CERTIFICATE OF PARTICIPATION

We hereby certify that **Mohamed Ilyas Rahal** participated with an oral presentation at the *First International Conference on Mechanical and Electrical Engineering for Green Energy Technologies*, held from 25 to 27 November 2025 in Algiers, Algeria.

Paper Title : Comparative Study of Power Control Strategies for DFIG Wind Turbines: PI vs Sliding Mode.

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International Conference on Mechanical and Electrical Engineering for Green Energy Technologies – MEEGET 2025, 25-27 November 2025, Algiers, Algeria

Comparative Study of Power Control Strategies for DFIG Wind Turbines: PI vs Sliding Mode

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Abstract— ***The electrical subsystem of a wind energy conversion system is the main subject of this research. A thorough mathematical model of the Doubly-Fed Induction Generator (DFIG) is created in the first section, accounting for its dynamic behaviour in different wind situations. In order to achieve independent regulation of active and reactive power—a crucial component of grid stability and effective energy transfer—a control strategy is suggested based on this model. A Sliding Mode Controller (SMC) and a Proportional-Integral (PI) controller are the two controller kinds that are designed and put into use. The effectiveness of both control schemes is assessed through MATLAB/Simulink simulation. The outcomes show how well each technique works to guarantee dynamic stability and precise power control.***

Keywords—Control strategy, Proportional-Integral (PI), Sliding Mode Controller (SMC), Doubly-Fed Induction Generator (DFIG), Wind energy conversion.

I. INTRODUCTION

Renewable energy existed for centuries—hundreds of years back. These ancient civilizations utilized nature's energy through technologies such as windmills, wood burning, water mills, animal transport, and sail ships. These systems were very important in socioeconomic development, particularly in rural communities, and were as much a part of living as farming itself [1].

The global energy consumption is increasing with increasing domestic and global energy demand. The fossil fuels, i.e., oil, natural gas, and coal, continue to occupy the lion's share in the existing energy mix. Utilization of these finite energy resources is still causing worry about their exhaustibility and enormous environment effect. Air pollution and global warming are the main issues and are chiefly triggered by the emission of greenhouse gases [2].

With all these problems, renewable energy sources are gaining attention, i.e., wind power, one of the finest substitutes [3]. The capacity of power generation by wind turbine systems (WTS) has increased dramatically since their first installation in the 1980s, whose capacity was just tens of kilowatts. Wind turbines, apart from being installed more often, are also becoming more powerful and bigger [4].

Most wind turbines installed today use doubly-fed induction generators (DFIG) as their power conversion technology. Using this, power extraction will always be optimized at any operating condition for efficient performance for a larger range of wind speeds. On this operating mode, power converter supplies the rotor circuit and the stator circuit is supplied directly to the grid. The size and cost of the power converter will be much smaller than in full capacity converters used for variable-speed turbines with stator-side control due to the fact that little energy is transferred across it [5]. One of the major causes of repeated over production of DFIG-based system power output is this ability. Also, overall system performance is enhanced and flexibility is provided by the provision to adjust the voltage point of connection to the grid [6].

Thus, the present study investigates the robust control of a Doubly-Fed Induction Generator (DFIG) based wind energy

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conversion system (WECS) in order to maximize its overall capacity. Two most controversial constraints of techniques in literature [7] addressing control of WECS technology have been low damping and inadequate dynamic response. Consequently, there was an increasing concern over adopting advanced control schemes to address these limitations. Some of the earlier research in the literature had explored improving dynamic performance by means of techniques such as fuzzy logic control (FLC) [9], backstepping control [8], and sliding mode control in Permanent Magnet Synchronous Generator (PMSG) machines [10].

Comparative studies on controllers for DFIG wind turbines have explored both conventional and modern approaches: PI, FLC, SMC, and FSMC. With respect to the robustness, and efficiency, particularly steady-state precision as well as optimal power decoupling, Bouguerra et al. (2023)[17] claimed FSMC to be superior to other control techniques. Feddaoui and Lotfi (2023)[18] pointed out that while SMC is comparable to PI in terms of response time, it is PI that is quicker; SMC also lowers static error and response time, which contributes to system efficiency as a whole, and additionally, system efficiency in the work of Dekhane et al. (2024)[19] is claimed. PI is uncomplicated, and while SMC and FLC, which deals with nonlinear control issues, SMC, has design problems. U 2025, it is claimed by Itouchene et al.[20] that control strategy of VGSTA SMC is the most robust technique for MPPT, and it is claimed superior to conventional PI and SMC controllers due to improved energy extraction, reduced chattering, and stability with variable wind in the SMC.

The main concern of this paper is modeling the electrical component of a wind power conversion system. First, the doubly-fed induction generator (DFIG) model is introduced. Second, there is a control scheme developed through which it is possible to control active and reactive power independently. The control scheme contains two controllers, proportional-integral controller (PI) and sliding mode controller (SM). We provide simulation results for both control schemes.

II. MODELING OF DOUBLY FED INDUCTION GENERATOR DFIG

The Doubly Fed Induction Generator (DFIG) optimizes wind power by enabling efficient and cost-effective energy conversion, regardless of wind speed. Its ability to absorb voltage fluctuations makes it ideal for large-scale wind power generation.11], [12], [13], [14].

The DFIG, modeled as an input-output system using transfer functions or state-space representation in paper [15], facilitates control design and transient behavior analysis. The Park transformation, used in [16], is applied to obtain the electrical equations of the machine, providing a simple representation of the windings in matrix form.

$$[u_{abc}] = R_s\,[i_{abc}] + \frac{d}{dt}\,\varphi_{abc}$$

$$[u_{ABC}] = R_r\,[i_{ABC}] + \frac{d}{dt}\,\varphi_{ABC}$$

Where: R_s is the resistance of a stator phase;

The rotor vectors: R_r is the resistance of a rotor phase;

- $[u_{ABC}] = [u_A \;\; u_B \;\; u_C]^t$: the rotor voltage vector;
- $[i_{ABC}] = [i_A \;\; i_B \;\; i_C]^t$: the rotor current vector;
- $[\varphi_{ABC}] = [\varphi_A \;\; \varphi_B \;\; \varphi_C]^t$: the rotor flux vector.The rotor vectors are defined in the same way

with $[R_s] = \begin{bmatrix} R_s & 0 & 0 \\ 0 & R_s & 0 \\ 0 & 0 & R_s \end{bmatrix}$; $[R_r] = \begin{bmatrix} R_r & 0 & 0 \\ 0 & R_r & 0 \\ 0 & 0 & Rr_r \end{bmatrix}$

$[R_s]$,$[R_r]$ are the matrices of the stator and rotor resistances.

The totalized flux equations coupled with the stator and rotor phases are given by the following expressions:

For the stator and rotor:

$$[\varphi_{abc}] = [L_s]\,[i_{abc}] + [L_{sr}]\,[i_{ABC}] \qquad (1)$$

$$[\varphi_{ABC}] = [L_r]\,[i_{ABC}] + [L_{rs}]\,[i_{abc}] \qquad (2)$$

With: $[L_s]$, $[L_r]$ stator and rotor inductance matrices by:

$$[L_{sr}] = L_{aA} = \begin{bmatrix} \cos\theta & \cos(\theta + \frac{2\pi}{3}) & \cos(\theta - \frac{2\pi}{3}) \\ \cos(\theta - \frac{2\pi}{3}) & \cos\theta & \cos(\theta + \frac{2\pi}{3}) \\ \cos(\theta + \frac{2\pi}{3}) & \cos(\theta - \frac{2\pi}{3}) & \cos\theta \end{bmatrix}$$

$$[u_{abc}] = R_s\,[i_{abc}] + [L_s]\,\frac{d}{dt}\,[i_{abc}] + [L_{sr}]\,\frac{d}{dt}\,[i_{ABC}] \qquad (3)$$

$$[u_{ABC}] = R_s\,[i_{ABC}] + [L_r]\,\frac{d}{dt}\,[i_{ABC}] + [L_{sr}]\,\frac{d}{dt}\,[i_{abc}] \qquad (4)$$

Applications of Park transformation at MADA

Park's transformation converts a three-phase system into a two-phase system while maintaining the same magnetomotive force, with the zero-sequence component balancing the system without affecting this force and generating a rotating electromagnetic field with equal electromotive forces.

The general form of the electromagnetic torque of a three-phase asynchronous machine modeled in Park's reference frame is given by the following relationship:

$$C_{ém} = \frac{P\,M}{Lr}\,(\varphi_{dr}\,i_{qs} - \varphi_{qr}\,i_{ds}) = P\,(\varphi_{ds}\,i_{qs} - \varphi_{qs}\,i_{ds}) \quad (5)$$

The stator active and reactive powers are given by:

$$\begin{cases} P_s = U_{ds}\,i_{ds} + U_{qs}\,i_{qs} \\ Q_s = U_{qs}\,i_{ds} - U_{ds}\,i_{qs} \end{cases} \qquad (6)$$

The charts illustrate the outcomes from simulating a 1.5Kw power Doubly-Fed Induction Generator (DFIG) model. Key plots detail speed development, torque, flux components, current components, and power metrics. The system operates steadily at a constant speed of 1450 rpm, powered by two pure three-phase voltage sources—one supplying the stator at 220 V, 50 Hz, and the other supplying the rotor at 12 V at the stator frequency.

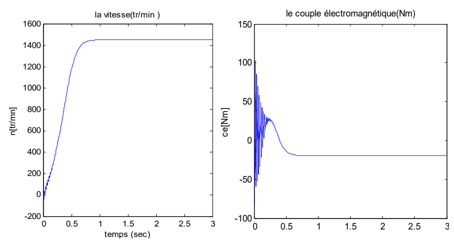

Fig. 1. Electromagnetic speed and torque.

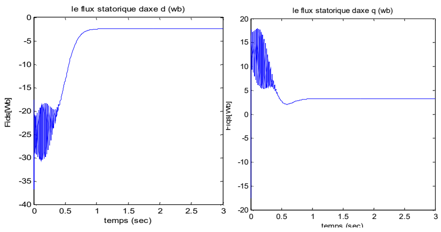

Fig. 2. The components of the stator flux of axis dq.

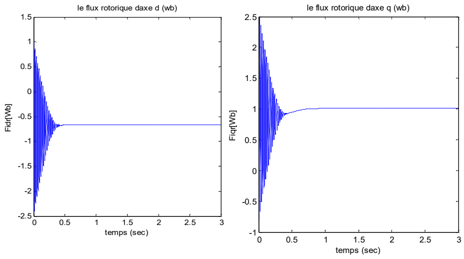

Fig. 3. The components of the rotor flux of axis dq.

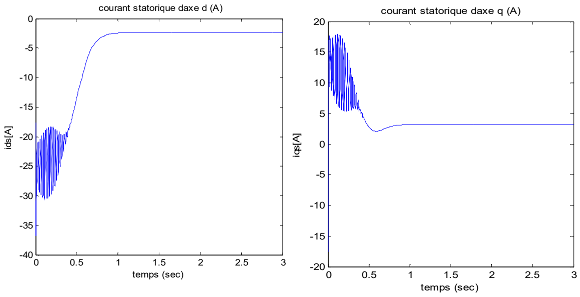

Fig. 4. The components of the dq axis stator current.

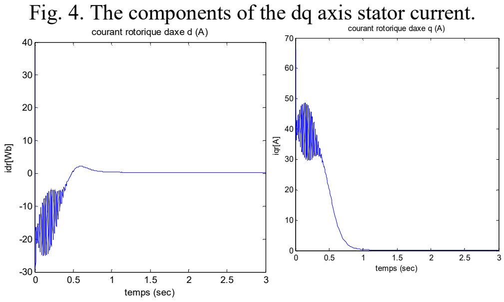

Fig. 5. The components of the rotor current of axis dq.

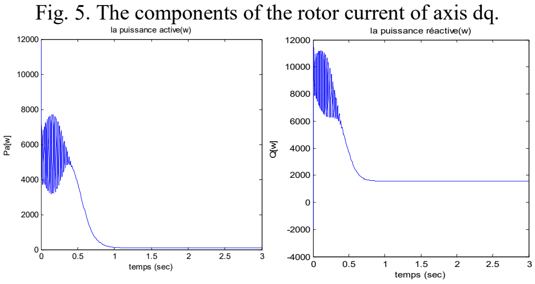

Fig. 6. Active and reactive stator powers.

The model output suggests that the electromagnetic torque is maximum at -50 N·m during startup and is negative during dynamic. Furthermore, the stator current and rotor currents are at their highest during startup, and the currents reach their steady state after 0.5 seconds.

A. Active and reactive power control of the Doubly-Fed Induction Generator:

Medium and high power machines are the common machines used to generate wind turbine power. By this, we can safely omit stator resistance. Assume stator flux to be constant:
The active and reactive power formulae are as follows:

$$\begin{cases} P_s = V_{ds}\, i_{ds} + V_{qs}\, i_{qs} \\ Q_s = V_{qs}\, i_{ds} - V_{ds}\, i_{qs} \end{cases} \qquad (7)$$

Using the Laplace transform on the rotor voltage equations, we obtain:

$$\begin{cases} V_{dr}(s) = R_r\, I_{dr}(s) + \left(L_r - \frac{M^2}{L_s}\right) s\, I_{dr}(s) - g\omega_s \left(L_r - \frac{M^2}{L_s}\right) I_{qr}(s) \\ V_{qr}(s) = R_r\, I_{qr}(s) + \left(L_r - \frac{M^2}{L_s}\right) s\, I_{qr}(s) \\ \quad + g\omega_s \left(L_r - \frac{M^2}{L_s}\right) I_{dr}(s) + g\omega_s \left(\frac{M V_s}{\omega_s L_s}\right) \end{cases} \qquad (8)$$

We can create a block diagram of the electrical system that needs to be controlled using the following formulas (Fig. 7).

$$\begin{cases} P_s = -V_s \frac{M}{L_s} \dfrac{V_{qr}(s) - g\omega_s \left(L_r - \frac{M^2}{L_s}\right) I_{dr}(s) - g\omega_s \left(\frac{M V_s}{\omega_s L_s}\right)}{R_r + \left(L_r - \frac{M^2}{L_s}\right) s} \\ Q_s = \frac{V_s \varphi_s}{L_s} - \frac{V_s M}{L_s} \dfrac{V_{dr}(s) + g\omega_s \left(L_r - \frac{M^2}{L_s}\right) I_{qr}(s)}{R_r + \left(L_r - \frac{M^2}{L_s}\right) s} \end{cases} \qquad (9)$$

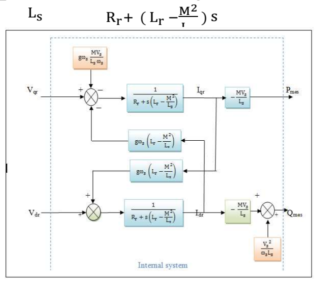

Fig. 7. Block diagram of the system to be regulated.

Direct control :

Controlling the machine's active and reactive powers is the goal.

In this study, two regulators are used for PI and MG power control.
PI: Proportional-Integral regulator;
MG: Sliding-Mode regulator.

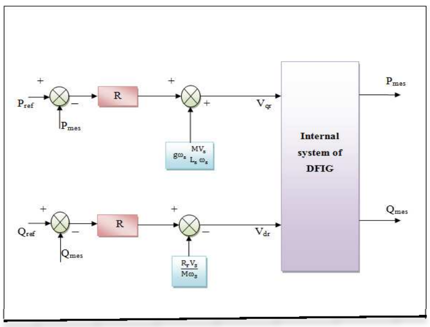

Fig. 8. Block diagram of the direct control.

Control of Doubly-Fed Induction Generator by PI

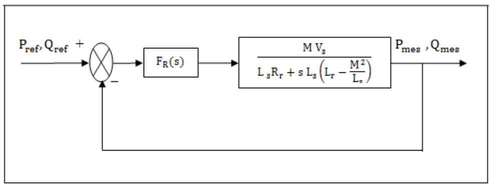

Fig. 9. PI regulated system..

$$FTBF = \frac{FTBO}{1+FTBO} = \frac{K_p \frac{M V_s}{L_s (L_r - \frac{M^2}{L_s})}}{s + K_p \frac{M V_s}{L_s (L_r - \frac{M^2}{L_s})}} \quad (10)$$

$$FTBF = \frac{1}{1+ s.\tau_r} \quad \text{with : } \tau_r = \frac{1}{K_p} . \frac{L_s (L_r - \frac{M^2}{L_s})}{MV_s}$$

With :

τ_r : is the actual time constant of the system, which will be chosen throughout the simulation to provide the optimum performance compromise, particularly as incorrectly value would lead to inappropriate overshoot and instability, and disturbance during the transient regimes [14].

$$K_p = \frac{1}{\tau_r} . \frac{L_s (L_r - \frac{M^2}{L_s})}{M V_s}$$

And (11)

$$K_i = \frac{1}{\tau_r} . \frac{R_r L_s}{MV_s}$$

Control of the DFIG using Sliding Mode Control:

We extract the derivatives of the rotor currents we obtain the following state model:

$$\begin{cases} \dot{x} = \begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} -\frac{R_r}{L_r\sigma} & 0 \\ 0 & -\frac{R_r}{L_r\sigma} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} -\frac{MV_s}{L_sL_r\sigma} & 0 \\ 0 & -\frac{MV_s}{L_sL_r\sigma} \end{bmatrix} \begin{bmatrix} u_1 \\ u_2 \end{bmatrix} + \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} P_1 \\ P_2 \end{bmatrix} \\ y = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} \end{cases} \quad (12)$$

Let us recall the command algorithm which is:

$$u = u_{éq} + u_n$$

For the first control law u_1 :

$$u_1 = \frac{L_sL_r\sigma}{MV_s}\left(P_1 - \dot{x}_{1d} - \frac{R_r}{L_r\sigma} x_1\right) - k_1 \text{signe } (S_1(x))$$

For the second control law u_2 :

$$u_2 = u_{2éq} + u_{2n}$$

$$u_2 = \frac{L_sL_r\sigma}{MV_s}\left(P_2 - \dot{x}_{2d} - \frac{R_r}{L_r\sigma} x_2\right) - k_2 \text{signe } (S_2(x))$$

The block diagram for direct control by a sliding mode (MG) type regulator is displayed in the accompanying figure:

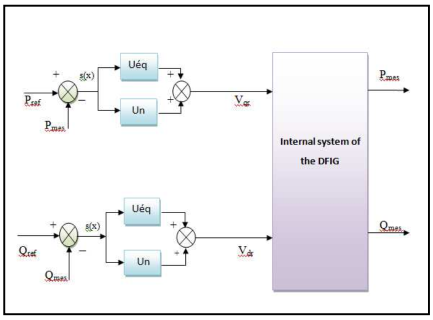

Fig. 10 . Block diagram of direct control by the MG regulator.

Setpoint tracking

Two Controllers will be tested for setpoint tracking

This test involves performing active and reactive power increments while maintaining a constant DFIG drive speed.

Performance analysis and comparison

Test Conditions

Machine driven at 1450 tr/m

At t = 1s: active power step (Pref goes from 2000W to -2000W) and At t = 2s: reactive power step (Qref goes from 1000VAR to -1000VAR)

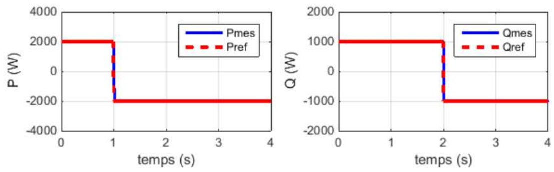

Fig 11. Direct control of active and reactive powers for the case of sliding mode control SMC (Setpoint tracking).

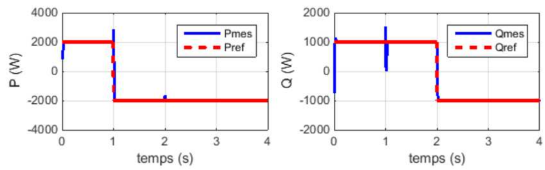

Fig. 12 Direct control of active and reactive powers for the case of PI control(Setpoint tracking).

Simulations performed on the DFIG model were used to evaluate the performance of the two control strategies studied: the conventional PI controller and sliding mode control (SMC). The performance indicators taken into account were stabilization time, maximum overshoot, and total harmonic distortion (THD) of the forward voltage (ud).

Table I. Comparison of Control Methods: Stabilization Time, Maximum Overshoot, and THD

Control method	Stabilization time (s)	Maximum overshoot (%)	THD(ud) (%)
PI Controler	2.001	50.26	-3.07
Sliding Mode Controler	4.000	284.47	-1.98

Analysis of the results shows that the PI controller provides a rapid response with a reduced stabilization time (2.001 s), but at the cost of significant overshoot (50.26%), indicating a slight lack of damping. The THD of -3.07% reflects moderate harmonic distortion, which is acceptable for a linear controller. On the other hand, the sliding mode control has a longer stabilization time (4 s) and very high overshoot (284.47%), a consequence of the chattering inherent in this method. However, it offers a lower THD (-1.98%), which reflects better signal quality and increased robustness against model disturbances and uncertainties.

Thus, the PI corrector stands out for its simplicity of implementation and speed, while sliding mode control offers greater robustness and superior control quality, but at the cost of more oscillatory transient behavior.

In conclusion, the choice of strategy depends on the objective:

- if speed is a priority, PI is preferable;
- if robustness and signal quality are essential, sliding mode is more suitable.

Robustness: The robustness test consists of testing the stability of the DFIG model in the face of parameter variations, to verify that the control remains compliant with the constraints. This is essential because in a real system, these parameters can vary due to physical phenomena and inaccuracies in identification. Simulations will be performed by modifying the resistances and inductances independently to identify the variables where the controls are not robust.

Test conditions: Resistances increased by 50% and inductances reduced by 20%, with a constant speed of 1450 tr/m.

Test: At t = 2s: Pref goes from 2000W to -2000W.

At t = 2.5s: Qref changes from 1000 VAR to -1000 VAR.

Inductances decrease by 20%.

Results and interpretations

Figure 13 shows the evolution of power during a 20% variation in inductances Ls, Lr, and Msr. It has been observed that direct control becomes unstable with a PI controller, particularly at t = 2.5s, when the active power (Q) changes from 1000 VAR to -1000 VAR, causing an increase in oscillations around the reference (Figure 13). In addition, the change in the reactive power Q setpoint with the PI controller causes an overshoot of 500 VAR.

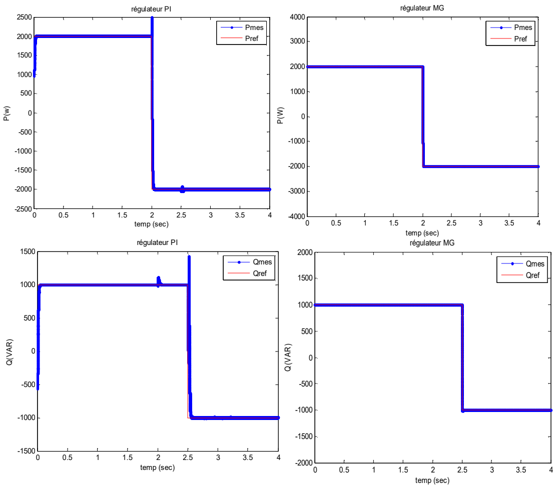

Figure 13 : Robustness test with 20% reduction in inductance(direct control).

The Chattering Phenomenon

In practice, the term discontinuous $u = -k\ \text{signe}\ (S)$ with $k > 0$

This can cause unmodeled high-frequency dynamics, resulting in “reluctance” or “chattering” (characterized by strong oscillations around the surface). To reduce or eliminate chattering, three types of controls are used:

- Composite control based on Utkin's equivalent vector principle;
- Higher-order sliding modes;
- Boundary layer solution (modified sign function).

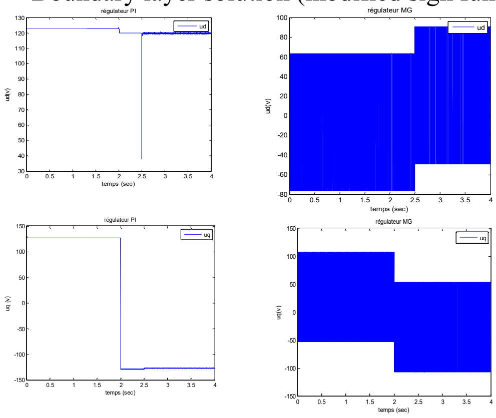

Fig. 14 : The different dq axis commands applied to the diagram to be regulated (direct control).

In order to eliminate (or reduce) oscillations (chattering), the sign(s) function is replaced by a saturation function Sat(s), or an arc tangent function tansig(s) at the discrete control level (Fig. 15).

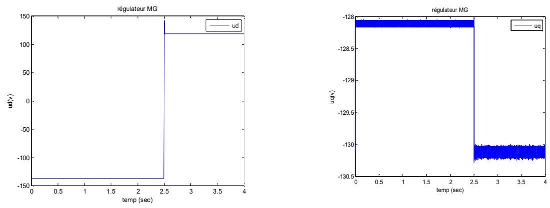

Fig. 15 : The different axis commands (dq) applied to the diagram to be regulated with the saturation function (Sat(s)).

Sensitivity to disturbances

The test evaluates the impact of sudden speed variations on the measured power of the machine.

Test conditions:

The machine runs at 1450 tr/m.

Active power: -2000W, reactive power: +1000VAR.

At t = 2s, the speed increases from 1450 tr/m to 1550 tr/m.

Results:

For direct control: The disturbance has a more pronounced effect, with the PI controller unable to cancel out the impact of the speed variation. The MG controller remains unaffected by this disturbance.

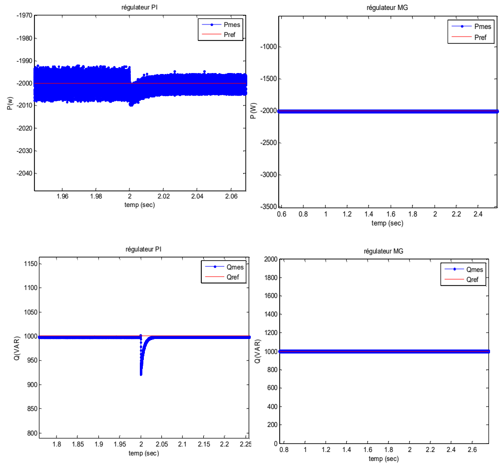

Fig. 16 : Effect on active and reactive power of a sudden change in speed (direct control).

III. CONCLSUION

This paper illustrates the modeling of DFIG and its control applied to two controllers: Sliding Mode Control (SMC) and Proportional-Integral (PI). Both of the controllers' objectives were designed and tested in independent active and reactive power regulation. Simulation results showed that the differences between the two controllers are relatively minor in terms of setpoint tracking. However, the SMC regulator proved to be more suitable in terms of performance. The PI controller exhibited lower performance compared to the SMC. The Sliding Mode Controller (SMC) is characterized by:

- Very fast response time;
- Nearly zero steady-state error;
- High-frequency oscillations known as “chattering.”

Finally, due to its simplicity, high robustness, and because it can be implemented directly in digital control systems, the SMC regulator appears the most suitable for use in wind power systems.

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APPENDIX

Parameters used for simulations.

Nominal values:

- Mechanical power: Pm = 1.5 KW.
- Nominal speed: Nn = 1450 tr/min.
- Nominal stator frequency: f_{sn} = 50 Hz.
- Nominal rotor frequency: f_{rn} = 50 Hz.
- Nominal stator single voltage: V_{sn} = 220 V.
- Nominal rotor single voltage: V_{rn} = 12V.
- Nominal stator line current: I_{sn} = 4.3 A.
- Nominal rotor line current: I_{rn} = 1.5 A.

Parameters of DFIG:

Stator winding resistance: R_s = 1.75 Ω

- Rotor winding resistance: R_r = 1.68 Ω.
- Stator cyclic inductance: L_s = 295 mH.
- Rotor cyclic inductance: L_r = 104 mH.
- Mutual cyclic inductance: M_{sr} = 165mH.
- The number of pole pairs: p = 2.

. Mechanical constants of the DFIG :

- Moment of inertia: $J_{méc}$ = 0.01 Kg.m².
- Viscous friction coefficient: f = 0.0027 N.m.s/rd.

PI regulator	MG regulator
Kp = 0.0410 Ki = 5.8753	K_1 = 80 K_2 = 70

MEEGET

INTERNATIONAL CONFERENCE ON MECHANICAL AND ELECTRICAL ENGINEERING FOR GREEN ENERGY TECHNOLOGIES

المدرسة الوطنية المتعددة التقنيات
Ecole Nationale Polytechnique

First International Conference on Mechanical and Electrical Engineering for Green Energy Technologies

MEEGET 2025

25-27 November 2025
Mercure Hotel, Algiers, Algeria

Conference Program

First Day: November 25, 2025

8:00 - 9:00	**Registration**
9:00 - 10:00	**Opening Ceremony** • Prof. Abdelouahab Mekhaldi, Directeur ENP • Prof. Chems-Eddine Chitour, Honorary Chair • Prof. Mourad Haddadi, Honorary Chair • Prof. Arezki Smaili, General Chair • Prof. Mohamed Bouhicha, General Director DGRSDT • Prof. Kamel Baddari, Minister MESRS
10:00 - 10:40	**Plenary Session 1: Hydrogen Storage Technologies: Unlocking the Future of Clean Energy** **Prof. Nouredine Fenineche**, *University of Technology of Belfort-Montbéliard, France*
10:40 - 11:20	**Plenary Session 2: Designing with Disorder: High-Entropy Alloys for Next Generation Energy Materials and Technologies** **Prof. Tahar Laoui**, *University of Sharjah, UAE*
11:20 - 11:50	**Coffee Break**

Oral Session O 1: Wind Energy

Time: 11:50 - 14:20 | Chairs: Dr. Abdelhamid Bouhelal, Dr. Abdelhamid Kaabeche | Room: Conference Room

Oral	ID.90	**Effect of Variable Blade Pitch on the Aeroacoustic Performance of a Darrieus Rotor.** Ahmed Chafik Guermache, Ayoub Talamalek, Smail Khalfallah.
	ID.121	**Comparative Evaluation of Actuator Disk and Actuator Line Models for Wind Turbine Aeroacoustics Prediction.** Abdessabour Amoura, Mohammed Nadjib Hamlaoui, Abdelhamid Bouhelal, Arezki Smaili, Sofiane Khelladi.
	ID.139	**Effect of Helical Pitch Angle on Start-Up Behavior and Aerodynamic Performance of a Savonius Wind Turbine.** Alaeddine Zereg, Mounir Aksas, Mohamed Taher Bouzaher, Nadhir Lebaal.
	ID.146	**Performance Evaluation of a Hybrid PV–Wind Grid-Connected System under Variable Irradiance and Wind Speed Using a Three-Level NPC Inverter.** Sidi Moussa Fayçal Hadj Mihoub, Abdelkader Morsli, Abdelhalim Tlemçani.
	ID.156	**Comparative Study of Power Control Strategies for DFIG Wind Turbines: PI vs Sliding Mode.** Mohamed Ilyas Rahal, Mourad Naidji, Adel Makhbouche, Zine Eddine Meguetta, Gerardo Ayala-Jaimes.
	ID.167	**A Supervised Machine Learning SVR-MPPT Algorithm for Wind System.** Fatima Salhi, Fethia. Hamidia, Amel. Abbadi.
	ID.169	**Design of a Wind Turbine System Based on a Permanent Magnet Synchronous Machine.** Yasmine Saadoune, Kamel Boughrara.
	ID.191	**Intelligent Control of DFIG for Variable-Speed Wind Turbine Generation System.** Ibrahim Yaichi.
	ID.194	**Influence of Free-Stream Turbulence on the Aerodynamic Performance of Paired Vertical-Axis Wind Turbines.** Ayoub Talamalek, Ahmed Chafik Guermache, Akram Gouaidia.
	ID.221	**Fluid–Structure Interaction in Horizontal-Axis Wind Turbines: Recent Progress and Challenges in Lattice Boltzmann Method Applications.** Sofiane Zemoura, Abdelhamid Bouhelal, Mohammed Nadjib Hamlaoui, Arezki Smaili.
	ID.225	**Towards Quieter and More Efficient Wind Farms: Multi-Objective Layout Optimization.** Abdessabour Amoura, Mohammed Nadjib Hamlaoui, Arezki Smaili, Sofiane Khelladi, Abdelhamid Bouhelal.

Oral Session O.2: Solar Energy

Time: 11:50 - 14:20 | Chairs: Dr. Smail Semaoui, Prof. Fouad Khaldi | Room: OASIS

Oral	ID.95	**Comparing the Effectiveness of Classical MPPT and Intelligent MPPT Algorithms for PV Systems under Standard and Changing Environmental Conditions.** Oqeyl Djebouri, Djallel Kerdoun, Seif Eddine Boukebbous.
	ID.101	**Modeling and Simulation of a Solar PV/Wind Turbine/Alkaline Electrolyzer/PEM Fuel Cell Power System.** Hammou Tebibel.
	ID.109	**Experimental Study on Enhancing Hemispherical Solar Still Performance Using Small Stones and Reflective Mirrors.** Reski Khelifi, Tawfiq Chekifi, Mohamed Lebbi, Sofiane Kherrour, Lyes Boutina, Khaled Touafek.
	ID.129	**Performance Monitoring of a Dual Axis Sensor-Based Solar Tracking System Using IoT.** Sakina Atoui, Said Boudjana, Ouail Yousra, Kherrour Loubna.
	ID.231	**µ-Synthesis Based Fault-Tolerant Control for Improved Reliability of the Wind Turbine.** Bachir Batoun, Houri Merabet, Abdelkader Chaker, Hamza Assia.
	ID.147	**Passive Cooling of PV Panels Using Thermal Radiation.** Salah-Eddine Bensalem, Nasreddine Belhaouas, Hichem Hafdaoui, Linda Hassaine.
	ID.157	**Enhancing Solar Chimney Power Plant Efficiency Through Advanced Thermal Storage Systems.** Chaima Zouzou, Khaoula Ikhlef, Salah Larbi, Ibrahim Ucgul.
	ID.173	**Experimental Investigation of Geometric Parameters and Flow Optimization of a Solar Vortex Prototype in North Algeria.** Fatma Hedmessaoud, Youcef Mouadji, Rassim Belakroum.
	ID.217	**Machine Learning Models for Prediction of Solar Power Energy.** Rahmani Okba, Abderrezak Guenounou, Fathia Chekired, Amel Bouacida.
	ID.224	**MPPT-Harris Hawks Optimization for PV and Pumping System.** Fatima Salhi, Fethia Hamidia, Amel Abbadi.
	ID.230	**Economic and Technical Evaluation of Hybrid (PV-Diesel-Battery) Systems for Mosques in Constantine.** Abdelmounaim Abdesselem, Adel Yahiaoui, Younes Chiba.
	ID.233	**Preliminary Results of Low-Cost Integrated Storage Solar Water Heater Thermal Performance.** Hichem Bendjebbas, Mohamed Abbas, Lilia Saidi.

Oral Session O.3: Green Hydrogen Technologies

Time: 11:50 - 14:20 | Chairs: Prof. Nadhir Lebaal, Dr. Abdelhamid Mraoui | Room: MOURAD RAIS

Oral	ID.12	**Electrical Investigation of Methane Conversion through Non-Thermal Plasmas Reactor.** Khadidja Khodja, Issam Abadlia, Abir Azara, Ilyes Nouicer, Hanene Benchikh Le Hocine, Djamoui Lalmi.
	ID.47	**Hydrogen Production from Chemical Reactions under the Effect of a Heat Source.** Omar Benbrika, Adel Benarfa, Ahmed Bensenouci.
	ID.93	**Phosphorus Deactivation in the n+ Emitter and Its Impact on Defect Passivation in Hydrogenated n+pp+ Polycrystalline Silicon Solar Cells.** Roza Ouldamer.
	ID.102	**Sizing of a Photovoltaic System for Hydrogen Production via Water Electrolysis.** Medekhel Lamine, Labiod Chouaib, Kamel Srairi.
	ID.118	**Process Modeling and Optimization of Biomass Solar Gasification for Hydrogen Production.** Ines Chabani, Alaeddine Zereg, Salaheddine Tabet.
	ID.136	**Modeling of Biogas to Hydrogen Conversion via Steam Reforming.** Ines Chabani, Mohamed Meguellati, Aissa Bensmaine, Yousra Abdelmoumenaoui.
	ID.152	**Hydrogen–Diesel Dual-Fuel Direct Injection in a Compression Ignition Engine.** Hassina Ghodbane, Fouad Khaldi, Derradji Bahloul.
	ID.172	**Paths toward Efficient Hydrogen Energy Production: Innovative Fuel Cell Technology.** Mohamed El Amine Guerbazi.
	ID.186	**Design and Thermal Analysis of Triply Periodic Minimal Surface Lattices.** Nadhir Lebaal, Alaeddine Zereg, Djafar Chabane.
	ID.222	**Magnetocaloric Hydrogen Liquefiers: A Review.** Samir Ait Ali, Arezki Smaili, Nouredine Fenineche, Nadhir Lebaal, Abdelhamid Bouhelal.

Oral Session O.4: Sustainable Transportations, Buildings & Cooling Systems

Time: 11:50 - 14:20 | Chairs: Prof. Mohamed Becherif, Prof. Wahid Maref | Room: ANDALOUSSIA

Oral	ID.114	**Hybridization of an Internal Combustion Engine with a Molten Carbonate Fuel Cell.** Jaroslaw Milewski.
	ID.123	**Performance Evaluation of Solar Thermal and PV Systems for Residential Buildings in Mediterranean and Semi-Arid Climates.** Ouiza Ait Abderrahim, Abdelkader Aris, Touhami Baki.
	ID.130	**Analysis of the Thermal Load on Cooling Systems in Electric Cars.** Artur Rusowicz, Bartosz Kowalski.
	ID.143	**Experimental Analysis of a Reversible Ventilation System Enhanced with a Heat Pump Module.** Andrzej Grzebielec, Adam Szelągowski, Katarzyna Katana, Krzysztof Bruzi.
	ID.163	**Feasibility Study of Rooftop PV System for the Residential Building in Algeria.** Ghania Mohand Kaci, Achour Mahrane, Smain Berkane.
	ID.166	**Energy Performance Enhancement through Bioclimatic Design: A Case Study of a Single-Family House in Tlemcen, Algeria.** Fatiha Smain.
	ID.171	**Performance of Indirect Evaporative Cooling System in Hot and Dry Climate.** Zoheir Derghout.
	ID.177	**Analysis of Travelling Fire in a Compartment Structure.** Mounir Alliche, Tassadit Mekkour, Abdellah Benarous.
	ID.216	**Development of a CAN Bus-Based Diagnosis Prototype for Electric Vehicle Batteries.** Selma Tchoketch Kebir, Redouane Drai.
	ID.234	**Determining the Optimal Specification of Different Cooling Systems to Optimize the Indoor Environment in Highly Glazed Buildings Using Taguchi Method and CFD Simulation.** Shengqiang Shi, Abdelatif Merabtine, Rachid Bennacer.

Poster Session P.1: Wind Energy

Time: 11:50 - 14:20 | Chairs: Dr. Mahmoud Mekadem, Dr. Mohammed Nadjib Hamlaoui | Hall

Poster	ID.65	**Optimization of Electro-Energetic System Reliability Associated with a Wind Farm.** Aissa Assas, Hocine Guentri, Tayeb Alaoui, Aissa Belhadj, Rachid Meziane.
	ID.103	**Virtual Inertia and Droop Control Implementation in DFIG-Based Wind Turbines.** Anwar Guessabi.
	ID.104	**Fault Detection in DFIG Wind Turbines Using Multi-Domain Feature Extraction.** Mohamed Seif Lalem, M'hamed Ouadah, Omar Touhami, Rachid Ibtiouen.
	ID.120	**Modeling and Analysis of a Flux Modulated Permanent Magnet Generator.** Ihab Benayache, Khalil Touimi, Abdelhalim Zaoui.
	ID.150	**Wind Power Integrated Economic Dispatch Solution Using Nature-Inspired Bald Eagle Search Algorithm.** Nour El Islem Ferroudj.
	ID.188	**Feasibility Study on the Use of Date Palm Fibers in 3D Printing for Blades.** Fouad Menani, Mohamed Samy Dehina, Zouheyr Belouadah, Abdelhamid Bouhelal, Arezki Smaili.
	ID.226	**Aerodynamic Optimization Methods for the Design of Wind Turbine Rotor Blades: A Review.** Nacer Eddine Boumezbeur, Arezki Smaili.

Poster Session P.2: Solar Energy

Time: 11:50 - 14:20 | Chairs: Dr. Amar Hadj Arab, Dr. Razika Kharchi | Hall

	ID.20	**Enhanced Energy Management in Grid-Connected PV Systems Using a Fractional Order Calculus.** Antar Beddar, Issam Abadlia, Farid Hadjrioua, Djafer Djelloul, Idriss Hadj Mhamed, Messaoud Bendjouad.
	ID.82	**Real-Time PIL-Based Validation of a Dual-EKF Algorithm for PV Inverter Control.** Aboubakr Brahimi, Djallel Kerdoun, Abderraouf Boumassata, Kaouthar Dahmani.
	ID.107	**Grid-Battery Balance: Optimizing Low-Pass Filters for PV Smoothing.** Saliha Boulahchiche, Ismail Bendaas, Smail Semaoui, Kada Bouchouicha, Amar Hadj Arab, Abdelhak Razagui, Kamel Abdeladim.

Poster	ID.119	**Towards Climate-Resilient Solar Energy: Temperature Coefficients and Degradation.** Amina Chahtou.
	ID.131	**Electron Acceptor-Assisted Solar Photocatalysis for Efficient Amoxicillin Degradation.** Meriem Akkar, Nadia Aicha Laoufi.
	ID.134	**CFD Modeling for Thermal Efficiency Enhancement in Parabolic Trough Collectors.** Mammar Bouhelal, Amar Rouag, Abdelhamid Bouhelal, Yousef Belloufi.
	ID.162	**Smart DC Energy Meter for Solar Systems.** Saad Khadar.
	ID.174	**Numerical Investigation of Conduction Band Offset Using SCAPS-1D.** Ziyad Younsi, Hichem Bencherif, Fayçal Meddour.
	ID.180	**Structured Irradiance Benchmark for Performance Assessment of MPPT Algorithms.** Hania Ladaycia.
	ID.193	**LCL Filter Design for Single-Phase PV Grid-Tied Inverter Based on PR Controller.** Linda Hassaine, Nihad Asfirane, Haithem Boukerdoun, Mohamed Rida Bengourina, Bilal Taghezouit.
	ID.202	**Efficient Drying of Onions and Garlic Using a Smart Greenhouse Solar Dryer.** Nadia Metidji, Mohand Berdja, Ouassila Badaoui, Houda Tassoult.
	ID.205	**Interfacial Engineering for Sustainable Photovoltaics: SnS_2/SnS-Optimized CZTSSe.** Bentoumi Khaoula.
	ID.210	**Robust-MPPT in PV-Powered Water Pumping System for Irrigation.** Fethia Hamidia, Amel Abbadi, Ahmed Medjber, Mohamed Redha Skender, Fatima Salhi.
	ID.213	**Optimizing Shallow Solar Pond Performance with Nanofluids.** Abdelkrim Terfai, Younes Chiba, Mounir Zirari.
	ID.223	**MPPT-Cuckoo Search Algorithm for Grid-Connected PV System.** Fatima Salhi.
	ID.228	**Development of Tin Doped Zinc Oxide Semiconductors for Efficient Solar Energy Conversion.** Meriem Boudoukhani, Younes Chiba, Malika Amari.
	ID.235	**Neural-Network Estimation of Parabolic Bending Integrated with MCRT–CFD Modeling.** Belkacem Agagna, Abdelhamid Bouhelal, Charaf-Eddine Bensaci.

Poster Session P.3: Green Hydrogen, Transport & Buildings

Time: 11:50 - 14:20 | Chairs: Prof. Abdelatif Merabtine, Prof. Mohamed Ouzzane | Hall

Poster	ID.3	**Decoupling and Electrification of Automotive Turbocharger Components.** Mohamed Amine Elhameur, Mouaad Belguedri, Alaeddine Metatla, Alfredo Gimelli, Lyes Tarabet.
	ID.19	**A Reconfigurable Fixed-Frequency LCL-LC Resonant Converter for Onboard Chargers.** Ibrahim Chibane, Yahia Achour, Bekheira Tabbache.
	ID.117	**Assessment of an Off-Grid Solar Photovoltaic–Geothermal Cooling System.** Saida Makhloufi, Salima Ouali, Abdelkader Ait Ouali, Mohammed Mondji Hadjiat, Noureddine Benaouda.
	ID.187	**Towards Mobility Applications of Solid-State Hydrogen Storage Tanks: A Review.** Isra Teldjia, Abdelhamid Bouhelal, Arezki Smaili.
	ID.200	**Review of Advances in the Design and Modeling of Composite Pressure Vessels for Hydrogen Storage.** Nour El Houda Boughedaoui, Omar Labbadlia, Zakarya Madaoui, Camelia Ait Hammouda, Younes Chiba.
	ID.202	**Efficient Drying of Onions and Garlic Using a Smart Greenhouse Solar Dryer.** Nadia Metidji, Mohand Berdja, Ouassila Badaoui, Houda Tassoult.
	ID.229	**Impact of the Use of Insulating Materials on Energy Consumption.** Kawthar Hadja, Omar Bouksani, Ilyas Khelifa Kerfah, Fatiha Abba, Younes Chiba.

14:20 - 15:20	Lunch Break
15:20 - 16:20	**Plenary Session 3: Success Story of LiFePO4 as Cathode for Li Ion Batteries for Electric Vehicle and Energy Storage: From Idea to the Market** **Prof. Karim Zaghib**, *Concordia University, Canada*
16:20 - 17:30	Coffee Break

Second Day: November 26, 2025

8:00 - 9:00	**Registration**
9:00 - 9:40	**Plenary Session 4: Construction in Service of the Energy Transition and Decarbonization** **Prof. Wahid Maref**, *École de Technologie Supérieure, Canada*
9:40 - 10:20	**Plenary Session 5: Multi-agent AI for Fluid and Energy Systems Design and Performance Analysis** **Prof. Sofiane Khelladi**, *Arts et Métiers Institute of Technology, France*
10:20 - 10:40	**Coffee Break**
10:40 - 11:20	**Plenary Session 6: Molten Carbonate Electrolyser for White/Blue Hydrogen or/and Synthetic Fuel Generation** **Prof. Jaroslaw Milewski**, *Warsaw University of Technology, Poland*
11:20 - 12:20	**Panel Session 1: Sustainable Buildings** • Prof. Abdelatif Merabtine, ETS, Canada • Prof. Mohamed Ouzzane, BLIDA 1 UNIV, Algeria • Mr. Merouane Chabane, APRUE, Algeria • Dr. Amel Limam, CNERIB, Algeria • Dr. Soumia Oukaci, CNERIB, Algeria
12:20 - 13:30	**Lunch Break**

Oral Session O.5-A: Hybrid Renewable Energy Systems

Time: 13:30 - 16:00 | Chairs: Prof. Younes Chiba, Dr. Hocine Belmili | Room: OASIS

Oral	ID.14	**Mechanical Properties of Palm Fiber and Silicon Nitride Hybrid Natural Composite Materials.** R. Suguvanan.
	ID.33	**Regenerating Lead-Acid Batteries for Second-Life Use.** Aicha Degla.
	ID.81	**Advanced Power Flow Control in Hybrid Renewable Energy Systems for Sustainable Water Pumping.** Hocine Belmili, Ahmed Medjber.
	ID.87	**A Comparative Analysis of Decentralized Control Techniques for Grid-Forming Inverters Using Finite Control Set Model Predictive Control.** Mohamed Islam Grairia, Riad Toufouti, Abderezak Lashab, Markala Karthik, Nabil Mohammed.
	ID.92	**Life Cycle Assessment of an Integrated Microalgae-Based Biofuel Production System.** Mohammed Amouri, Majda Aziza, Toudert Ahmed-Zaid.
	ID.94	**Modeling and Finite Element Analysis of a Lightweight Lever-Type Amplifier.** Somia Lemoussi, Adel Zemirline, Mohammed Ouali.
	ID.96	**Evaluating the Energy and Optical Behavior of Glazing Systems Integrated with Solid–Solid Phase Change Materials in Cold Climates.** Hossein Arasteh, Wahid Maref, Hamed Saber.
	ID.99	**Advanced Feature Selection Approach for Accurate Power Transformer Fault Identification.** Yassine Mahamdi, Abdelouahab Mekhaldi, Ahmed Boubakeur, Youcef Benmahamed.
	ID.122	**Optimal Allocation of DSTATCOM for Performance Improvement of Distribution Network.** Daili Mahdi, Mohammed Amroune, Linda Slimani.

Oral Session O.5-B: Hybrid Renewable Energy Systems

Time: 13:30 - 16:00 | Chairs: Prof. Tahar Laoui, Prof. Fateh Krim | Room: ANDALOUSSIA

Oral	ID.125	**Micromechanical Analysis of the Effect of Voids and Microstructure in Aluminum/Graphene Composites.** Hadjila Balit.
	ID.133	**Predictive Current Control of Five-Phase Two-Level Voltage Source Inverter.** Meriem Latrache, Ali Benachour, Mohamed Merouane Silem, El Madjid Berkouk.
	ID.142	**Model Predictive Current Control for Two-Level Five-Phase Z-Source Inverter.** Meriem Latrache, Ali Benachour, El Madjid Berkouk.
	ID.151	**FCS-MPCC of a Three-Phase Two-Level Inverter Feeding an RL Load: Simulation and Real-Time Implementation on DSP TMS320F28335.** Tarek Benhacine, Abdeldjalil Benslimane, Ali Dali.
	ID.158	**Smart Textile Machinery Monitoring System for Small-Scale Industries.** M. Kavitha, B. Madhumitha, P. Deepadharshini, S. P. Aksharasree.
	ID.192	**Walrus Optimization Algorithm for Optimal Sizing of Hybrid Renewable Energy System.** Dalila Fares, Saad Mekhilef.
	ID.197	**AI-Based Classification of Site Pollution Severity Levels on High-Voltage Insulators.** Imene Ferrah.
	ID.203	**Hardware Design for Fault Detection in Photovoltaic Arrays Using an IP Core.** Faiza Belhachat, Rachid Bennia, Cherif Larbes.
	ID.208	**Innovative Numerical Analysis of Electromagnetic Tube Compression.** Ilhem Boutana, Oussama Cheriet, Oussama Kouissem.

Poster Session P.4: Hybrid Renewable Energy Systems

Time: 13:30 - 16:00 | Chairs: Prof. El-Madjid Berkouk, Prof. Samir Hanchi | Hall

Poster	ID.17	**Electrical Modelling and Simulation of a DBD Plasma Supplied by Matrix Converter.** Issam Abadlia.
	ID.19	**A Reconfigurable Fixed-Frequency LCL-LC Resonant Converter for Onboard Chargers.** Ibrahim Chibane, Yahia Achour, Bekheira Tabbache.
	ID.52	**Valorization of Natural Gas in the GTL Process.** Rachida Chemini, Rachida Rihani, Radja Benhaddouche.
	ID.55	**A Simple Control Strategy Using an INC-MPPT Controller and an EKF-Based Backstepping Controller.** Samir Zoughab, Nouri Belhaouchet, Samir Sayah.
	ID.64	**Towards Transition from Natural Gas to Green Energy Sources in Algeria.** Madjid Amani, Arezki Smaili.
	ID.75	**Robustness-Driven Optimization of Fractional PIλ Dμ Control for AVR in Renewable Energy Systems Using Hyperbolic Sine-Cosine Algorithm.** Elouahab Bouguenna.
	ID.77	**Electrical Modelling and Simulation of a DBD Plasma Supplied by Matrix Converter.** Issam Abadlia, Khadidja Khodja, Anatar Beddar.
	ID.83	**A Comprehensive Analysis of the Impact of Tracking Errors on Solar Tracker Efficiency.** Khadidja Dahli, Karim Selam, Tayeb Allaoui.
	ID.85	**Optimization of Dielectric Strength in High-Voltage Insulators.** Lamine Medekhel, Guia Talal, Chouaib Labiod, Kamel Srairi, Abdelhamid Mosbahi, Redha Meneceur.
	ID.88	**Hybrid Grey Wolf Optimizer and Equilibrium Optimizer Algorithm for Directional Overcurrent Relays.** Bouchra Hamai, Khaled Guerraiche, Djamel Eddine Fekir, Amel Abrouche.
	ID.97	**Overview and Comparison of MPPT Control Techniques Used in Photovoltaic Systems.** Ahmed Zaoui, Rezki Tadrist, Ali Nesba.
	ID.105	**Estimation of the Monthly Energy Production of a Photovoltaic Module over Its Entire Lifetime.** Houaria Bouchama, Mohammed El Bachir Ghribi, Ahmed Wahid Belarbi.

Poster	ID.112	**Comparative Analysis of Capacitive Stress Grading Techniques in High-Voltage XLPE Cable Terminations.** Zoubida Azaizia, Houssam Mehibel, Abdallah Hedir, Madjid Teguar.
	ID.113	**Implementation of DQ-Based Grid-Forming Inverters for Renewable Integration.** Lakhder Ayhar, Ahmed Safa, Abdelmadjid Gouichiche, Fayssal Elyamani Benmohamed.
	ID.115	**Electronic and Magnetic Properties of Double Perovskite Oxide Ba_2TiTaO_6.** Atika Guendouz.
	ID.127	**Study of Electrical Phenomena in Circuit Breakers.** Ali Ghelmoul, Mohammed Messaad, Bachir Ghalem, Mohammed Bachir Ghribi.
	ID.128	**Numerical Investigation of the Effect of Radiation on a Porous Spiral Convective Fin.** Nadia Daradji.
	ID.140	**MPPT-Assisted Multilevel Space Vector Modulation for a Three-Phase Switched Capacitor Boost Inverter.** Rania Omar Amrani, Ali Benachour, El Madjid Berkouk, Bouchra Belili, Selma Chellal.
	ID.148	**Construction of Detailed Equivalent Circuits for Turbogenerators.** Farid Leguebedj.
	ID.164	**Real-Time Animal Detection Behind Obstructions Using YOLOv8.** T. M. Bharath, S. Haripriya, V. Gomathi, B. Hirankumar.
	ID.168	**HVDC Signal Selection for Power Systems Congestion Alleviation.** Karim Sebaa, Abdelhafid Hellal, Tawfik Guesmi, Yang Zhou, Yong Li.
	ID.182	**Study of Voltage Stability Using Sensitivity Analysis by Optimum Capacitor Placement.** Sandesh Acharya.
	ID.183	**Load Flow Study for Economic Dispatch Optimization for 5-Bus System.** Sandesh Acharya.
	ID.198	**Multi-Resolution Fractal Dimension Analysis of Leakage Currents for Insulator Diagnosis.** Imene Ferrah.
	ID.199	**RGB Image-Based Fractal Dimension Analysis for Diagnosing Electrical Discharges.** Imene Ferrah.

	ID.204	**Numerical Modeling and Diagnosing of Defects in PMSM Using Vibration Analysis.** Nassira Ferkha, Dounia Sedira, Walid Boutbiba, Abdesslem Djerdir, Ahsene Ferkha.
	ID.212	**Dominated Sorting Optimization Algorithm (DSOA) Implementing Optimal Capacitor Placement.** Sandesh Acharya.
	ID.232	**AVOA-Based Calibration of an Enhanced Self-Correcting Battery Model for Digital Twin Integration.** Walid Merrouche.

16:00 - 17:00 | Coffee Break

Third Day: November 27, 2025

8:00 - 9:00	**Registration**
9:00 - 9:40	**Plenary Session 7: Hydrogen and The Fuel Cell Electrical Vehicle** **Prof. Mohamed Becherif**, *Université of Technology of Belfort-Montbéliard, France*
9:40 - 10:20	**Plenary Session 8: Traction Motors for EV & HEV Applications: Renault Experience No or Low Rare Earth Materials** **Dr. Sid Ali Randi**, *Ampere & Renault Group Technocenter, France*
10:20 - 10:40	**Coffee Break**
10:40 - 11:20	**Plenary Session 9: The Future of Thermal Management in Electric Vehicles** **Dr. Kamel Azzouz**, *VALEO, France*
11:20 - 12:20	**Panel Session 2: Sustainable Transportations** • Dr. Ali Benmeddour, NRC, Canada • Prof. Mohamed Becherif, UTBM, France • Dr. Sid Ali Randi, Ampere & Renault Group, France • Dr. Abdelhamid Mraoui, CDER, Algeria • Dr. Billel Kalache, DC-REN, SONATRACH, Algeria • Mr. Boukhalfa Yaïci, Green Energy Cluster Algeria
12:20 - 13:20	**Closing Ceremony**
13:20 - 14:30	**Lunch Break**

GREEN ENERGY TECHNOLOGIES HACKATHON PROGRAM

Room: TIKEJDA

First Day: November 25, 2025

Theme: Project Proposals, Team Formation, and Kick-off

8:00 - 9:00	**Registration**
9:00 - 10:00	**Opening Ceremony**
10:00 - 12:40	Conference sessions
12:40 - 13:40	**Lunch Break**
13:40 - 16:00	Project presentations
16:00 - 17:00	Selection of the best project ideas and team formation
17:00 - 18:00	Launch of project development

Second Day: November 26, 2025

Theme: Project Development and Final Presentations

9:00 - 12:20	Conference sessions
12:20 - 13:30	**Lunch Break**
13:30 - 16:00	Developing selected projects
16:00 - 18:00	Final project presentations

Third Day: November 27, 2025

Theme: Evaluation and Awards Ceremony

9:00 - 12:20	Conference sessions
12:20 - 13:20	**Awards for the best projects & Closing Ceremony**
13:20 - 14:30	**Lunch Break**