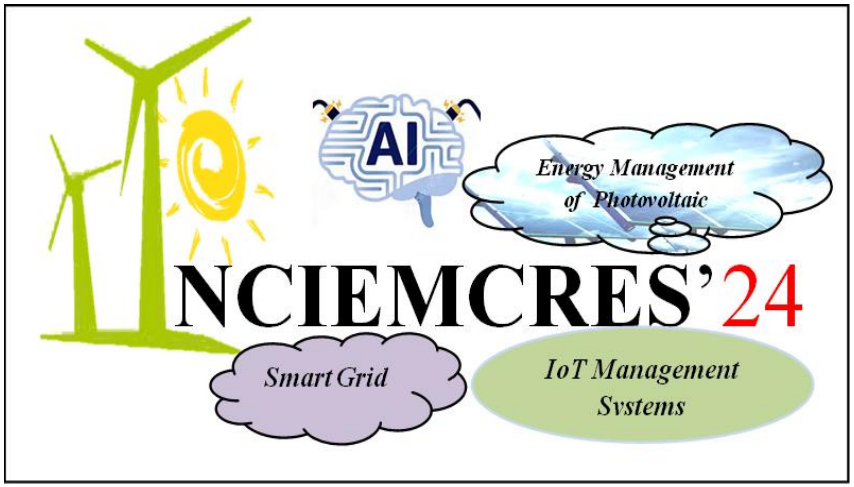
Université Abderahmane Mira de Bejaia-Algérie

Laboratoire TAMAYOUZ de Technologie Industrielle et de l'Information(L.T.2.I)

Book abstracts

National Conference on Intelligent Energy Management and Control of Renewable Energy Systems (NCIEMCRES'24)

Béjaia, October 30th -31st 2024


AI
Energy Management
of Photovoltaic
NCIEMCRES'24
Smart Grid
IoT Management
Systems

1.KEYNOTES SPEAKING

Keynote 1:

La transition énergétique : une alternative ou une fatalité?

Presented by**: Pr Seddik BACHA**

Résumé de la présentation

L'accélaration de l'intégration des système de production électriques à base de renouvelable est un fait indéniable dont la puissance installée , voire la production, dépasse les systèmes conventionnels dans beaucoup de pays. Toutefois nombe de problèmes sont apparus au fil du temps, ces derniers se trouvent accentués par l'émergence du véhicule électrique et ont porté le système électrique à ses limites structurelles et opérationnelles.
Entre autres problèmes, les plans de tension, de fréquence et de protection sont en constante révision afin de faire face à cette large intégration. Il s'agit des moyens physiques et algorithmiques qui contribuent à la maîtrise en temps réel des flux d'énergie dans les réseaux.Nous parlerons ici de flexibilisation du réseau électrique. Ces moyens de flexibilisation peuvent se décliner en :

- Ressources physiques à même d'absorber ou de fournir de l'énergie de manière contrôlée
- Une opration adaptée selon différentes échelles de temps
- Des modèles économiques adaptés ainsi que les opératuers y inhérents

La conférenceaura pour finalité de décrire ce nouveau éco-système de la flexibilité, de sa mise en œuvre et défis de sa mise en place.

Keynote 2:

Défis, Opportunités, Économies d'Énergie, et Technologies avancées associées aux Énergies Renouvelables

Présenté par: Pr REKIOUA née ZIANI Djamila

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Abstract:

Cette présentation porte ur l'évolution des ER, pour enchainer sur les défis, opportunités et économies d'énergie, puis je vais présenter les différents Technologies avancées utilisées dans le domaine des énergies renouvelables dans l'enseignement et la recherche scientifique. En effet, les ajouts de capacités renouvelables mondiales devraient faire un bond spectaculaire de 107 gigawatts pour atteindre plus de 440 gigawatts en 2023. Il s'agit de la plus forte augmentation absolue jamais enregistrée, et elle est facilitée par l'amélioration du soutien politique, les préoccupations en matière de sécurité énergétique et les prix compétitifs du solaire, de l'éolien et du stockage de l'énergie. Il existe différents facteurs qui ont contribué à promouvoir l'émergence et l'adoption croissante des énergies renouvelables dans le paysage énergétique mondial. Nous allons citer les deux plus importants: le développement de la population (dont le besoin augmente) et la préoccupation environnementale. Un accent est mis sur les systèmes de stockages utilisés et particulièrement sur l'hydrogène, son codage, la production, le stockage, le transport et ses applications terminales. Les principaux défis auxquels sont confrontées les énergies renouvelables, ainsi que les opportunités qu'elles offrent en termes de développement durable, de réduction des émissions de gaz à effet de serre et de création d'emplois verts seront présentés, ainsi que les différentes technologies avancées utilisées dans le domaine des énergies renouvelables dans l'enseignement et la recherche scientifique

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Keynote 2:

Contrôle de la mise en parallèle des convertisseurs MLI pour l'intégration des systèmes d'énergie renouvelable

Presented by: **Prof. Ali CHEBAHI**

Abstract: Dans les systèmes triphasés autonomes déséquilibrés, où la circulation du courant homopolaire (séquence zéro) est nécessaire, les onduleurs à quatre bras fournissent une connexion neutre pour les charges monophasées ou autres charges déséquilibrées typiquement utilisées dans les systèmes de distribution triphasés. De plus, le contrôle de l'amplitude et de la phase de la tension et/ou du courant de séquence zéro est également réalisé à l'aide des onduleurs à quatre bras. En raison de ces avantages, les onduleurs à quatre bras sont largement utilisés dans de nombreuses applications d'alimentation autonome basées sur les ressources d'énergie renouvelable, notamment les systèmes d'alimentation autonomes (Stand-alone power-supply systems : SPSS), les configurations parallèles et les micro-réseaux isolés à quatre fils.

Voici les défis auxquels sont confrontés les SPSS basés sur des onduleurs à quatre bras, les configurations d'onduleurs à quatre bras parallèles et les micro-réseaux isolés à quatre fils basés sur des onduleurs à quatre bras :

(1) Déséquilibre et perturbations de la tension de charge, (2) Grandes erreurs statiques sous des charges monophasées et triphasées déséquilibrées, (3) Réponses dynamiques lors de la variation de la charge ou de la tension de référence de charge, (4) Grand courant de circulation pour les configurations d'onduleurs à quatre bras parallèles qui circule entre les bras de chaque phase de ces onduleurs lorsque les onduleurs fonctionnent avec un partage de courant déséquilibré ou des paramètres de filtre de sortie déséquilibrés, (5) Partage de puissance, gestion du courant homopolaire et du courant de circulation pour les micro-réseaux isolés à quatre fils lorsque les onduleurs fonctionnent avec des paramètres des files déséquilibrés, (6) Analyse et contrôle de la qualité de l'énergie pour les trois systèmes, (7) Complexité et charge de calcul pour les trois systèmes, (8) Nombre élevé de capteurs nécessaires pour les trois systèmes**.**

Les travaux futurs et les solutions pour chaque configuration seront détaillés dans chaque partie de cette présentation.

Keynote 4:

Grid-Forming Power Inverters Control and Applications

Presented by: **Pr SOUFI Youcef**

Abstract:

In recent years, the world energy transition shifts towards greater adoption of more renewable and sustainable future energy, there has been a significant increase in investments in renewable power generation technologies. Electric power systems are increasingly being augmented with the growing demand for renewable energy technologies, mainly wind and solar, inverter-based resources are becoming an inevitable part of AC power systems. Due to the intermittent nature of these sources, IBRs often tend to extract the maximum available power at any time and feed the extracted power into the grid. While having a growing share of inverter-based resources, conventional synchronous generator-based voltageand frequency control mechanisms are still prevalent in the power industry. Therefore, inverter-based resources are experiencing a growing demand for mimicking the behaviour of synchronous generators, which is not possible with conventional grid following inverters. As the present-day inverter-based resources control may not be sufficient to ensure grid stability in a future inverter dominated power system, grid-forming inverter control technology has been considered as a potential solution. The concept of grid-forming inverters is currently emerging, which is drawing increased attention from academia and the industry. These inverters play a crucial role in stabilizing the grid and facilitating the smooth integration of intermittent renewable energy into the existing power infrastructure. In region with underdeveloped or weak grids, grid forming inverters can provide an effective solution to maintain grid stability and improve power quality. The application of inverter-based resources to electrical and renewable energy power systems has been an active area of research, has grown predominantly in recent years and has been applied to various areas of power systems where the rapid development and advancement of grid forming inverters can provide powerful tools in many aspects of the power system, including power system planning and design, coordinated control, simulation. The presentation initially deals with the need for this technology due to the substantial annual integration of inverter-based renewable energy resources and the key differences between the traditional grid-following and the emerging grid-forming inverters technologies. Also, this presentation addresses critical issues on the introduction grid grid-forming inverters technologyin power system where the main objective of this presentation is to provide a contemporary look at the current state of the art on the application of grid-forming inverters in renewable power systems. as well as to provide a better understanding of the technologies, potential advantages and research challenges of this approach and provoke interest among the research community to further explore this promising research area

Keynote 5

Energy Efficiency and Energy Savings as key drivers for climate change mitigation

Presented by **Dr. Amel Ferial BOUDJABI**

Abstract:

The world commitments are the foundations for sustained efforts to address climate change mitigation. The purpose is to challenge states, regions, cities, companies, investors and citizens to step up actions in: Energy transition, climate finance and Carbon market, Industry transition, local actions and cities and resilience. In fact, the main challenges of climate change require a global response. All the world reports outline a strategy focused on what to do to capture the economic, social and environmental benefits of enhanced energy efficiency. The last IEA's global analysis of energy efficiency and energy savings has identified the key actions that can deliver the most positive impact, this includes improving the energy efficiency of buildings and industry.It also highlights the importance of other sectors as transport where energy efficiency is becoming increasingly important. Achieving these goals requires urgent actingonthe four climate pillars as defined by the IEA. To meetthe 1,5°C and the net zero carbon emissionstargets by 2050, it is time to accelerate the scenario of decarbonation, energy mix and energy efficiency improvement by tripling the implementation of renewable energy plants beyond 2030, increasing the part of electrical vehicles to 60% , encouraging the renewable energy installations and doubling the gain of energy efficiency to at least 4%. As an example, there is not a credible scenario for the climate change mitigation without a radical change in the building sector which is responsible of more than 40% of the final energy worldwide, while in Algeria, it has reached 47% . Energy savings and sufficiency implies a drastic evolution of individuals and society,indeed , with the important growth of energy prices and economic crisis it has never been more important to use energy more wisely with simple changes in behaviour and habits to consume less for the different energy uses : heating, cooling, cooking and hot water. Investing in more efficient products and equipment can also save energy, contribute to reduce energy bills and environmental footprint as well as other energy efficiency enhancements as insulating materials, bioclimatic and energy recovery or coupling systems, new technologies and smart or AI solutions. Otherwise, the main condition to ensure evolving energy consumption and saving model remains to set up relevant policies and to attract a massive investment to support Energy efficiency and renewable projects.

Keynote 6

Adaptive control for three-phase grid-connected photovoltaic systems

Presented by **Pr. LABIOD Salim**

Abstract:

Solar energy, considered as an abundant and clean renewable resource, has found a wide range of applications. With the increasing integration of photovoltaic (PV) systems into the energy grid, there is a growing demand for reliable and efficient grid-connected PV systems that leverage advancements in power electronics and control technology. As a result, single-stage grid-connected PV systems have garnered significant interest, particularly in low-voltage applications. However, these systems exhibit nonlinear behavior with uncertain parameters due to the inherent characteristics of PV cells and the nonlinear switching functions of inverters. If left unaddressed, the nonlinearity and the uncertainty can adversely affect system performance. In this presentation, we introduce two adaptive control designs to tackle these challenges: a model-free controller and an L1 adaptive controller. These controllers aim to optimize maximum power tracking under varying atmospheric conditions and manage reactive power without the need for additional power converters. Analysis and simulation results demonstrate the effectiveness of these adaptive control schemes, highlighting their potential to enhance PV system performance.

Keynote 7:

Grid-Connected Photovoltaic Systems
An overview of recent research and emerging PV converter technology

Presented by **Pr KRIM Fateh**

Abstract: In the last five years the photovoltaic (PV) energy has grown with an average annual rate of 60%, surpassing one third of the cumulative wind energy installed capacity, is quickly becoming an important part of the energy mix in some regions and power systems. This growth has also lead to the evolution of classic PV power converters from single–phase grid-tied inverters to more complex topologies to increase efficiency, power extraction from the PV modules, and reliability without impacting the cost. This talk presents an overview of the existing PV energy conversion systems, addressing the system configuration of different PV plants and the PV converter topologies that have found practical applications for grid-connected systems. In addition, the recent research and emerging PV converter technology are discussed, highlighting their advantages comparatively to the present technology.

Keynote 8:

Fractional order adaptive control applied in Renewable Energy systems:

Promising results and future prospects'

Presented by: **Prof. Samir LADACI**

Abstract:

There is more and more demand of energy in the world with its growing population and developing industry. This fact has considerably increased interest in renewable energy sources for power generation. However, this new kind of energy, unlike fossil one, is generally instable or less regular, as the steady and continuous power output is not available. For example, in solar energy, we have to deal with a varying irradiation over the day. This is a real drawback of this option, because it disturbs the electrical output of the system. In Wind energy also, the wind is a varying phenomena making it difficult to maintain a stable frequency and output voltage for the electrical output. All these problems, express a real need for powerful control solutions, in order to improve the dynamics and performance of the generated energy. Recently, many researchers have proposed fractional order controllers to deals with these fluctuations and uncertainties, as they proved to be more efficient than classical control tools. Fractional order systems, have the ability to modelize more accurately dynamic systems with memory or subject for disturbances and noses. Besides, the fractional order controllers are able to improve the performance of the controlled energy system, while rejecting disturbances and guaranteeing a robust behavior. In this talk, I will focus on fractional adaptive control as an interesting and efficient solution for such problems. I will present two kinds of adaptive control: fractional extremal control, and fractional Model Reference adaptive control to deal with three renewable energy problems:

- Maximum Power Point Tracking Technique for Efficient Photovoltaic based integration of fractional order,
- Fractional-order model reference adaptive control of a multi-source renewable energy system with coupled DC/DC converters power compensation, and
- Fractional-order model reference adaptive control applied to a wind energy system.

These control techniques have been developed by our research team, and works are ongoing towards more proper energy with good quality.

Some future development and perspectives will be presented and discussed to demonstrate the importance and necessity of fractional order control solutions in this field.