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Imperialistic competition algorithm: Novel advanced approach to optimal sizing of hybrid power system

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Energy is vital to social and economic development. Increased energy demand and reduced fossil fuel resources led to use of renewable energy (RE) resources, whose intermittence and high investment cost spur research into optimal sizing of hybrid systems. Advancements in computer hardware and software enable solution of optimization problems through algorithms such as Genetic Algorithm (GA), Particle Swarm Optimization (PSO), etc. The recently introduced Imperialistic Competition Algorithm (ICA) has shown excellent capability in solving various optimization problems. This paper introduces it and shows its benefits to an optimal-sizing problem of a hybrid RE system. The results will be shown and the effect of changing optimization's parameters will be discussed. To test the potential of proposed algorithm for minimum cost solution finding, a comparison between ICA and PSO algorithm will be provided. Results show the advantage of using ICA algorithm to find a better optimum solution for hybrid power system. © *2013 AIP Publishing LLC*. [http://dx.doi.org/10.1063/1.4824977]

I. INTRODUCTION

The world's fossil fuel resources steadily declined over the past decade.[1] This has become a strong reason for us to reduce our reliance on fossil fuels on top of the growing evidence of global warming, too.[2,3] Energy options that fulfill increasing demand but minimize environmental impact have thus become necessary.

Electricity generation by renewable energy (RE) sources is one way to overcome global warming and future shortage of energy.[4,5] For effective and economical use of RE resources, optimal sizing is necessary.[6–8] Optimization generally makes something better.[9] For a function f(x), an argument x whose relevant cost is optimum (usually minimum) is needed. Therefore, the system is able to fulfill the requirements of power-reliability as the size optimization methods enable for lowest cost-maximum benefit investment and optimum usage of components in a hybrid power system.

Various methods have been considered for optimization problems.[10–13] Some are computer simulations of natural processes. GA, for example, is a branch of evolutionary algorithm that evolves a population of candidate solutions to a specified problem; it uses operators that are inspired by natural selection and natural genetic variations.[14–17] Ant-colony optimization, which is inspired by the foraging of real ants, has solved optimization problems.[18–22] As Edward and Kennedy presented (1995), animal social behaviors such as flocking (birds) or schooling (fish), too, inspired Particle Swarm Optimization (PSO).[9] This algorithm, alone or in combination with other algorithms, is used often in finding the best optimization solution.[23–26] Various

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