Smart Microgrid Management: A Hybrid Optimisation Approach

amoura yahia (✉ yahia.amoura@yahoo.com)

Instituto Politécnico de Bragança: Instituto Politecnico de Braganca <https://orcid.org/0000-0002-8811-0823>

Ana Isabel Pereira

Instituto Politécnico de Bragança: Instituto Politecnico de Braganca

José Lima

Instituto Politécnico de Bragança: Instituto Politecnico de Braganca

Angela Ferreira

Instituto Politécnico de Bragança: Instituto Politecnico de Braganca

Fouad Boukli-Hacene

Higher school of Applied sciences of tlemcen Algeria

Kerboua Abdelfettah

Higher school of applied sciences of Tlemcen -Algeria-

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Abstract

Background: The association of distributed generators, energy storage systems and controllable loads close to the energy consumers gave place to a small-scale electrical network called microgrid. The stochastic behavior of renewable energy sources, as well as the demand variation, can lead in some cases to problems related to the reliability of the microgrid system. On the other hand, the market price of electricity from mainly non-renewable sources becomes a concern for a simple consumer due to its high costs.

Method: In this work, an energy management system was developed based on an innovative optimization method, combining linear programming, based on the simplex method, with particle swarm optimisation algorithm. Two scenarios have been proposed to characterise the relation price versus gas emissions for optimal energy management. The objective of this study is to find the optimal setpoints of generators in a smart city supplied by a microgrid in order to ensure consumer comfort, minimising the emission of greenhouse gases and ensure an appropriate operating price for all smart city consumers.

Results: The simulation results have demonstrated the reliability of the optimisation approach on the energy management system in the optimal scheduling of the microgrid generators power flows, having achieved a better energy price compared to a previous study with the same data.

Conclusion: The energy management system based on the proposed optimisation approach gave an inverse correlation between economic and environmental aspects, in fact, a multi-objective optimisation approach is performed as a continuation of the work proposed in this paper.

Full Text

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Figures

Figure 1

The architecture of the microgrid

Figure 2

The daily power profile from renewable sources [18]

Figure 3

Hourly Load Distribution [18]

Figure 4

Flow-chart of the proposed energy management system

Figure 5

Hourly dispatch set-points of microgrid generators for the rst scenario.

Figure 6

Hourly dispatch set-points of microgrid generators for the second scenario.

Figure 7

Day profile of the obtained operating cost.

Figure 8

Daily profile of the obtained emissions.