Chapter 3
Nature-Inspired Algorithm Applied to a Renewable Energy-Integrating Hydro-Thermal Power Plant

Sunanda Hazra
https://orcid.org/0000-0002-0612-9521
Central Institute of Petrochemicals Engineering and Technology, India

Provas Kumar Roy
https://orcid.org/0000-0002-3433-5808
Kalyani Government Engineering College, India

ABSTRACT

Due to the rising requirement on energy sources and the global doubts for using fossil fuel because of its consequences on the climate changes and the global warming caused by hazardous gases, the scientific research has shifted to the renewable energy. To minimize the usage of thermal power generation plants and to meet the rising load demand, a thermal-integrated wind-hydro-system is taking an important role in renewable power systems. A proficient nature-inspired optimization is proposed for solving economic and emission dispatch for the hydro-thermal-wind (HTW) scheduling problem. Further, the opposition-based learning have been incorporated with the chemical reaction optimization for improving the performance of the algorithm. To investigate the performance of oppositional chemical reaction optimization algorithm, the algorithm is tested on two different cases. Along with this, some statistical tests have also been performed. The results obtained by the OCRO algorithm are compared with other recently proposed methods to establish its robustness.

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I INTRODUCTION

In latest trends, a few factors like rising in the globe residents have led to a spectacular hike in ordered of energy all across the every places. Certainly, this energy expenditure creates an extreme utilization of fossil fuels to adjust the energy claimed. Although, using fossil fuels such as gas, coal, petroleum, and few non-renewable energy sources have been previously used to generate electric energy and it results in extraordinary rising in ecological pollutants. In such situations, the energy resources with less emission generation has seem to be suitable alternatives to alleviate the environmental impacts, particularly in the electric power region. To reduce the habit of thermal power generation plants and to meet up the growing load demand, thermal integrated wind-hydro-system is delightful system and it plays an important task in renewable power system that have been represented by Hazra et al. (2019), and Li et al. (2014). In this manuscript, hydro thermal scheduling incorporating wind energy has been discussed and successfully been solved using three efficient meta-heuristics algorithms as well as power system operation and generation using conventional and non-conventional energy sources has been discussed. So, the proposed research work is very significant topic for the power system researchers. Conventional algorithms do not perform satisfactorily for non-linear optimization problem. Since, the proposed research work is non-linear in the presence of uncertain wind speed; the conventional algorithms will give local optimal solution instead of global optimal solution. The proposed research work is one of the promising topics for power system operation because by using the renewable energy sources the society can be protected from the effect of dangerous greenhouse gases as well as the power can be generated at cheap rate and it helps the consumer to get electricity at affordable price. Moreover, in this research work, few efficient meta-heuristics optimization algorithms are used to obtain optimal performance of renewable energy based power system.

II BACKGROUND

In a few decades ago, Newton's method (Lee et al. 1998) and dynamic programming (Farag, et al. 1995) etc. are used for the cost minimization. Traditional techniques have the complexities in non-linear constraints as well as considerable time-consuming effect. For that reason, previously developed techniques do not deal with sufficiently for solving economic optimization problems. The methods mentioned above suffer from poor local optimal optimization and slow convergence rate. To overcome this drawback, many populations based methods such as chemical reaction optimization (CRO) (Hazra & Roy, 2015), krill herd algorithm (Mandal et al. 2014), oppositional moth flame optimization (OMFO) (Hazra & Roy, 2019), quasi-oppositional chemical reaction optimization (QOCRO) (Hazra & Roy, 2019), grasshopper optimisation algorithm (GOA) (Hazra & Roy, 2020) etc. are represented. Chen et al. (1993) proposed distribution management-oriented renewable energy generation using novel interval. Aghaei et al. (2013) suggested programming framework over the 24hour time span based on wind power in a scenario-based stochastic dynamic economic and emission load transmit problem. Hetzer et al. (2008) briefly discussed the wind power underestimation cost and overestimation cost of available generation for renewable power. Bai et al. (2016) projected an artificial bee colony (ABC) to compact with the uncertainty of wind power for solving load dispatch problem. Panigrahi et al. (2010) discuss about wind resources as the stochastic nature type and for that reason wind generation output is difficult to predict. Earlier, the problem has been measured for several times as the progress of load dispatch, but now a day's research focuses on