# Chapter 9
# An Overview of Machine Learning Algorithms on Microgrids

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## ABSTRACT

*The concept of microgrid (MG) is based on the notion of small-scale power systems that can operate independently or in conjunction with the larger power grid. MGs are generally made up of renewable energy resources, such as solar panels, wind turbines, and energy storage devices (batteries). Overuse of non-renewable resources causes depletion of the ozone layer and eventually leads to global warming. The classical techniques are not sufficient to solve the problem and require modern solutions like machine learning (ML) algorithms—a subset of artificial intelligence, and deep learning -a subset of ML algorithms. Though MGs have many advantages, they also have issues like high costs, complex management, and the need for better energy storage. ML can predict energy demand, optimize power flow to save money, improve energy storage management, enhances cybersecurity, and protects MGs from hackers. The chapter presented here provides a review of different ML techniques that can be implemented on MGs, their existing problems, and some improvised solutions to overcome the grid issues.*

## INTRODUCTION

The massive and intricate electric power system (Shahgholian, G. et.al, 2019) is controlled by the power system community. The network has shared a variety of renewable sources (Ferraro, M. et.al,2020) and will continue to do so. A growth in renewable sources enables the worldwide distribution of power production. The integration of renewable energy sources (Wang, Y., et al. 2018; Sadegheian.et.al,2020) tends

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to the distribution network due to industrial advancements and concerns regarding the environment. MGs (Karimi,et.al. 2019) are small-scale local power systems that operate within larger distribution networks. Microgrids (MGs) (Zhang, T. 2018; Wang, G, et al. 2018) are growing in popularity as a result of their capacity to: (a) lessen their impact on the environment, (b) increase energy stability efficiency, (c) use energy storage's ride-through capability, and (d) lessen the effects of sudden grid outages (Mahmoud, M. S.,et.al 2014; Kuznetsova, E. 2014). Renewable energy sources such as wind (Shahgholian, G. 2018; Thakur, D., et.al.2017), solar (Hedarpour, F., et.al.2017), and hydropower (Liu, Y., et.al 2015) can efficiently fulfil their portion of the energy need. In terms of power supply, the MG technology offers rural communities' significant advantages with increased local energy security. By lowering the requirement for energy imports, this technology makes a significant contribution to the assurance of more secure energy. By connecting a MG for renewable energy to the utility grid, frequency control does not need extra work. The most important MG issues include stability, bidirectional power flows, bidirectional power flows in both directions, modelling, low inertia, the impact of load disturbance, and uncertainty. Each distributed generator (DG) application (Shahgholian, G., et.al. 2015) has the potential to create more issues than it can resolve.

MGs are small-scale energy systems that use integrated renewable energy generating and storage technologies (Ghahremani, B.,et.al, 2013) to deliver enough electricity to meet local demand. MGs may be created using either direct current (dc) or alternating current (ac), and they have the inherent potential to help future energy systems achieve quality, efficiency, and dependability of supply via the use of multi converter devices. Numerous research has been conducted on this subject, with a particular emphasis on classifications, control methods (Muzaffarpur, G. et.al 2016; Jafari,et.al A., 2017; Hosseini, E., et.al 2019), optimisation method, combustion control, stability (Yan,et.al 2019; Malek Jamshidi, Z., et.al 2019), power sharing Chang, et.al 2018), protective devices (Hosseini, S. A.,et.al 2016) and reactive power compensation approaches (Golpîra, H. 2019).

## MG'S CONCEPTS

A set of linked loads and DERs that operate as a single, controlled entity with regard to the grid is referred to as an MG Carpintero-Renter, M., et.al 2019). An MG (refer Fig.1) may function in both grid-connected and islanded modes by connecting to and disconnecting from the grid. Figure.1 depicts the MG's components. A small-scale power grid made up of DERs, loads, and controllers is referred to as an MG. An MG's ability to function in grid-connected or island modes, which may produce, distribute, and manage the flow of electricity to nearby users, is one of its main benefits. Electricity distribution systems (Carpintero-Renter, M., et.al 2019) sections that incorporate loads and DERs (such as DGs, storage devices, or controllable loads) that may be operated in a controlled, coordinated manner both when linked to the main power network and/or while islanded.

### MG Structures

MG's are classified (Ghafouri, A., et.al 2017) based on the type of current and the method of connection of the buses. The classification based on type of current(alternative or direct) the MGs are classified into three main groups: AC Microgrid (ACMG) (Justo, J. J., et.al 2013), DC microgrid (DCMG) (Shuaia, Z., et.al 2018; Zhang, L., et.al 2018; Chandra, A., et.al 2020) and Hybrid microgrid (HMG) (Cao, W.-

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