Optimization of a Shave Profile in a Grid-Tied Solar Power System with Energy Storage

Nuttachat Wisittipanit

Department of Materials Engineering, School of Science, Mae Fah Luang University, Chiang Rai, Thailand
E-mail: nuttachat.wis@mfu.ac.th

Abstract

Solar energy, particularly in the form of photovoltaic cells, has been widely adopted around the world, becoming one of the most essential alternative power sources. Currently, more than 1 TW of photovoltaics are installed throughout the world. However, only a small portion of such enormous solar power is collected. Modern battery technology is capable of efficiently storing electrical energy as its energy density is high. This research focused on the optimization of a grid-tied solar power system with a lithium-ion battery as the main energy storage device. The system was designed for a typical household in which the utility input is 1 phase and 220V/50Hz. The battery is connected through AC coupling mode and can be charged by a solar cell or the grid. It can also provide a third power source other than sun light and the grid. The optimization process utilizes Differential Evolution (DE) as the main optimizing algorithm, which has two objectives: (1) maximizing the solar power and battery usage, and (2) minimizing total electricity cost by optimizing a shave profile - guiding profile for the actual grid shave. Further, the attainment of a shave profile is achieved via electronic switches so that the actual shave profile is analogous to the guided shave profile. The computational results indicate that the optimization process for this particular grid-tied solar system with a battery could yield suitable electrical power flow and help achieve the optimum utilization of green energy.

Keywords: *Engineering optimization, Solar cells, Grid-tied inverter, Li-On battery, Energy storage*