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Optimization Techniques for Hybrid Power Systems: Renewable Energy, Electric Vehicles, and Smart Grid

Sunanda Hazra (Budge Budge Institute of Technology, Kolkata, India), Sneha Sultana (Dr. B.C. Roy Engineering College, Durgapur, India), and Provas Kumar Roy (Kalyani Government Engineering College, India)

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Description:

Optimization Techniques for Hybrid Power Systems: Renewable Energy, Electric Vehicles, and Smart Grid is a comprehensive guide that delves into the intricate world of renewable energy integration and its impact on electrical systems.

This book has a focus on nature-inspired and meta-heuristic optimization methods, and it demonstrates how these techniques have revolutionized renewable energy problem-solving and their application in real-world scenarios.

This book is explored as a crucial recipe for modern power system processes and management. The integration of energy storage, distributed generation, demand response, and thermally activated technologies into electric distribution and transmission systems is examined in detail.

This book serves as a valuable resource for researchers, academicians, industry delegates, scientists, and final-year master's degree students. It covers a wide range of topics, including novel power generation technology, advanced energy conversion systems, low-carbon technology in power generation and smart grids, AI-based control strategies, data analytics, electrified transportation infrastructure, and grid-interactive building infrastructure.

Coverage:

The many academic areas covered in this publication include, but are not limited to:

- Advanced Multi-Energy-Based Hybrid System
AI Software Tools and Platforms
AI-Based Decision-Making Process
Artificial Intelligence
Data Analytics in Generation, Transmission and Consumption
Electrified Transportation Infrastructure
Energy Cascade Conversion System
Energy Infrastructure with Energy-Efficient Functionalities
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Low Carbon Technology in Power Generation
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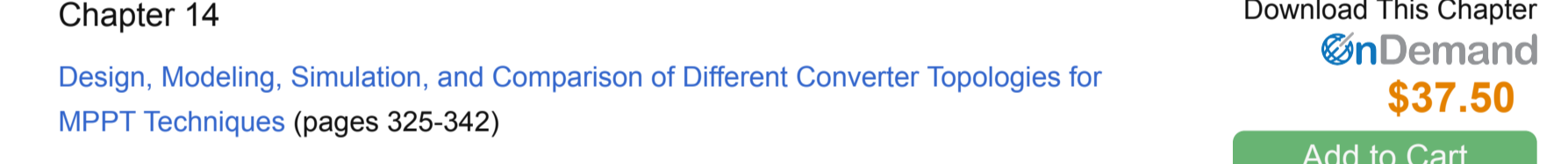
Sunanda Hazra received the Ph.D. degree in Electrical Engineering. He is presently associated with Electrical Engineering Department of Budge Budge Institute of Technology, Kolkata, W.B. India. He has eight years of teaching experience. He has published many research papers in International Journals, Conferences, Book Records. His research interest includes load dispatch, hydro thermal scheduling, renewable energy, optimization techniques, etc. He has been awarded with Young Scientist from VD Good Technology Factory in 2021. He has reviewed few research works submitted to National/International Journals. He has attended several short-term courses/faculty development programmes. He is a member of IET.

Sneha Sultana was born on 12th July, 1988. She received B.Tech degree in 2010 from Academy of Technology, Adisaptagram, West Bengal, India. She received M.Tech degree from Dr. B. C. Roy Engineering College, Durgapur, West Bengal, India, in 2012. Presently she is acting as Assistant professor in Electrical Engineering department, Dr. B. C. Roy Engineering College, Durgapur, West Bengal, India. Her field of research interest includes radial distribution system, optimal placement of distributed generator, combined heat and power dispatch, evolutionary algorithms.

Provas Kumar Roy obtained PhD degree in Electrical Engineering from National Institute of Technology Durgapur in 2011. He received his Master degree in Electrical Machine in 2001 from Jadavpur University. He finished his Engineering studies in Electrical Engineering from Regional Engineering College, Durgapur. Presently, he is working as a Professor in Electrical Engineering Department at Kalyani Government Engineering College, India. He was the recipient of the Outstanding Reviewer Award for International Journal of Electrical Power and Energy Systems (Elsevier) in 2018, Engineering Application of Artificial Intelligence (Elsevier) in 2017, Renewable Energy Focus (Elsevier) in 2018, Air Streams Engineering Journal (Elsevier) in 2017. He has published more than 120 research papers. Six research scholars have obtained their Ph.D. degree under his guidance and 10 students are pursuing their Ph.D. under his guidance. His research interest includes economic load dispatch, optimal power flow, FACTS, automatic generation control, radial distribution network, power system stability, image processing, machine learning, evolutionary computing techniques, etc.

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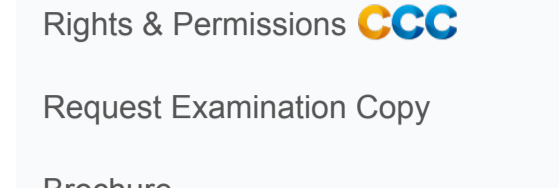
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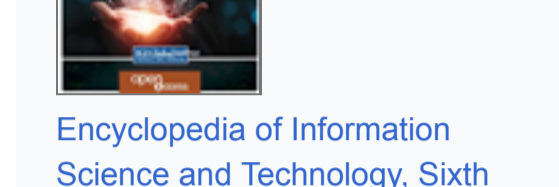
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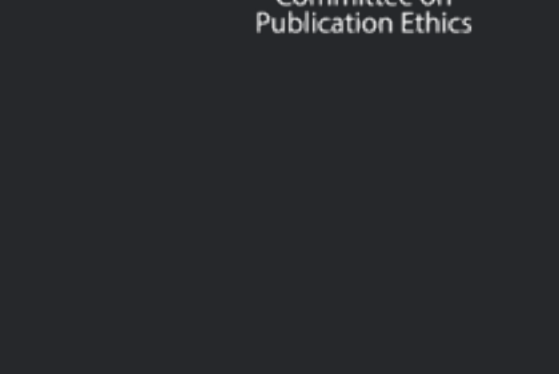


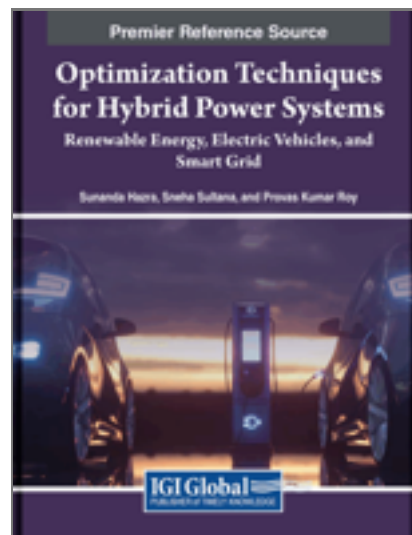
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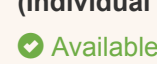


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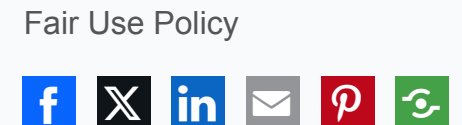
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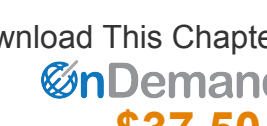
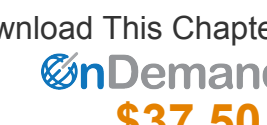

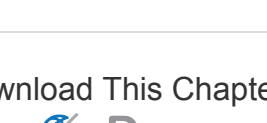
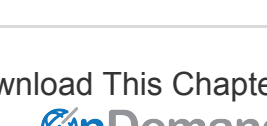
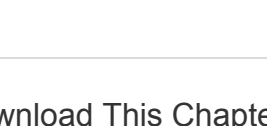
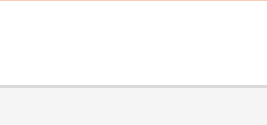
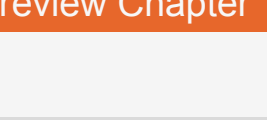
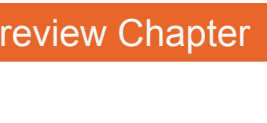
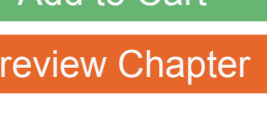
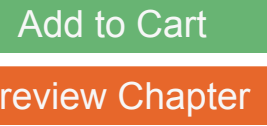
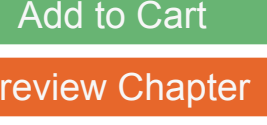




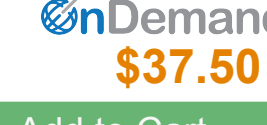
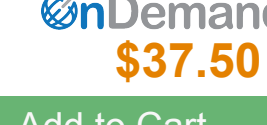
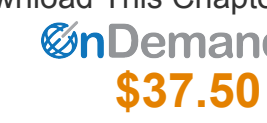
A power plant often has a lot of synchronous generators installed to control the energy at the contact spontaneously. The Power network component, which has the innate potential to increase power system cohesion limits while maintaining high electrical Power Strength (PS), is seen to be a useful tool in many Distributed Generation (DG) applications. The scale and complexity of modern power systems are constantly growing, which increases the need for a reduced oscillations damping in the power network stabiliser. The low magnitude and low frequency often prolong in some scenarios even restricting the power transfer capacity. As a result, low-frequency oscillation or electro-mechanical oscillations (EMO) (Leonard, 2006) conventionally takes place in large power systems and occasionally make the feeding system unstable. Also, the incorporation of AVR used to improve the transient stability during fault also contribute to the reduction in damping of the power system owing to its high gain and fast-acting effect. Power system stabiliser (PSS) is utilised in the auxiliary feedback to add additional braking to the system to dampen these a reduced oscillations on the rotor in order to mitigate the negative impacts of the AVR.

The lead-lag compensators, also known as the PSS or conventional PSS (CPSS), are made up of gain stage  $K$ , a high pass filter, and temporal constants  $T1$  through  $T4$ . To enhance the system damping, these parameters must be fine-tuned at a specific set of operating circumstances, often nominal. The operational environment is continually changing because of how highly nonlinear the power system is. As a result, it may be necessary to fine-tune the CPSS's parameters if they do not give an appropriate performance. (Ferber *et al.* 1968; Graham, 2012) details the impact of excitation and PSS. Several academics have worked to improve the PSS parameter tweaking methods. Yet, because of the non-linearity and multi-modality features, modelling the PSS is a difficult endeavour.

After changing system operating conditions, the PSS may not provide satisfactory damping in an unstable system. Several academics have worked to improve the PSS parameter tuning methods. These solutions include robust control (Gupta *et al.* 2006; Sambariya *et al.* 2013), optimization strategies (Magzoub *et al.* 2014; Mariano *et al.* 2016) artificial intelligence techniques like neuro-fuzzy (Eke *et al.* 2015; Segal *et al.* 2004) and fuzzy logic (Bhati *et al.* 2013; Hiyama *et al.* 1999). These methods demand a lot of calculation time because they are complicated and use numerous particles in the optimization process.

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