Workshop on Energy Flexibility in Smart Buildings and Smart Grids

10 December 2021,

Instituto Superior de Engenharia do Porto,

Porto, Portugal

Implementation of Risk-Based Analysis using Conditional Value-at-Risk for a Robust Energy Resource Scheduling

José Almeida

Research Group on Intelligent Engineering and Computing for Advanced Innovation and Development (GECAD)

Type of talk: Invited talk

Abstract:

The increasing penetration of distributed energy resources in todays' electricity grid makes the energy resource management problem one of the most complex problems in electrical power systems. The uncertainty associated with these resources concerns the optimization problem, the existence of extreme events. These events have a low probability of occurrence but can cause a high impact on the scheduling solution. In this talk, we introduce a risk-based analysis for a robust energy resource scheduling solution incorporating the conditional value-at-risk as a tool for risk measurement. This mechanism improves the value-at-risk tool allowing risk evaluation beyond the proposed confidence level, presenting greater security in the solutions, but requiring a higher investment. We use a novel metaheuristic named cellular univariate marginal distribution algorithm with Normal-Cauchy distribution for the optimization problem due to the high number of variables and constraints. A Monte Carlo Simulation is used to generate a set of scenarios to deal with the uncertainty associated with the distributed energy resources and market prices. Results show that incorporating the conditional value-at-risk mechanism allows a better and more robust scheduling solution even with an almost 4% increase in operational costs and 6.2% in expected costs when not considering the risk measuring tool. In this situation, the cost of the worst scenario reduces around 52%. This situation causes a reduction of the expenses of 13.86% when the aggregator accepts the risk in its formulation, that is, in the occurrence of extreme events.

Related References:

[1] J. Chen, "On Exactitude in Financial Regulation: Value-at-Risk, Expected Shortfall, and Expectiles," Risks, vol. 6, no. 2, p. 61, Jun. 2018, doi: 10.3390/risks6020061.

[2] M. Esmaeeli, A. Kazemi, H. Shayanfar, G. Chicco, and P. Siano, "Risk-based planning of the distribution network structure considering uncertainties in demand and cost of energy," Energy, vol. 119, pp. 578–587, Jan. 2017, doi: 10.1016/j.energy.2016.11.021.

[3] F. Samadi Gazijahani and J. Salehi, "Optimal Bilevel Model for Stochastic Risk-Based Planning of Microgrids Under Uncertainty," IEEE Trans. Ind. Inf., vol. 14, no. 7, pp. 3054–3064, Jul. 2018, doi: 10.1109/TII.2017.2769656.