1- The competition title.

2025 Competition on Evolutionary Computation in the Energy Domain: Summer Finals of the Risk-based Energy Scheduling

2- A description of the competition.

Following the success of the previous editions at major events IEEE PES; CEC; WCCI, and GECCO, we are launching the summer finals of the competition at major conferences in the field of computational intelligence. This year, the IEEE CEC 2025 competition proposes one track in the energy domain that follows the winter challenge launched at the IEEE SSCI 2025 conference:

Testbed - Risk-based optimization of aggregators' day-ahead energy resource management (ERM) considering the uncertainty of high penetration of distributed energy resources (DER). This testbed represents a centralized day-ahead ERM in a smart grid with a 13-bus distribution network using a 15-scenario case study with 3 scenarios considering extreme events (high impact and low probability). A conditional value-at-risk (CVaR) mechanism is used to measure the risk associated with extreme events for a confidence level (α) of 95%. We also added some restrictions to the initialization of solutions and allowed repairs, and tweak heuristics.

Note: The track is developed to run under the same framework as past competitions.

3- Motivations and expected impact on evolutionary computation.

The IEEE CEC 2025 competition on "2025 Competition on Evolutionary Computation in the Energy Domain: Summer Finals of the Risk-based Energy Scheduling" has the purpose of bringing together and testing the more advanced Computational Intelligence (CI) techniques applied to energy domain problems, namely a centralized risk-based energy resource management considering extreme event occurrence. The competition provides a coherent framework where participants and practitioners of CI can test their algorithms to solve a real-world optimization problem in the energy domain. The participants have the opportunity to evaluate if their algorithms can rank well in the proposed problem since we understand the validity of the "no-free lunch theorem", making this contest a unique opportunity worth exploring the applicability of the developed approaches in a real-world problem beyond the typical benchmark and standardized CI problems.

The competition aims to bridge the gap of knowledge between computer and AI scientists and energy experts. We propose a complex problem in the energy domain encompassing large dimensionality and uncertainty, which meets the characteristics of a real-world problem where deterministic approaches fail to provide a solution in a useful time. So, we challenge experts to provide novel efficient metaheuristic algorithms that can provide good solutions to the problem. Also, algorithms should be designed generally enough to handle different case studies of the same problem.

To further encompass experts in the energy and CI fields we intend to launch this competition at IEEE CEC and GECCO together following the winter edition launched at the SSCI conference. Therefore, contestants will be automatically participating in a competition at three major conferences in the field of CI, namely IEEE CEC 2025, and ACM GECCO 2025.

4- Data description.

The data represents a medium voltage (MV), distribution network (DN) of an smart city located in the BISITE laboratory in Salamanca, Spain, was chosen for this case study [1]. This DN features one 30MVA substation in bus 1, 15 DG units (2 wind farms and 13 PV parks), and four 1Mvar capacitor banks. When it comes to consumption, this DN has 25 different loads composed of residential and office buildings and some buildings that provide a service (hospital, fire station, and shopping mall). The smart city in question has seven charging stations allowing EVs to charge their batteries, including four 7.2kW slow charging stations per connection point and 50kW fast charging stations per connection point. This case study considers the high penetration of EVs and renewables.

[1] B. Canizes, J. Soares, Z. Vale, and J. Corchado, “Optimal Distribution Grid Operation Using DLMP-Based Pricing for Electric Vehicle Charging Infrastructure in a Smart City,” Energies, vol. 12, no. 4, p. 686, Feb. 2019, doi: 10.3390/en12040686.

5- Evaluation procedures and established baselines.

Rules:

-Participants will propose and implement metaheuristic algorithms (e.g., evolutionary algorithms, swarm intelligence, estimation of distribution algorithm, etc.) to solve the proposed track problem in the energy domain.

-The organizers provide a framework, implemented in MATALAB© 2021a 64 bits, in which participants can easily test their algorithms (we also provide a hybrid-adaptive differential evolution algorithm implementation as an example). The guidelines include the necessary information to understand the problem, how the solutions are represented, and how the fitness function is evaluated. Also, we provide information on mathematical formulation regarding the objective function value and problem constraints. Those elements are common for all participants.

-A maximum number of "function evaluations" is considered for all algorithms. However, this year, the algorithms' convergence properties, measured as the number of "functions evaluations", are part of the evaluation criteria in the competition. Thus, participants should strive to obtain the lowest number of "function evaluations" as well.

-20 independent trials should be performed in the framework by each participant.

- How to submit an entry and how to evaluate them

-The winner will be the participant with the minimum ranking index in the proposed track, which is calculated as the sum of the normalized values of the average fitness value and the average number of function evaluations for the 20 trials. Possible outliers in the normalization will be handled by the winsorizing of the results.

- Each participant is kindly requested to put the text files corresponding to final results (see guideline document), as well as the implementation files (codes), obtained by using a specific optimizer, into a zipped folder named.

CEC2025_track1_AlgorithmName_ParticipantName.zip (e.g.) CEC2025_track1_HyDE_Lezama.zip).

6- Schedules.

Submission deadline: 1st June 2025 (Anywhere on earth).

The established deadline is sufficient for the organizers to validate the results for dissemination at the CEC conference.

7- Expected number of participants.

The expected number of entries for this competition is 10 at least (as a reference, the 2023 edition gathered 17 entries, and the 2024 edition 9).

8- Additional information.

We have obtained IEEE CIS sponsorship in the six previous editions (2019-2024), offering monetary prices. We will pursue this goal again to offer IEEE CIS winning certificate and prize. We are also open to other sponsorships.

9- Main team biographies.

Organizer 1: José Almeida (jorga@isep.ipp.pt), GECAD, LASI, Polytechnic of Porto.

Bio: Jose Almeida has a degree in Electrical and Computer Engineering (2019) and a Master's in Electrical Engineering - Power Systems (2021) from Polytechnic Institute of Porto, Portugal. He is currently pursuing a Ph.D. in Intelligent Systems at the University of Salamanca, Spain. He is a Researcher with GECAD–Research Group on Intelligent Engineering and Computing for Advanced Innovation and Development, ISEP/IPP. He is also a member of the IEEE CIS TF 3 on CI in the energy domain. He has also organized special sessions, workshops, and competitions to advance the use of CI in addressing complex challenges within the energy sector.

Organizer 2: Fernando Lezama (flz@isep.ipp.pt), GECAD, LASI, Polytechnic of Porto.

Bio: Fernando Lezama (Senior Member, IEEE) received the Ph.D. in ICTs from the Monterrey Institute of Technology and Higher Education (ITESM) in 2014. He is currently a Researcher at GECAD-Polytechnic of Porto, where he contributes to applying computational intelligence (CI) in the energy domain under various problems. He has published over 100 articles in intelligent systems, energy conferences, and SCI journals. Since 2016, he has been part of the National System of Researchers of Mexico and the Co-Chair of the IEEE CIS TF 3 on CI in the energy domain (he was appointed Chair from 2019 to 2021). He has also been involved in organizing special sessions, workshops, and competitions at IEEE WCCI, IEEE CEC, and ACM GECCO to promote the use of CI to solve complex problems in the energy domain.

Organizer 3: João Soares (jan@isep.ipp.pt), GECAD, LASI, Polytechnic of Porto.

Bio: João Soares (Senior Member, IEEE) received the B.Sc. degree in computer science and the master's degree in electrical engineering from the Polytechnic Institute of Porto, in 2008 and 2011, respectively, and the Ph.D. degree in electrical and computer engineering from UTAD University, in 2017. He is currently a Researcher with ISEP/GECAD. His research interests include optimization in power and energy systems, including heuristic, hybrid, and classical optimization. He is the Chair of the IEEE CIS TF 3 on CI in the Energy Domain and has been involved in the organization of special sessions, workshops, and competitions to promote the use of CI to solve complex problems in the energy domain.

Organizer 4: Bruno Canizes (bmc@isep.ipp.pt), GECAD, LASI, Polytechnic of Porto.

Bio: Buno Canizes received the Ph.D. degree in computer engineering in the field of smart power networks from the University of Salamanca (USAL), Spain, in 2019. He is currently a Researcher at GECAD—Research Group on Intelligent Engineering and Computing for Advanced Innovation and Development, ISEP/IPP. His research interests include distribution network operation and reconfiguration, smart grids, smart cities, electric mobility, distributed energy resources management, power systems reliability, future power systems, optimization, electricity markets, and intelligent house management systems.

Organizer 5: Filipe Sousa (ffeso@isep.ipp.pt), GECAD, LASI, Polytechnic of Porto.

Bio: Filipe Sousa is currently pursuing a Master's Degree in Industrial Management at Instituto Superior de Engenharia do Porto (ISEP) and holds a Master's Degree in Multimedia from Faculdade de Engenharia da Universidade do Porto (FEUP). He is currently a Researcher at GECAD-Polytechnic of Porto. Additionally, he has been involved in organizing workshops, webinars, special sessions, and has disseminated multiple projects (e.g., H2020).

Organizer 5: Zita Vale (zav@isep.ipp.pt), GECAD, LASI, Polytechnic of Porto.

Bio: Zita Vale (Senior Member, IEEE) received a Ph.D. degree in electrical and computer engineering from the University of Porto, Porto, Portugal, in 1993. She is currently a Professor at the Polytechnic Institute of Porto. Her research interests include artificial intelligence, smart grids, electricity markets, demand response, electric vehicles, and renewable energy sources.