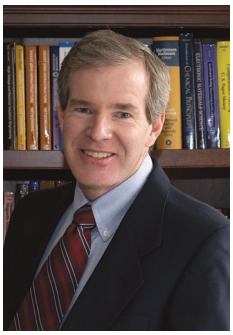
BOOK REVIEWS



by John J. Shea

Computational Intelligence Applications in Smart Grids

A. F. Zobaa and A. Vaccaro, Editors
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Smart grid (SG) is the convergence of information and operational technologies applied to the electrical grid. Advances in SG technologies hold the promise for increased efficiency of the modern electrical power grid by supporting massive penetration of small-scale distributed generation, facilitating the integration of synchronized metering systems, improving the interaction and cooperation between network components (e.g., circuit breakers, relays, controllers, etc.), and introducing self-healing protective control/protection algorithms.

However, there are many challenges and issues to be overcome before these advances become reality. SG technologies require advanced sensing systems, two-way high-speed communication systems, and monitoring and enterprise analysis software to provide enhanced services for both the system operator (i.e., asset management, distribution automation) and end users (i.e., demand side management, demand response). The key is in the ability of multiple devices or software processes to manage accurate information and respond in real time, through the use of a reliable and flexible distributed measurement system.

This book provides information on crucial areas of research in SG technology. It begins with an analysis of the role of wide-area monitoring, protection, and control (WAMPAC). WAMPAC involves the use of system-wide information to avoid large disturbances and reduce the probability of catastrophic events, by supporting the application of adaptive protection and control strategies aimed at increasing network capacity and minimizing wide-area disturbances. The book describes methods that use power flow measurements from multiple synchronized devices at various locations to allow the power system to operate closer to stability limitations than it would without SG control.

An advanced optimization algorithm is presented, which integrates software and hardware using relays commonly used in today's power system. An analysis of the enormous amount of data created by such as system is described, and possible theoretical methods for handling, interpreting, and using these data are presented. Methods for load-shedding in order to ensure voltage stability are described. Artificial dynamic models and adaptive fuzzy agent methods, for improving state variable estimates and voltage regulation, respectively, are discussed. Some examples of commercially available smart meters are also given.

This book provides an in-depth survey of the technology of SG control methodologies. Since it examines many of the current key issues associated with the deployment of large-scale SG, engineers, computer scientists, and educators working in SG technologies would all benefit from this book. Presenting many conceptual methodologies, it will inform the reader on the latest challenges and potential solutions for the future power grid.

Tailoring of Nanocomposite Dielectrics

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Incorporating nanoparticles generally enhances the breakdown strength of polymers. A small loading of nanoparticles improves the breakdown performance of composites. The inclusion of nanoparticles within a host matrix has been used for many years to produce new composite materials with unique properties. More recently, there has been exponential growth in studies aimed at improving the range of electrically relevant properties of bulk commodity polymers. Until recently, the understanding of these effects and the issues of scale-up and reproducibility have limited the use of nanoparticles.

This book brings together contributions from researchers active in the area of nanocomposites for electrical appli-

cations. It is divided into four sections, addressing nanoparticle preparation, experimental characterization, techniques for computer simulation, and properties, both surface and bulk, relevant to dielectric applications and a range of potential devices.

Nano-tailoring is the theme of this book. The incredibly high surface areas of nanocomposites, and the resulting interfacial effects, can lead to unique properties and improved performance of conventional polymeric materials. This book is loaded with the most recent information on nanodielectric research, information that can be applied by those who develop their own nanocomposites. The preparation section provides in-depth technical details that will allow the reader to prepare their own nanocomposites.

The sections on surface modification provide details on how to modify the surface of nanoparticles with silane, barium titanate, phosphoric acid, dopamine, and polymer coatings. Characterization includes spectroscopic, microscopic, and scattering measurements of nanocomposites. There are interesting discussions on the theoretical aspects of interfaces, with various models proposed. The short computer simulation section of the book describes modeling of band structures, electrical conduction, and the effects of defects on the properties of nanocomposites. The surface- and bulk-properties section provides an excellent review of the influence of preparation technique on dielectric breakdown of nanocomposite materials. There is an interesting comparison between the breakdown mechanisms of unfilled polymers and nanocomposites, which includes the potential charge barrier and charge transport models.

Many aspects of degradation, which is important for electrical insulation, are explored, including suppression of surface erosion, degradation of polymeric micro- and nanocomposites, permittivity gradient composites, and permeability control with magnetic fillers. Some of the applications cover sealing resins for semiconductor packaging, high-dielectric constant capacitor materials, and electrically insulating materials with high heat dissipation. Specific power applications cover motors and generator insulation, high voltage cables, capacitors, tracking resistant insulation, and solid-state insulated switchgear.

Researchers working in this area of research will greatly benefit from reading this book. So also will those in electrical power engineering technology, who will be able to use it to understand the implications of nanocomposite materials for the future of power distribution, and other applications where dielectric and insulating materials exposed to an electric field can offer significantly improved electrical properties as a result of inclusion of nanoparticles.

Smart Microgrids—Lessons from Campus Microgrid Design and Implementation

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The existing electrical grid is inherently unidirectional. It was built to transport and distribute power from a centralized generation station to the loads in one direction, typically over long distances. While highly efficient, the centralized generation and unidirectional grid suffers from resiliency problems, aging infrastructure, and lack of demand response. In many cases the use of fossil fuels can be polluting and limited.

A smart grid is needed to address the major shortcomings of the existing grid. It needs to provide utilities with full visibility and control over their assets and services, be resilient to system anomalies, and engage various stakeholders to implement various forms of two-way energy transactions in the system.

This book describes how a microgrid is designed, implemented, tested, and used. It details the experiences of a team at the British Columbia Institute of Technology, accumulated over an eight-year period of research designing and constructing a campus microgrid. It is intended to capture the team's thought processes in specification design, technology selection, integration methodology, and realization of various components of the microgrid and its larger system as a whole.

The topics discussed include cogeneration plants, selection of battery storage systems, energy management system considerations, communications and control, interconnections, economic considerations, use cases, testing, and validation. There is also a section on lessons learned from the campus microgrid project.

Rather than being a microgrid cookbook, this book provides the reader with essential insight into the right questions to ask when designing a microgrid system, and outlines the best practices and lessons learned, which are being passed down to the engineering community. While there is constant change in the available technology with new developments and improved device characteristics, the methodology used by this team is very relevant today. So, if you are contemplating the design of a microgrid system or are part of the team developing microgrids, this book can save you and your team a lot of time by pointing out important considerations necessary for designing and building a successful microgrid.

Principles and Applications of Ubiquitous Sensing

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Applications using wireless sensors are growing. The emergence of wireless sensor networks in home, commercial, and business applications continues to grow at a rapid rate. Self-learning thermostats, internet connect security systems, remote controlled lighting, and many other applications are just some of the latest wireless sensors on the market.

This book provides a concise review of sensing methods and many sensor types,

with a focus on medical applications. While these may not be the most relevant applications for most of our readers, the descriptions of the sensing methods given in this book are second to none. The author does an excellent job in describing many modern-day, highly technical, sensing methods, such as optical methods that cover Raman Scattering, Surface Plasmon Resonance, Compton Effect, Pair Production, and the Photoelectric Effect, to name just a few. The author does not assume extensive background in these areas, and does an amazing job at providing the reader with outstanding technical descriptions of these advanced sensing methods.

The book also contains the essential aspects of electrical, ultrasonic, optical, and magnetic sensing, covering a wide spectrum of sensing applications. There are chapters devoted to various medical sensing applications, with descriptions of many medical conditions and how sensors are used to measure, monitor, and help diagnose those conditions.

The use of microelectromechanical switches (MEMS) in optical, electrical, and magnetic sensing to develop practical sensors such as inertial, pressure, and fluid sensors is described. Details on signal condition methods illustrate ways to develop practical circuits that ensure reliable sensor operation. The section on energy harvesting methods describes suitable sensing mechanisms, conceptual circuit architectures, and the pros and cons of various methods. System integration of sensors, with the goal of minimizing undesirable side effects resulting from unexpected interactions of sensors in the system, is discussed. Data processing aspects of sensing, with the goal of minimizing uncertainty in the measurement, are also covered.

Readers interested in learning about many types of sensing methods will find this book extremely interesting and well worth reading, especially those who have any medical or medical-related applications in mind. It could also be used in an electrical engineering curriculum that involves a laboratory course in developing sensors. Accompanying PowerPoint slides of lecture notes containing figures from the book can be found at www.wiley.com/go/dargie2017.

Understanding Symmetrical Components for Power System Modeling

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The method of symmetrical components simplifies the analysis of unbalanced three-phase power systems under both normal and abnormal conditions. The basic idea is that an asymmetrical set of N phasors can be expressed as a linear combination of N symmetrical sets of phasors using a complex linear transformation.

In the most common case of three-phase systems, the resulting "symmetrical" components are referred to as positive, negative, and zero. The analysis of a power system is much simpler when using symmetrical components, because the resulting equations are mutually linearly independent if the circuit itself is balanced.

In 1918 Charles Fortescue presented a paper that demonstrated that any set of N unbalanced phasors could be expressed as the sum of N symmetrical sets of balanced phasors, for values of N that are prime. Only a single frequency component is represented by the phasors. However, the credit for the first formal statement should go to L. G. Stokvis, who explained the principle and gave experimental verification of its correctness in 1915. In a three-phase system, one set of phasors has the same phase sequence as the system under study (positive sequence; say ABC), the second set has the reverse phase sequence (negative sequence; ACB), and in the third set the phasors A, B, and C are in phase with each other (zero sequence, the common-mode signal). Essentially, this method converts three unbalanced phases into three independent sources, which makes the asymmetric fault analysis more tractable.

This book provides good technical depth, yet also provides a practical treatment of symmetrical components. It will enable a reader to gain a full working knowledge of symmetrical components for power system analysis. The book begins with matrix algebra to demonstrate the nonuniqueness of symmetrical component transformations, followed by definitions of sequence impedances and formulas used to make calculations. Models are described, using symmetrical components, for transmission lines, cables, induction motors, and synchronous generators. Unsymmetrical shunt and series faults and overvoltages are also analyzed.

This book is for those who want to learn how to use symmetrical components to perform fault analysis calculations in power systems. It provides many example calculations to reinforce learning. There is also good practical insight given, e.g., on the effects of harmonics, limitations when using this method, and multiple grounded systems. This would be a very handy book for power system engineers.

Internet of Things and Data Analytics Handbook

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The internet of things (IoT) can be described by four different layers of technology. First is the hardware layer consisting of sensors, actuators, chips, and radios, i.e., physical devices that interact with the world. Next is the communications layer, which enables the hardware to be connected via wireless or wired communication technologies. The third layer, data analytics, is where data collected from the other layers are analyzed to obtain actionable and useful information. Finally, the fourth layer is the service layer, which makes decisions based on the information from the data analytics layer, and takes appropriate action. This is the vision of interconnecting fast growing technology.

This handbook covers essential technical background, processes, designs, implementation, and marketing for IoT projects. It contains six parts. Part I describes various models for digital services, the industrial internet of things, smart cities, medical applications, and human psychological behavior. Part II reviews the current technologies used to enable the IoT system, such as software, MEMS sensors, electro-optical infrared sensors, wireless networks, wearable sensors, beacon technology, and SCADA (supervisory control and data acquisition), a connected network of computers used for gathering and analyzing real-time data to monitor and control a plant or equipment in industries such as telecommunications, water and waste control, energy, oil and gas refining, and transportation.. Part III, data analytic technologies, covers the fundamentals of handling large data sets and how to apply predictive analytics. Risk modeling, Hadoop Technology (a software library that allows for the distributed processing of large data sets across clusters of computers using simple programming models), and security are discussed. Part IV describes applications of connectivity technologies to certain industries and how these industries could benefit from such technology. Some application areas cover vehicles, smart cities, smart power grids, oil and gas, and mining. Part V covers case studies from these industries and smart home services, public transportation, and health monitoring. Part VI reviews cloud computing, innovation, and business models.

This book is a great way to quickly introduce yourself to the IoT methodologies and vision. Much of the book presents ideas and visions of what the future possibilities may be in an interconnected world. Many of the case studies and applications provide the reader with intriguing ideas to consider. Regulations and policy issues, which could be crucial in shaping the future of these systems, are discussed. This book gives the best overview of IoT today.

Physics of Digital Photography

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Digital cameras are ubiquitous today. They are incorporated into cell phones, surveillance systems, handheld cameras, and research applications. They have almost completely displaced film cameras. While many people use digital cameras, very few understand the technical details of this modern marvel. Many engineers, scientists, and researchers in general also use digital cameras in support of their work. This book provides in-depth technical details of the inner workings of digital cameras, and is intended for use by graduate students and researchers beginning imaging science, and to help photographers with a graduate-level technical background to maximize the technical quality of the final image.

The book primarily focuses on the conversion of light into electrical signals stored in the camera. It starts with the fundamentals of optics, including field of view, depth of field, photometric exposure, and digital output to obtain a standard brightness. It continues with the physical phenomena that affect the nature of the raw data produced by the camera. These phenomena include diffraction, sensor resolution, aliasing, noise, and analog-to-digital conversion. Linear systems theory is also used to provide a description of the point spread and optical transfer functions used to describe image quality. The main steps used to convert raw data into viewable images are described, along with color theory and white balance details. Finally, practical strategies for maximizing the full image quality are described in detail.

This book covers the optical aspects of imaging as they apply to digital cameras. It does not cover specific cameras, camera functions, electrical function, or specific photographer knowledge such as lighting, composition, post-processing images, etc. However, if you are interested in learning about the in-depth technical physics of light, and the ability of a digital camera to capture this light image, then this is the book for you.