A Hierarchical Control Strategy for Efficiency Improvement and Economical Operation in Isolated Microgrid Systems

Due to the environmental effects, the traditional energy sources, such as coal and oil, have been replaced by different types of renewable energy source (RES). However, these sources are unable to operate efficiently and economically because of the intermittent nature of the RESs. In this research, a control algorithm is developed to cooperate every coordinate every participating RESs in order to enhance the generation cost and improve the efficiency of the entire microgrid system. In other words, the RES with lower generation cost can produce more power to support the one with higher generation cost, which minimize the generation cost of the whole system.

Abstract

Renewable energy sources (RESs) have received much great attention in the last two decades due to their declined cost and eco-friendly characteristics. However, with a massive integration of RESs, the modern power systems should not only operate economically but also ensure their efficiency during the normal operation. In this research, a novel hierarchical control strategy is introduced to improve the efficiency of the islanded microgrid and reduce its the total generation cost at the same time. A state-space model of the entire MG system is developed to analyse the stability of the system. The effectiveness of the proposed controller is validated through different simulation scenarios using MATLAB/SIMULINK software environment. Because every participating RES connects to each other through a distributed communication network, the need of having a central controller is neglected, which improves the scalability of the entire microgrid system. Therefore, this research will contribute to enhance the penetration of renewable energy sources in the Northern Territory power grid. Moreover, by adopting grid-forming inverters, the RESs have ability to maintain both frequency and voltage magnitude. This might support the main grid in an emergency event such as a power outage.