

Chapter 17

Artificial Bee Colony– Based Optimization of Hybrid Wind and Solar Renewable Energy System

Diriba Kajela Geleta

Madda Walabu University, Ethiopia

Mukhdeep Singh Manshahia

Punjabi University Patiala, India

In this chapter, the artificial bee colony (ABC) algorithm was applied to optimize hybrids of wind and solar renewable energy system. The main objective of this research is to minimize the total annual cost of the system by determining appropriate numbers of wind turbine, solar panel, and batteries, so that the desired load can be economically and reliably satisfied based on the given constraints. ABC is a recently proposed meta heuristic algorithm which is inspired by the intelligent behavior of honey bees such as searching for food source and collection and processing of nectar. Instead of gradient and Hessian matrix information, ABC uses stochastic rules to escape local optima and find the global optimal solutions. The proposed methodology was applied to this hybrid system by the help of MATLAB code and the results were discussed. Additionally, it is shown that ABC can be efficiently solve the optimum sizing real-world problems with high convergence rate and reliability. The result was compared with the results of PSO.

INTRODUCTION

Unless there is a difference in consumption from place to place, energy becomes one of the vital elements for human life which comes mainly from fossil fuel. Even though, the conventional energy source has been used as the main energy source for past decades all over the world, due to its number of limitations like the issue of global warming, depletion of its sources and continuous increase in oil prices have forced the world attention for the development and utilization of alternative renewable energy sources (Rubio, Perea, Vazquez, & Os-Moreno., 2012).

DOI: 10.4018/978-1-5225-9420-8.ch017

These Conventional energy sources which include power plants using fossil fuels (natural gas, coal, etc.) are not ever lasting and have a lot of disadvantages like the issue of environmental degradation and continuous fuel supply for operation (Geleta & Manshahia, 2018; Kosmadakis, Sotirios, & Emmanuel, 2013).

In addition to the above-mentioned drawback of conventional energy source, due to rapid increment of industrialization all over the world, the need for energy was exponentially increases from time to time and also depletion of fossil fuels has been occurred which leads to an initiation for the need of alternative inexhaustible sources of energy to satisfy the continuously increasing energy demand. Another important reason to reduce our consumption of fossil fuels is the growing global warming phenomena (Zong, 2012; Kosmadakis, Sotirios, & Emmanuel, 2013).

To minimize some of the problems associated with these conventional energy sources, other sources which are environmentally clean, naturally endless, in- exhaustible and renewable energy are getting much attention and growing up nowadays (Geleta & Manshahia, 2017; Luna, Trejo, Vargas, & Os-Moreno, 2012).

Renewable energy sources are environmentally clean, abundant and friendly used power generation sources which has to play an important role for the future power supply by diversifying and maintaining the energy supply market (Kaabeche, Belhamel, & Ibtouen, 2010). Nowadays, the electrification of rural villages in most of the places have been electricity from extension of main grids and installation of diesel generators as an option. In reality, grid expansion to all the places of such areas is impossible to satisfy the power demand of the society. This is because of either financial constraint or practically not feasible for a lot of reasons like geographical location, low densely populated and a very low power demand. Thus, to increase the power utility coverage, applying standalone renewable energy sources will made such society more beneficiary (Geleta & Manshahia, 2018; Zong, 2012).

In the past decade, energies from wind turbine and solar panel generation technologies have increased their use in either wind alone, solar alone or hybrid of wind and solar configurations are common. Moreover, the economic aspects of these renewable energy technologies are gradually increasing at present including the development of their market. Wind and Solar have abundant power which can be exploited as electric energy by the help of wind turbines and solar panels. Based on the daily average data of wind speed, isolation, temperature and power demand, the system capacity is determined to best match the power demand by minimizing the difference between generation and load demand over a 24-hour period (Kaabeche, Belhamel, & Ibtouen, 2010; Al-Shamma & Khaled, 2012). The capacity of the storage needed to make the system operate independently as a stand-alone system is determined from the hourly information obtained from power demand. The main disadvantage of these technologies is fluctuation of their power output depending on weather condition. To overcome these limitations which can affect the power output, using hybrids of renewable energy technology was important (Geleta & Manshahia, 2018; Luna, Trejo, Vargas, & Os-Moreno, 2012).

The most commonly known renewable energy sources are wind, solar, hydro, biomass, ocean wave, geothermal and tides which are naturally replaceable. The result of many researches shows that, using hybrid system reduce operation cost through reducing fuel consumption, increasing system efficiency and reduce noise and emission. The only limitation of renewable energy technologies is the fluctuation of their power output which can be managed by applying hybrids renewable energy technology (Geleta & Manshahia, 2017).

Here we use hybrid of wind and solar which applicable at any remote society of the world and relatively cheaper to implement.

23 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:

www.igi-global.com/chapter/artificial-bee-colony-based-optimization-of-hybrid-wind-and-solar-renewable-energy-system/232103

Related Content

Approach for the Domestication and Propagation of Stingless Bees

Ali Agusand Agussalim Agussalim (2023). *Recent Advances in Global Meliponiculture* (pp. 69-80).

www.irma-international.org/chapter/approach-for-the-domestication-and-propagation-of-stingless-bees/315991

Prevalence of *Bacillus cereus* in Ready-to-Eat Foods in Northern Perak, Malaysia

Noor Azira Abdul Mutalib, Noor Aniza Abdul Rahimand Ungku Fatimah Ungku Zainal Abidin (2022). *Food Safety Practices in the Restaurant Industry* (pp. 26-40).

www.irma-international.org/chapter/prevalence-of-bacillus-cereus-in-ready-to-eat-foods-in-northern-perak-malaysia/291992

On the Use of Artificial Intelligence Techniques in Crop Monitoring and Disease Identification

Muzaffer Kanaan, Rütü Akayand Canset Koçer Baykara (2021). *Precision Agriculture Technologies for Food Security and Sustainability* (pp. 166-186).

www.irma-international.org/chapter/on-the-use-of-artificial-intelligence-techniques-in-crop-monitoring-and-disease-identification/265206

Greek Consumers' Perceptions on Sponsored Food Advertisement Through Social Media and Its Effects on Their Purchasing Behavior

Nikolaos Sklavounos, George Kartsiotisand Konstantinos Rebholz (2023). *Influences of Social Media on Consumer Decision-Making Processes in the Food and Grocery Industry* (pp. 56-85).

www.irma-international.org/chapter/greek-consumers-perceptions-on-sponsored-food-advertisement-through-social-media-and-its-effects-on-their-purchasing-behavior/328373

Community Colleges and Universities in the Arab Countries

Mohamed Hassan Abdelgwad (2023). *Agricultural Education for Development in the Arab Countries* (pp. 83-107).

www.irma-international.org/chapter/community-colleges-and-universities-in-the-arab-countries/320278