings show also that the battery autonomy can be doubled if there are intermittent cycling periods.
3810 **12:00**	20’	Elkssayer Mohamed Khalil, Naoui Mohamed, Hajejj Mohamed and Sbita Lassad. “*Enhancement of Finite Set Model Predictive Control for Direct Matrix Converter fed DFIG-Wind Energy Conversion System*” ***Abstract*** This paper deals with the study of finite set model predictive current control (FS-MPC) for doubly fed induction generator (DFIG) derived by direct matrix converter (DMC). The FS-MPC has proven it effectiveness in many power applications. This control technique possess a small steady state error in different operating conditions, a high sensitivity and fast dynamic response, and it can be applied in both linear and non -linear systems. In the other hand, the frailty of this method consists of parameter mismatches which affect mathematical model. To overcome this problem, we propose to add past errors of rotor current to the cost function and adjust the weighting factors of the cost function with fuzzy decision making approach (FDM). The MATLAB/Simulink tool is used to evaluate the performance of this system in various scenarios.
8398 **12:20**	20’	Ayyoub Zeghlache, Hemza Mekki, Ali Djerioui and Mohamed Fouad Benkhoris. *“Fault-tolerant control of PMSM based on second-order sliding mode”* ***Abstract*** This paper presents a fault-tolerant control (FTC) based on a second-order sliding mode using a super-twisting algorithm applied to a 3-phase permanent magnet synchronous motor (PMSM). First, a second-order sliding mode control (SOSMC) is applied to the direct field-oriented control (FOC), which improves dynamic response and anti-disturbance performance by maintaining the speed and currents within their desired reference values. Second, a second-order sliding mode observer (SOSMO) is constructed in order to estimate and reconstruct the faults. Finally, the effectiveness of the proposed FTC has been verified through simulation using MATLAB/Simulink software.

TT11 • Technical Track: Electrical Grid: Power Quality and Stability

TT11		THURSDAY 27 October (11:00 AM – 12:40 PM) @C.R.2 Chairs: Mohamed Boudour, Khadija Ben Kilani
2000 **11:00**	20’	Aziz Boukadoum, Tahar Bahi, Abla Bouguerne and Hichem Merabet. “*Faults Diagnosis of Active Power Filter Using Fuzzy Logic Controller under different conditions”* ***Abstract*** this paper proposes a fault diagnosis of three phase shunt active filter using fuzzy Logic controller under different conditions such as harmonic distortion, open-circuit voltage...etc. First, a mathematic model is presented for SAPF. Second, the active power filter employs a simple method for the calculation of the reference compensation current based on p-q theory. The proposed system should maintain the THD well within harmonics standards. After that, fault diagnosis is performed using three-phase system algorithm to isolate the faulty phase. Simulation results verified the feasibility and effectiveness of the proposed method.
5788 **11:20**	20’	Salma Bennai, Afef Bennani-Ben Abdelghani, Ilhem Slama-Belkhodja and Mahrane Khalfoun. “*Sensitivity Analysis to Grid Line Impedance for Grid Characterization and Stability Assessment Investigations”* ***Abstract*** Since the massive integration of inverter-based resources in the distribution grid especially for residential applications, power quality, and grid stability became two of the most important issues of the electrical system. This paper deals with the grid line impedance impact on these emerging challenges, and their determination complexity and cost. The presented work analyses the impact of the grid impedance parameters uncertainty through a sensitivity study. As a result of this theoretical development, different sensitivity coefficients are obtained to evaluate grid impedance parameters variation effect on the voltage RMS value, the short-circuit ratio, and the network hosting capacity, for different power exchange scenarios in a 15 kVA low voltage distribution line. Simulation results carried out with Matlab software are given to illustrate this sensitivity analysis.
3547 **11:40**	20’	Mohamed Hajjej, Mohamed Naoui, Khalil Elkssayer Mohamed and Lassaad Sbita. “*Experimental and Digital Simulation Investigations of Harmonics Injection by CFLs Into a LV Network”* ***Abstract*** Today, the demand on electrical appliances, such as power converters, economic lamps and LEDs, speed drives and regulators etc..., is increasing in recent years, but despite their robustness and good dynamic responses, they inject harmonic currents into the network. This article presents in-depth studies on the effect of the use of Compact fluorescent lamps CFL on a Low Voltage (LV) local area network, as well as an interest in modelling this type called non-linear charge under PSIM and MATLAB Software.
6209 **12:00**	20’	Salma Bennai, Afef Bennani-Ben Abdelghani, Ilhem Slama-Belkhodja and Mahrane Khalfoun. “*Review on power quality disturbances assessment and advanced control-based mitigation techniques”* ***Abstract*** With the distributed energy resources massive integration and the power electronic devices rapid proliferation, tremendous new challenges around power quality are emerging. Thus, new performance indicators are established, and several revisions of the power quality standardization corpus is being deployed. Moreover, different advanced control-based mitigation techniques are being developed to prevent power quality deterioration. This paper presents a review of the power quality disturbances, standards, and performance indicators along with some of its control-based mitigation techniques.
588 **12:20**		Kahina Yahia Cherif, Lounis Latiki, Abdellah Medjdoub and Nabil Taib. “*Effect of Active Power Injection on the Voltage Stability Margin of a Power System”* ***Abstract*** The great demand of energy has increased considerably these last decades. Consequently, many

	20’	problems have emerged. Among these problems, voltage stability that can generate many disturbances and voltage collapses. Injection of an active power can improve the voltage stability of the power system. In this paper, PV and QV curves are used in voltage stability analysis of the IEEE 9bus system before and after the active power injection. The effect on the different buses’ voltage and stability margin of the system is shown on the results’ section. The simulation of the system is carried out on MATLAB environment.

TT12 • Technical Track: Electromagnetics in Electrical Systems

TT12		THURSDAY 27 October (11:00 AM – 12:40 PM) @C.R.3 Chairs: Sami Hlioui, Mouhamadou Falilou Ndiaye
9909 **11:00**	20’	Idris Laouar and Ahcene Boukadoum. “*Design Optimization of a Three-Phase Squirrel-Cage Induction Motor by Algorithm Harmony Search”* ***Abstract*** Three-phase squirrel-cage induction motor has been widely used in industries because of its easy manufacturing, robustness, simple operation, low cost, high reliability, and efficiency. Many classical techniques were used in the design problem of IM but most of them are time-consuming, difficult in handling non-linear and discontinuous objectives and they may lead to a non-optimal dimensioning and low efficiency. To overcome these drawbacks, nature-inspired metaheuristic optimization algorithms are widely used in the design optimization problems of IM. This paper deals with the optimization of an induction motor using a harmony search algorithm (HSA). The objective is to increase the efficiency of the 90 kW, 4-pole, 50 Hz squirrel cage induction motor, which is designed by conventional design and optimized by HSA using MATLAB. The resulting designs were validated by performance curves obtained using their equivalent circuit parameters, and also for comparison between the performance of the conventionally designed motor and an optimally designed motor. The optimized design shows an efficiency improvement of 1% over the conventional design.
6534 **11:20**	20’	Salah Beni Hamed, Aicha Abid, Mouna Ben Hamed and Lassaad Sbita. *“A high efficient Double diode equivalent circuit based model for triple-junction solar cells”* ***Abstract*** In this paper, we are focused on the multijunction solar electric characteristic study. The concerned multi-junction solar cell is the one investigated using a high efficient multi-junction solar cell GaInP/GaAs/Ge. To achieve this step, a detailed dynamic model is investigated. It is based on the double diode electric equivalent circuit. The developed equivalent circuit model integrates the fundamental parameters of each sub-cell on the one hand. On the other hand, it includes the effect of the temperature and the solar radiation variations on the energy gap, on the sub-cells parameters as well as on the reverse diode saturation currents for both used diodes.
5045 **11:40**	20’	Moussa Sari and Youcef Ouazir. “*Analytical computation of eddy currents and inductances in a conductive rod of finite length wound by a moveable cylindrical coil”* ***Abstract*** This paper presents a complete 2D analytical model for calculating the magnetic field, eddy current and mutual inductance in a conductive rod of finite length wound by a cylindrical coil. The proposed model combines the truncated region eigenfunction expansion (TREEM) method with the separation of variables technique to solve Maxwell's equations in terms of the magnetic vector potential in the axisymmetric problem. This developed analytical model allows considering the finite length of the cylindrical coil and the conductive rod at the same time, also solves the nonlinear equation that gives the complex eigenvalues. The analytical results are compared to the numerical ones obtained by FEM (COMSOL).
9397 **12:00**		Abdi Ammar, Abdelmalek Aissaoui and Moulai Hocine. “*Overhead Lines Induced Transient Overvoltage Analysis using FDTD Method”* ***Abstract*** In this work, a new approach based on transmission lines theory is presented. It is exploited for

	20’	the calculation of overvoltage created by direct impacts of lightning waves on a guard cable of an overhead high voltage line. First, we show the theoretical developments leading to the propagation equation, its discretization by finite difference time domain method and the resulting linear algebraic equations, followed by the calculation of the linear parameters of the line. The second step consists of solving the transmission lines system of equations by the FDTD method. This enabled us to determine the spatio-temporal evolution of the induced overvoltage.
1560 **12:20**	20’	Abdi Ammar. “*2D Semi-analytical Model for Electromagnetic Field Calculation in Axisymmetric Device”* ***Abstract*** In this paper, we have developed a semi-analytical 2D model to calculate the magnetic field generated by a variable current density along a non-magnetic conductor. In first step, the cylindrical geometry is discretized in meshes, which an analytical expression derived from the law of Biot–Savart is applied . The analytical solutions of the vector potential and the magnetic field are determined. Then, the total field is determined by the contribution of the superimposition of each element of the discretized geometry. This leads to determine the resulting heating power density, which constitutes the heat source. Results obtained by the simulation of finite element method, agree well with those issued from the developed model.

TT13 • Technical Track: Energy Management in Electrical Systems

TT13		**THURSDAY 27 October (14:00 AM – 16:00 PM) @C.R.2** **Chairs: Ilhem Slama Belkhodja, Jaouher Chrouta , Marwa Ben Said-Romdhane**
6164 **14:00**	20’	Mazen Takriti, Sondes Skander-Mustapha, Zina Boussaada, Mrabet Bellaaj Najiba and Octavian Curea. “*Energy management system for residential customers integrating Multi Agent Approach”* ***Abstract*** The paper deals with an Energy Management System of a micro-grid feeding a community of several residential buildings. The proposed micro-grid includes a photovoltaic energy production and a storage system based on batteries. The energy management system object is to optimize the main grid energy efficiency. To ensure the concept of management decentralization, we propose in this study the integration of an Artificial Intelligence Algorithm: The Multi Agent Systems. A specific agent is dedicated to each micro-grid component. Physical agents using Raspberry Pi are also presented and the communication between the different agents is insured by Wi-Fi technology. The simulation results of Micro-Grid based Multi Agent Systems management are mentioned and a porotype of experimental exchange between two physical agents is also proposed.
7794 **14:20**	20’	Nassereddine Dahmane, Ali Djerioui, Samir Zeghlache, Azeddine Houari and Zine Elabadine Dahmane. *“Energy Management of PV/FC/BAT/SC and PEM Electrolyzer”* ***Abstract*** Fossil fuel is the primary energy source in the world due to its severe environmental problems and the possibility of depletion. The use of renewable sources has become a pressing need. On the other hand, the intermittency and dynamic response of renewable energy sources are two important issues that must be addressed. To resolve these issues, this paper proposes an energy management strategy (EMS) based on frequency separation of a multi-source system consisting of a photovoltaic array (PV), fuel cell (FC), battery (BAT) for energy storage, and a supercapacitor (SC), this last one maintaining the DC bus voltage. The hybrid power system supplies a stand-alone load and a PEM electrolyzer to generate hydrogen fuel for the FC. The energy transfer from the sources to the DC bus is guaranteed by four types of DC/DC converters: classic boost for the PV array; bidirectional

		DC/DC for the battery and SC; interleaved DC/DC boost for the fuel cell to reduce current ripples; and a DC/DC buck converter for the hydrogen generator. According to the proposed supervisory algorithm, the incoming solar power is used directly either to power the load or to charge the batteries and generate hydrogen. For the other power sources, an inner current control loop with a proportional-integral (PI) controller is used. The model of each component was designed under MATLAB/Simulink. The solar irradiance and load power change throughout the day to demonstrate the EMS's efficiency.
6532 **14:40**	20’	Abdelhakim Saim, Azeddine Houari, Manuel Antonio Barrios Flores, Mourad Ait Ahmed, Mohamed Machmoum and Josep. M Guerrero. “*Power management strategy with SoCs balancing of a battery powered shipboard DC Microgrid”* ***Abstract*** In this paper, an advanced power management and control strategy is proposed to manage the operation of a short-route all electric battery powered ferry. The objective of this strategy is to maintain reliable power supply for both propulsion and ferry service loads under all operations and achieve suitable exploitation of the batteries-based energy storage systems (BESSs). For this aim, and in order to achieve these objectives a hierarchical control strategy. This strategy includes an inner voltage-current control level to maintain the desired DC voltage at the onboard DC bus and a V/P droop-based power sharing control level to accurately share the power between BESSs. Additionally, an external power management level is implemented in order to define the power participation amount of each BESSs according to the ferry load power demand and to their state of charge (SOC). This power management strategy handles also the SOC balancing of the onboard BESSs using optimized participation factors. The optimized SOCs balancing aims at improving the performance and life cycles of the BESSs and avoiding excessive BESS discharge and disconnection. The validity of the proposed control and management strategy is verified using Hardware-in-the-Loop Simulation.
8599 **15:00**	20’	Yosra Ben Fadhel, Salem Rahmani and Kamal Al-Haddad. “*Energy management circuit from internal biomechanical energy harvesters for a pacemaker”* ***Abstract*** Over the world, many peoples have medical implants in order to replace a certain organ of the body function or to help an organ to function properly. These devices require electrical energy to operate properly. Several charging methods have been proposed in order to power an active medical implants; such as the management of energy from mechanical energy harvesters. But these methods can turn out to be critical given the low powers involved and the difficulty of having good yields between the output of the recuperator and the system to be powered. In this paper, we have prototyped a system for managing the energy from an internal biomechanical energy harvesters for a pacemaker. The obtained results in the air environment are very promising**.**
1408 **15:20**	20’	Jamel Eddine Boubakri, Habib Cherif and Jamel Belhadj. Optimal Sizing, “*Energy Management and techno- economic analysis for grid-connected microgrid in an industrial activity zone”* ***Abstract*** The industrial sector is experiencing an increase in electricity demand, which has led to higher electricity prices. The microgrid was created as a viable solution in the energy sector, promoting the use of renewable energies to achieve maximum energy efficiency. The main objective of our research in this project is to create a model of a dynamic simulator using Matlab Simulink to meet the power requirements of the loads. Which consists of PV modules, wind turbines, batteries, DC/AC, AC/DC converters and several electrical loads operating as a single network in parallel to the electrical grid? As well as developing management algorithms. This system must also take into account certain limitations in order to reduce the energy consumption of the electrical network. To choose the best configuration as well as the optimal sizing of the microgrid, a sensitivity analysis method was developed based on the concept loss of power supply probability (LPSP) and life cycle cost (Lcc).
5663 **15:40**	20’	Abir Zgalmi, Amine Ben Rhouma, Habib Cherif and Jamel Belhadj. “*Intelligent Artificial power sharing of water desalination plant fed by renewable source”* ***Abstract***

		This paper presents an energy management system based on artificial neural network (ANN) strategy integrated with a hybrid renewable production system (photovoltaic-wind) coupled to a brackish water reverse osmosis desalination unit in order to share the power flow during the system operation. A dynamic simulator of the proposed system which includes the renewable generators,three motor-pumps, reverse osmosis desalination unit,three water tanks,annual consumption data,annual meteorological data, and the energy management system is developed.The ANN models has been developed in the objective of sharing the generated power into the three motor pumps system (pumping motor-pump, desalination motor-pump, and storage motor-pump) taking into account not only the available hybrid power but also the three water tanks levels (brackish water tank, permeate water tank and fresh water tank). For this reason, the obtained results by an optimized fuzzy logic- genetic algorithm are used as training data. After training and testing, it is concluded that the ANN models show good performance. The results of yearly hybrid power test showed that the used ANN architecture can estimate the power sharing with a coefficient of correlation between the actual and estimated values equal to 99.8\%.

TT14 • Technical Track: Electrical Machines Design

TT14		THURSDAY 27 October (16:30 AM – 17:30 PM) @C.R.1 Chairs: Yacine Amara, Khadija Ben Kilani
5807 **16:30**	20’	Salim Asfirane, Mostafa Hatoum, Ferhat Chabour, Georges Barakat and Yacine Amara. “*Torque Generation Comparison Under Different Excitation Modes for the Classical and Mutually Coupled Winding Configurations of the Axial-Field Switched Reluctance Machine with Segmented Rotor”* ***Abstract*** This paper deals with a 3-phase double stator, 36-slot per stator and 24-pole segmented rotor axial-field switched reluctance machine. The topology of the axial-field double stator switched reluctance machine (AFDSSRM) is made of 2 stators connected in series and a segmented rotor in between. Each stator tooth holds one coil dedicated to one phase. In this paper, two winding configurations are explored for the AFDSSRM, the classical winding for SRMs (+A- -B+ +C- -A+ +B- -C+) and the mutually coupled one (+A- +B- +C- +A- +B- +C-). The AFDSSRM is modeled using 2D finite element model (FEM). The 2D-FEM is established at the mean radius of the machine with the hypothesis of radial invariance of local quantities. It is used to achieve calculations of self and mutual inductances, self and mutual flux-linkage. The 2D-FEM will then be used to assess performances of the classical winding configuration and the mutually coupled winding configuration with regards to output torque for three different current distributions. The motor is first fed with 3-phase step current in unipolar and bipolar mode. Then a 3-phase sinusoidal current is used.
5430 **16:50**	20’	Khadija El Kinani, Sandrine Le Ballois and Lionel Vido. “*Sensitivity analysis of a dual excitation synchronous wind generator design model.”* ***Abstract*** A sensitivity analysis is performed on the parameters of an offshore dual excitation synchronous wind generator (DESG) with a nominal power of 15MW. The results reveal that the nominal voltage, the normalized permeance, the saliency ratio, the number of pole pairs and the ratio between the joule excitation losses and the joule losses of the armature have the strongest influence over the design model outputs. These five parameters are thus the main parameters for an optimal design of the DESG.
6080 **17:10**	20’	Safa Affi, Habib Cherif and Jamel Belhadj. Design Optimization and Performance “*Evaluation of Hybrid Excited Low Speed Aero-generator”* ***Abstract*** This study presents an optimal design of a low-speed aero generator based on the approach of associating geometric parameterization with electromagnetic performance evaluation. The optimal topology of the hybrid excited flux switching (HE-FS) generator is dedicated to low-

		wind speed ranges. The machine is analyzed by the 2-D finite element method (FEM) and the influence of different excitation currents on the saturation state of the magnetic circuit is investigated. Sensitivity analyses of the Form Factor (FF), as well as the Flux Excursion Factor (FE), are investigated using the Non-Sorting Genetic Algorithm (NSGA II) to assess the speed/power limitations of the proposed topology. The two-dimensional FEM of the HE-FS generator is used to perform the sensitivity analyses and to establish a multi-objective optimization of the generator for a rated power of 3kW. The multi-objective design optimization leads to trade-off solutions between conflicting objectives (maximizing the generated power and minimizing the base speed). Three study cases, based on FEA simulations and conventional sequential design strategies, are presented for performance comparison in order to minimize the size of the generator and maximize its performance. By evaluating the criterion of minimizing the generator's weight, relevant machine candidates of the Pareto front solutions are compared to the initial machine as well as other existing prototypes for small wind turbine generators.

TT15 • Technical Track: Energy Transition

TT15		THURSDAY 27 October (16:30 AM – 17:30 PM) @C.R.3 Chairs: Hamid Ben Ahmed, Abdelli Abdenour
8844 **16:30**	20'	Emna Khamassi, Ferid Rehimi and Adel Kalboussi. "*Impact of energy transition on the composite transportation sustainability index: Case study of Tunisian cities"* ***Abstract*** The aim of this study is to investigate the energy transition impact on the transportation sustainability level in Tunisian cities taken as an illustrative case study by proposing a set of scenarios which consist of replacing a percentage of passenger cars with internal combustion engines by electric ones. A total of 89 sustainable transportation indicators were used in this study, which were normalized, weighted and aggregated using the principal components analysis method. Sustainable transportation indicators were categorized into three pillars of sustainability (environmental, social and economic) which were further divided into nine subdivisions. The proposed algorithm generates composite indices for each sub-dimension as well as for each dimension (Economic, social and Environmental), and aggregate them into a composite transportation sustainability index for each Tunisian city. Then scenarios were proposed to systematically introduce electric cars (5%, 10%, 15%, 20%, 25%, 30%, 40%, 50%) and to recalculate the composite transportation sustainability index for each Tunisian city to determine the impact of the electrification of the car fleet or a part of the fleet on the evolution of the composite index of mobility. Results show that the national territory is divided into two zones. Indeed, the most marginalized governorates belong to the so-called interior zone. As for the zones that are relatively better developed, they essentially include the coastal governorates. As energy transition takes place, the composite transportation sustainability index improves progressively according to the percentage of electric vehicles introduced for each Tunisian city
9398 **16:50**	20'	Saidi Mohamed, Habib Cherif, Othman Hasnaoui and Jamel Belhadj. "*Design and HOMER techno-economic analysis of a grid-connected energy system for an audiovisual application in Tunis, Tunisia"* ***Abstract*** This paper is based on the technical and economic analysis of the optimization model of the hybrid energy system. The analysis of the hybrid system is based on logistic type numerical models implemented in the software package HOMER (Hybrid Optimization Model for Electric Renewable). This software package is used to analyze wind and solar data from an audiovisual chain area in Tunis, Tunisia. An analysis of a grid-connected hybrid renewable system was performed. A study of different configurations was shown based on the unit cost of

		electricity generation, operating costs found from simulations, and traditional fossil fuel based energy sources. A hybrid energy power system is investigated and analyzed to provide the necessary energy consumption for an audiovisual application, located at (36°49.43'N and 10°09.27'E). The main objective is to reduce the cost of energy and ensure the continuity of energy supply. The main criteria of this software are NPC and LCOE to find the best possible results for the appropriate site. Based on the simulation results by HOMER, the levelized cost of energy (LCOE) is $0.0669/kWh (DT0.215/kWh), which is much less than the grid electricity price and a $5.21 M (DT16.6M) as a net present cost (NPC).
4315 **17:10**	20’	Amine Ben Alaya, Férid Kourda and Charfeddine Mrad. “*Experimental study on the effect of electrical and mechanical conditions on piezoelectric energy harvesting”* ***Abstract*** Energy harvesting systems for low power consumption devices are increasingly required for different applications, such as Internet of Things and autonomous sensors. This work is about the evaluation of the electrical energy recovered by a ceramic piezoelectric disc, under different electrical and mechanical conditions.The vibration excitation of the disk is of different frequencies and amplitudes, the disk is fixed in different ways, while therecovery electric circuit is of different configurations.

TT16 • Technical Track: Energy Storage Systems

TT16		**FRIDAY 28 October (11:00 AM – 12:40 PM) @C.R.1** **Chairs: Sondes Skander-Mustapha, Mohamed Chaker Zahgdoudi**
2972 **11:00**	20’	Hamza Mediouni, Soumia El Hani, Amal Ezzouhri, Amina Daghouri and Imad Aboudrar. “*A Comparative Study of Machine Learning Techniques used for Lithium-Ion Batteries State of Charge Estimation”* ***Abstract*** An effective Battery Management System (BMS) is compulsory for the safe and reliable operation of lithium-ion batteries, which are increasingly being used in Electric Vehicles (EVs). Accurate State of Charge estimation (SoC) is a cumbersome task since lithium-ion batteries are highly influenced by such random factors including driving loads, operational conditions, and aging. This work presents a comparison study of various machine learning algorithms for SoC estimation. To do this, a 3Ah LGHG2 battery cell was put through a series of temperature and driving cycle tests. The proposed models are evaluated in terms of accuracy and robustness. The simulation results have shown that the Gaussian Process Regression (GPR) model outperforms the other algorithms achieving R^2 and RMSE values of (97 %, 1.3 %) and (95 %, 1.6 %) in normal conditions and in a noisy environment, respectively.
5919 **11:20**	20’	Inès Gabsi, Imène Saad, Samah Maalej and Mohamed Chaker Zaghdoudi. “*Modeling of thermal performance of a nanofluid-filled loop heat pipe for battery thermal management in electric vehicles”* ***Abstract*** An analytical model is developed to determine the thermal performance of a nanofluid-filled copper loop heat pipe for battery thermal management in electric vehicles. Modeling the heat transfer in the evaporator is particularly considered, and the heat transfer coefficient of evaporation is determined from a dimensionless correlation that is developed based on experimental data. The working nanofluid is composed of de-ionized water and copper nanoparticles. The thermal performances of the LHP are predicted for different concentrations, and it is demonstrated that the heat transport capacity of the LHP is enhanced and the evaporator temperature is deceased by augmenting the nanoparticle concentration.

6239 **11:40**	20’	Corentin Boennec, Lucas de Oliveira Albuquerque, Bruno Sareni and Fabien Lacressoniere. “*Quantification of the Li-ion batteries modelling error for microgrid design”* ***Abstract*** This paper presents our analysis of the battery modelling choices to be made in the design of microgrids. The impossibility of integrating the most accurate models in the co-optimisation of operation and sizing leads us to analyse different types of models coupling energy efficiency and ageing. The interactions among those models will be analysed in order to determine the best compromise between accuracy and computational cost.
543 **12:00**	20’	Ayoub Igourzal, François Auger, Jean-Christophe Olivier and Clément Retière. “*PEMFC homogenization for aging assessment and energy management of stacks”* ***Abstract*** This paper details a design tool for Multi-Stack Proton Exchange Membrane Fuel Cell (PEMFC) systems. A model-based approach allows us to homogenize disparate Fuel Cells (FC), which serves to simplify and to represent the overall behavior of the real Fuel Cell system. Comparing Multi-Stack Fuel Cell (MFC) systems using this approach revolves around the definition of an overall degradation index and an overall degradation speed for the system. This work also allows comparing energy management strategies.
1647 **12:20**	20’	Sonia Moussa and Manel Jebali Ben Ghorbal. “*Shepherd Battery Model Parametrization for Battery Emulation in EV Charging Application”* ***Abstract*** This paper deals with battery model parametrization in view of battery emulation applied to onboard electric vehicle (EV) chargers featuring efficient energy management system. For this purpose, accurate battery modeling and to a good state of charge (SOC) estimation, are key issues. Hence Shepherd model is adopted as it corresponds to the one used by the target emulator and simulation environment PSIM. While the target emulator uses the original Shepherd model, the simulation environment uses the ameliorated model to enhance dynamics during battery current variation. A method to easily identify both models’ parameters is described. Simulation results comparing the datasheet typical characteristic curve to the simulated curves from the adopted model show the compatibility of the model to the real battery cells’ performance. Battery pack emulation presents good results while considering a Li-ion battery cell and as well as a battery pack for SOC higher than 20%.

TT17 • Technical Track: Applied Physics in Electrical Systems

TT17		FRIDAY 28 October (11:00 AM – 12:40 PM) @C.R.3 Chairs: Fatma Bouchelga, Nabila Dhahbi-Megriche
542 **11:00**	20’	Talit Belhoul, Adel Bekakria, Fatma Bouchelga and Stefan Kornhuber. “*Etude du champ électrique d’un système pointe – plan avec barrière hydrophile sous AC”* ***Abstract*** L´objectif essentiel convoité à travers ce papier consiste en l’étude de la distribution des lignes de champ d’un système pointe – plan avec barrière en verre au moyen du logiciel COMSOL multiphysics version 5.4. et la recherche de sa performance électrique sous conditions de pollution très sévères et tension alternative 50 Hz. Notre investigation est portée sur un intervalle d´air à champ électrique non uniforme de base: pointe – plan avec barrière plane en contact avec la pointe ou tubulaire enveloppant la pointe sous tension alternative, dont la longueur de tube et la distance interélectrode sont variables. Cette étude a été appuyée par des essais expérimentaux effectués au laboratoire de haute tension. Un dispositif expérimental, composé de deux supports emboîtés l´un dans l´autre afin de permettre la variation simultanée de la distance interélectrode et entre les barrières, a été confectionné. Les essais de disruption de l´intervalle d´air des deux systèmes avec barrières fortement polluées ont été appuyés par une visualisation du chemin de leur rupture électrique. Une équivalence parfaite a été établie entre l’étude expérimentale et numérique. Une meilleure performance du système a été obtenue avec l’utilisation des barrières tubulaires de longueur considérable.
1815 **11:20**	20’	Fatma Bouchelga, Khaled Hamour, Stefan Kornhuber and Rabah Boudissa. “*Quantification du champ et du potentiel électrique sur un dépôt des gouttes recouvrant une surface superhydrophobe sous AC”* ***Abstract*** Les résultats des travaux expérimentaux antérieurs, se rapportant au mouvement électrohydrodynamique d’un ensemble de gouttes d’eau, reposant sur la surface d’une isolation à base de suie superhydrophobe et mise sous tension alternative, ont mis en évidence un mode d´évacuation groupo-individuelle et bidirectionnelle des gouttes d´eau quels que soient le type d’arrangement, le volume et la conductivité électrique des gouttes d’eau ainsi que le degré de couverture de l’isolation. Concernant la direction de leur évacuation, celles se trouvant dans la zone avoisinant l´électrode haute tension transitent par celle-ci et celles déposées dans la zone proche de l´électrode terre transitent par cette dernière. Celles de la rangée du milieu de l’isolation, se répartissent de telle sorte que le nombre de gouttes d’eau transitant par l’électrode HT est légèrement supérieur à celui des gouttes passant par l’électrode T [2]. Justement, l´objectif visé à travers cette présente étude consiste en la prédiction du sens du mouvement de ces gouttes d’eau au moyen de la distribution de l’intensité du champ et potentiel électrique alternatif résultant au niveau de celles-ci. La mesure des champs électriques autour des isolateurs pratiques est difficile et devient de mieux en mieux compliquée. Des configurations expérimentales telles que la sonde électrostatique peuvent être utilisées, mais elles sont sujettes à des erreurs périodiques, bien que cela puisse être amélioré en utilisant un système de détection de champ plus avancé. En variantes, de nombreux chercheurs ont utilisé des techniques de simulation numérique en utilisant un logiciel électromagnétique disponible dans le commerce qui semble plus pratique et moins coûteux, évitant aussi des tests de laboratoire coûteuses et complexes souvent difficiles à réaliser. Lors de cette étude de simulation, les paramètres d’influence du champ et potentiel électrique, comme le volume des gouttes d’eau, le nombre de couches superhydrophobes de revêtement en suie de l’isolation ainsi que la permittivité du couvert diélectrique du matériau essayé ont été pris en considération.
5129 **11:40**	20’	Keltoum Bouherine and Olivier Leroy. “*Simulation of Microwave Plasma Torch characteristics at Atmospheric Pressure”* ***Abstract*** This paper presents a numerical characterization of microwave plasma axial injection torch at atmospheric pressure with the use of the Argon gaz. The Electromagnetic and plasma models

		are used in 2D axis-symmetric configuration. We have used Comsol Multiphysics software for resolution of Maxwell's equations and plasma equations. The results present the map of electromagnetic filed and plasma parameters.
675 **12:00**	20'	Khaoula Oueslati and Nabila Dhahbi-Megriche. "*Physics-Informed Neural Networks for modelling insulation paper degradation in Power Transformers"* ***Abstract*** We investigate the techniques used to monitor power transformer's insulation paper, which consists of a polymeric material, and focus on the Degree of Polymerization (DP), the most used health indicator. Given the physical and chemical nature of the degradation problem, we couple it with machine learning models to predict the desired parameters for considered equations. In particular, we investigate Physics-Informed Neural Networks (PINNs), a promising emerging deep learning method for solving scientific computing problems. PINNs are designed to incorporate prior knowledge of physical or chemical systems, and to respect any symmetries, invariances, and conservation laws. The dynamics of the degradation are modeled using ordinary differential equations. These models include unknown parameters. One major challenge in the degradation of Kraft paper is estimating the unknown model parameters (e.g. rate constants) and thus performing model dynamics prediction. For this work, we aim to solve the data-driven discovery of the degradation model, infer the hidden kinetic parameters and predict the degree of polymerization. We also address the advantages and limitations of PINNs and provide some solutions to address it.
4747 **12:20**	20'	Hamour Khaled, Bouchelga Fatma, Herzig Heike, Cervinka Rüdiger and Kornhuber Stefan. "*Evaluation de l'angle de contact dynamique des gouttes d'eau sur des surfaces isolantes hydrophobes et superhydrophobes"* ***Abstract*** L'objectif de notre étude concerne essentiellement à la caractérisation des propriétés de mouillage des surfaces hydrophobes et superhydrophobes pour des applications en tant qu´isolations électriques par une procédure de mesure d'angle de contact dynamique. Pour cela, une isolation à surface superhydrophobe à base de silicone a été fabriquée [15]. Ensuite, nous avons déterminé l'hystérésis par mesure d'angle de contact dynamique de cette surface et celle en silicone RTV par différents mode d'ajustement du volume des gouttes d'eau sur celles-ci. Les résultats de cette étude montrent que la méthode de mesure d'angle de contact dynamique fonctionne universellement sur des surfaces superhydrophobes et que l'ajustement du volume d'eau dans le processus de mesure d'angle de contact dynamique sur une surface superhydrophobe n'as aucune influence considérable comparant à celle de la surface hydrophobe en silicone RTV.

TT18 • Technical Track: Electric Vehicle

TT18	**FRIDAY 28 October (11:00 AM – 12:40 PM) @C.R.4** **Chairs: Azeddine Houari, Manel Jebali Ben Ghorbal**
1301 **11:00**	20'	Marwa Ben Said-Romdhane, Sondes Skander-Mustapha and Ramzi Belhassen. "*Adaptative Deadbeat Predictive Control for PMSM based Electric Vehicle"* ***Abstract*** This article proposes an adaptative deadbeat predictive control (ADPC) for permanent-magnet synchronous motor (PMSM) included in a solar powered electric vehicle. In fact, due to magnetic saturation, material aging or temperature rise, there may be mismatches between actual parameters and their nominal values. Affected parameters are essentially stator inductance, resistance and permanent-magnet flux-linkage. In this paper, the effects of parameter mismatches on the system stability and current tracking errors are theoretically analyzed.

		Furthermore, an adaptative control is proposed to reduce the influence of the stator resistance variation. Its principle is based on the real-time control adaptation by the continuous estimation of the resistance value, considering the actual winding temperature value. Proposed approach is developed on MATLAB Simulink environment. Simulation results show that the proposed method can effectively reduce the stator resistance sensitivity and thus enhance the robustness of the control.
352 **11:20**	20’	Reza Razi, Khaled Hajar, Ahmad Hably, Majid Mehrasa, Seddik Bacha and Antoine Labonne. “*Assessment of predictive smart charging for electric trucks: a case study in fast private charging stations”* ***Abstract*** Nowadays, the electrification of mobility and its charging by renewable energy sources has become a hot topic. In this regard, suitable solutions have been predicted for possible challenges in the presence of the high energy demand of passenger cars. Therefore, various charging algorithms with specific objective functions have been proposed for different applications. However, the emergence and growth of heavy electric vehicles such as trucks have a deeper impact on the local system, which reveals the need for more study in this field. In this paper, the impact of smart charging of electric truck as a flexible element in a fast-charging station of a factory is analyzed. The proposed predictive charging algorithm for different uncontrolled, unidirectional and bidirectional scenarios tries to minimize the cost of energy exchanged with the grid. In this regard, considering the health of the battery, the best scenario from the factory owner's point of view is selected for a two-day interval including four different charge periods. Although it is obvious that the best scenario depends on the different parameters of each case study, the smart charging scenarios impose less cost on the local system in the desired case study.
4408 **11:40**	20’	Majid Mehrasa, Khaled Hajar, Reza Razi, Antoine Labonne, Ahmad Hably, Seddik Bacha, Daisy Flora Selvaraj and Hossein Salehfar. “*Fuzzy Logic-based Charging Strategy for Frequency Control of an Electric Vehicles-Integrated Weak Grid”* ***Abstract*** In this paper, a Fuzzy logic-based charging strategy is proposed for electric vehicles (EVs) to provide a stable frequency response for a weak grid (WG)-microgrid. Along with the frequency control, another fuzzy charging method is designed for EV to increase the revenue for the EV charging station owner. Both strategies have the same output which is the normalized EV power. Moreover, the state of charge (SOC) of EV, PV power, price, and the WG frequency error are regarded as the inputs of the fuzzy-based charging strategies, however, the price and the WG frequency error don’t matter to the frequency control and the revenue growth, respectively. In return, a one-degree change method is introduced to modify the frequency control rules for obtaining more revenue while the less power is needed for the frequency error compensation. Simulation results in MATLAB/Simulink environment are presented to assay the proposed charging strategies in various operating conditions and verify their abilities.
9473 **12:00**	20’	Dhaou Said and Mayssa Elloumi. “*A New False Data Injection Detection Protocol based Machine Learning for P2P Energy Transaction between CEVs”* ***Abstract*** Without security, any network system loses its efficiency, reliability, and resilience. With the huge integration of the ICT capabilities, the Electric Vehicle (EV) as a transportation form in cities is becoming more and more affordable and able to reply to citizen and environmental expectations. However, the EV vulnerability to cyber-attacks is increasing which intensifies its negative impact on societies. This paper targets the cybersecurity issues for Connected Electric Vehicles (CEVs) in parking lots where a peer-to-peer energy transaction system is launched. A False Data Injection Attack (FDIA) on the electricity price signal is considered and a Machine Learning/SVM classification protocol is used to detect and extract the right values. Simulation results are conducted to prove the effectiveness of this proposed model.

6714 **12:20**	20’	Naoui Mohamed, Aymen Flah, Asma Boukchana and Sbita Lassaad. “*Sizing of a Dynamic Wireless Power Transfer System for Electric Vehicles in Highway”* ***Abstract*** Electric cars (EVs) on the road have been plagued by range anxiety. Additionally, the inconvenience of EVs having to spend a lot of time charging while on the highway. Future automated and electrified highways could be powered by inductive power transmission, according to a solution. In terms of providing EVs with convenient service and easing range anxiety, wireless charging has promise. It is essential to control the EVs correctly in order to avoid congestion and to provide high-quality service because the capacity for charging EVs on the highway is constrained (QoS).

Notes