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Innovations in Sustainable Energy and Technology

Proceedings of ISET 2020

Editors: P. Muthukumar, Dilip Kumar Sarkar, Debasis De, Chanchal Kumar De

Presents research works in the field of sustainable energy and technology

Contains best selected papers presented at ISET 2020 held in Bangalore, India

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About this book

This book presents best selected research papers presented at Innovation in Sustainable Energy and Technology India (ISET 2020), organized by Energy Institute Bangalore (A unit of RGIPT, an Institute of

National Importance), India, during 3–4 December 2020. The book covers various topics of sustainable energy and technologies which includes renewable energy (solar photovoltaic, solar thermal and CSP, biomass, wind energy, micro hydro power, hydrogen energy, geothermal energy, energy materials, energy storage, hybrid energy), smart energy systems (electrical vehicle, cybersecurity, charging infrastructures, IOT & AI, waste management, PHEV (CNG/EV) and mobility (smart grids, IOT & AI, energy-efficient buildings, mart agriculture).

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Keywords

Solar PV **solar thermal** **Bio Mass**

Energy materials **Energy storage**

Electric vehicle **Cyber security**

E-Waste Management **Smart Grids**

Smart Agriculture

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CEPSO-Based Load Frequency Control of Isolated Power System with Security Constraints

Santigopal Pain, Dilip Dey, Kamalika Tiwari & Parimal Acharjee

Conference paper | First Online: 14 May 2021

Part of the Advances in Sustainability Science and Technology book series (ASST)

Abstract

Considering physical limitations like generation rate constraint (GRC), governor dead band (GDB) and time delay (TD), a unique chaotic exponential particle swarm optimization (CEPSO) algorithm is proposed to design the control parameters of PID controller for an isolated realistic power system which consists of thermal and hydro-generating units. An exclusive cost function is framed by taking both transient and steady-state response specifications providing proper weighting coefficients. For avoiding the local optima and to obtain faster and sure convergence, the tuning

parameters of CEPSO algorithm like inertia weight, constriction factors and chaotic variables are properly designed. Because of exponential inertia weight and newly developed chaotic variables, optimal solutions are obtained. The simulation outcomes establish the superiority of the proposed CEPSO algorithm compare to genetic algorithm (GA), particle swarm optimization (PSO) and exponential particle swarm optimization (EPSO) algorithms.

Keywords

Load frequency control **PID controller**

Physical constraints

Chaotic exponential particle swarm optimization

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Appendices

Appendix 1: Parameters of GA, PSO, EPSO and CEPSO

Probability of Crossover = 0.8; Rate of Mutation = 0.03; Constriction Factors ($c1 = c2$) = 1.49455, w_0 = 0.95, m = 1; n = 1.

Appendix 2: CPI Calculation

As an example, the procedure of CPI calculation for t_s is given below. The CPI for M_p and SSE can be

calculated in the same way.

Here, CPI (t_s) = comparative performance index for settling time (t_s), GA (t_s) = settling time of GA method, CEPSO (t_s) = settling time of CEPSO method.

Now,

$$\mathrm{CPI}(t_s) = \frac{\mathrm{GA}(t_s) - \mathrm{CEPSO}(t_s)}{\mathrm{GA}(t_s)} \times 100\% = \frac{17.4557 - 14.1456}{17.4557} \times 100 = 18.96\%.$$

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