Electrical Transmission System Cascades And Vulnerability

Vol. 7, no.7, July 1924, contains papers prepared by Canadian engineers for the first World power conference, July, 1924.

This book constitutes the refereed proceedings of the 26th International Conference on Computer Safety, Reliability, and Security, SAFECOMP 2007. The 33 revised full papers and 16 short papers are organized in topical sections on safety cases, impact of security on safety, fault tree analysis, safety analysis, security aspects, verification and validation, platform reliability, reliability evaluation, formal methods, static code analysis, safety-related architectures.

Proceedings - International Conference on Large High Voltage Electric Systems (CIGRE).

Revue de L'ingénierie

Electricity Transmission

Electrical Transmission in a New Age

An Interaction Graph-based Approach

Electrical Transmission Systems and Smart Grids

A new edition of the classic text explaining the fundamentals of competitive electricity markets—now updated to reflect the evolution of these markets and the large scale deployment of generation from renewable energy sources The introduction of competition in the generation and retail of electricity has changed the ways in which power systems function. The design and operation of successful competitive electricity markets requires a sound understanding of both power systems engineering and underlying economic principles of a competitive market. This extensively revised and updated edition of the classic text on power system economics explains the basic economic principles underpinning the design, operation, and planning of modern power systems in a competitive environment. It also discusses the economics of renewable energy sources in electricity markets, the provision of incentives, and the cost of integrating renewables in the grid. Fundamentals of Power System Economics, Second Edition looks at the fundamental concepts of microeconomics, organization, and operation of electricity markets, market participants' strategies, operational reliability and ancillary services, network congestion and related LMP and transmission rights, transmission investment, and generation investment. It also expands the chapter on generation investments—discussing capacity mechanisms in more detail and the need for capacity markets aimed at ensuring that enough generation capacity is available when renewable energy sources are not producing due to lack of wind or sun. Retains the highly praised first edition's focus and philosophy on the principles of competitive electricity markets and application of basic economics to power system operating and planning Includes an expanded chapter on power system operation that addresses the challenges stemming from the integration of renewable energy sources Addresses the need for additional flexibility and its provision by conventional generation, demand response, and energy storage Discusses the effects of the increased uncertainty on system operation Broadens its coverage of transmission investment and generation investment Updates end-of-chapter problems and accompanying solutions manual Fundamentals of Power System Economics, Second Edition is essential reading for graduate and undergraduate students, professors, practicing engineers, as well as all others who want to understand how economics and power system engineering interact.

This book provides a rough entry into the interdisciplinary field of Infranomics. It enables better decision making in an increasing ambiguous, complex, emergent, interdependent, and uncertain world where we attempt to anticipate modern society trends and patterns in order to react appropriately. However, as with any emerging discipline, much research is needed at the applications and conceptual level. The applications level may require development and testing of methods, tools, and techniques to enable analysis and decision-making in ambiguous, complex, emergent, interdependent, and uncertain conditions while the conceptual level may require taping into driving philosophies, theories, and methodologies that form the basis for Infranomics. Striking the right balance between applications and conceptual foundation (theory) requires rigorous research. This book provides a springboard for robust discussions on applications, theory, and transformation of current thinking to better deal with modern society's problematic issues using Infranomics.

Second Edition

An Inquiry Into the Kind, Amount, and Utilization of the Resources of the Cascade Mountains of Washington as Delimited by the Boundaries of the Snoqualmie, Wenatchee, Columbia, Chelan, and Mount Baker National Forests

Sustainability, Engineering Design and Governance

Abstract Cascades, the Electric Power Grid, and Fedwire

Complex Networks and Their Applications VII

Fundamentals of Power System Economics

This innovative approach to the fundamentals of electric power provides the most rigorous, comprehensive and modern treatment available. To impart a thorough grounding in electric power systems, it begins with an informative discussion on per-unit normalizations, symmetrical components and iterative load flow calculations. Covering important topics within the power system, such as protection and DC transmission, this book looks at both traditional power plants and those used for extracting sustainable energy from wind and sunlight. With classroom-tested material, this book also presents: the principles of electromechanical energy conversion and magnetic circuits; synchronous machines - the most important generators of electric power; power electronics; induction and direct current electric motors. Homework problems with varying levels of difficulty are included at the end of each chapter, and an online solutions manual for tutors is

available. A useful Appendix contains a review of elementary network theory. For senior undergraduate and postgraduate students studying advanced electric power systems as well as engineers re-training in this area, this textbook will be an indispensable resource. It will also benefit engineers in electronic power systems, power electronic systems, electric motors and generators, robotics and mechatronics.
www.wiley.com/go/kirtley_electric
A revelatory, urgent narrative with national implications, exploring the decline of California's largest utility company that led to countless wildfires – including the one that destroyed the town of Paradise – and the human cost of infrastructure failure Pacific Gas and Electric was a legacy company built by innovators and visionaries, establishing California as a desirable home and economic powerhouse. In California Burning, Wall Street Journal reporter and Pulitzer finalist Katherine Blunt examines how that legacy fell apart—unraveling a long history of deadly failures in which Pacific Gas and Electric endangered millions of Northern Californians, through criminal neglect of its infrastructure. As PG&E prioritized profits and politics, power lines went unchecked—until a rusted hook purchased for 56 cents in 1921 split in two, sparking the deadliest wildfire in California history. Beginning with PG&E's public reckoning after the Paradise fire, Blunt chronicles the evolution of PG&E's shareholder base, from innovators who built some of California's first long-distance power lines to aggressive investors keen on reaping dividends. Following key players through pivotal decisions and legal battles, California Burning reveals the forces that shaped the plight of PG&E: deregulation and market-gaming led by Enron Corp., an unyielding push for renewable energy, and a swift increase in wildfire risk throughout the West, while regulators and lawmakers pushed their own agendas. California Burning is a deeply reported, character-driven narrative, the story of a disaster expanding into a much bigger exploration of accountability. It's an American tragedy that serves as a cautionary tale for utilities across the nation—especially as climate change makes aging infrastructure more vulnerable, with potentially fatal consequences.
Preprints
Understanding, Mitigation, and System Restoration
A Primer
IEEE PES Winter Meeting, February 4-9, 1979
Mathematical Modeling, Simulation and Optimization for Power Engineering and Management
Trophic Cascades

A focused presentation of how sparse optimization methods can be used to solve optimal control and estimation problems.
Offers a comprehensive introduction to the issues of control of power systems during cascading outages and restoration process Power System Control Under Cascading Failures offers comprehensive coverage of three major topics related to prevention of cascading power outages in a power transmission grid: modelling and analysis, system separation and power system restoration. The book examines modelling and analysis of cascading failures for reliable and efficient simulation and better understanding of important mechanisms, root causes and propagation patterns of failures and power outages. Second, it covers controlled system separation to mitigate cascading failures addressing key questions such as where, when and how to separate. Third, the text explores optimal system restoration from cascading power outages and blackouts by well-designed milestones, optimised procedures and emerging techniques. The authors — noted experts in the field — include state-of-the-art methods that are illustrated in detail as well as practical examples that show how to use them to address realistic problems and improve current practices. This important resource: Contains comprehensive coverage of a focused area of cascading power system outages, addressing modelling and analysis, system separation and power system restoration Offers a description of theoretical models to analyse outages, methods to identify control actions to prevent propagation of outages and restore the system Suggests state-of-the-art methods that are illustrated in detail with hands-on examples that address realistic problems to help improve current practices Includes companion website with samples, codes and examples to support the text Written for postgraduate students, researchers, specialists, planners and operation engineers from industry, Power System Control Under Cascading Failures contains a review of a focused area of cascading power system outages, addresses modelling and analysis, system separation, and power system restoration.
Cascade Mountains Study, State of Washington
Sources, Conversion, Distribution and Use
Modeling, Control, and Optimization
Proceedings of the 2nd International Symposium on Energy System Optimization
Electrical World
The Electric Journal

This volume consists of selected essays by participants of the workshop Control at Large Scales: Energy Markets and Responsive Grids held at the Institute for Mathematics and its Applications, Minneapolis, Minnesota, U.S.A. from May 9-13, 2016. The workshop brought together a diverse group of experts to discuss current and future challenges in energy markets and controls, along with potential solutions. The volume includes chapters on significant challenges in the design of markets and incentives, integration of renewable energy and energy storage, risk management and resilience, and

distributed and multi-scale optimization and control. Contributors include leading experts from academia and industry in power systems and markets as well as control science and engineering. This volume will be of use to experts and newcomers interested in all aspects of the challenges facing the creation of a more sustainable electricity infrastructure, in areas such as distributed and stochastic optimization and control, stability theory, economics, policy, and financial mathematics, as well as in all aspects of power system operation.

This book highlights cutting-edge research in the field of network science, offering scientists, researchers, students and practitioners a unique update on the latest advances in theory, together with a wealth of applications. It presents the peer-reviewed proceedings of the VII International Conference on Complex Networks and their Applications (COMPLEX NETWORKS 2018), which was held in Cambridge on December 11–13, 2018. The carefully selected papers cover a wide range of theoretical topics such as network models and measures; community structure and network dynamics; diffusion, epidemics and spreading processes; and resilience and control; as well as all the main network applications, including social and political networks; networks in finance and economics; biological and neuroscience networks; and technological networks.

The Engineering Journal of the Electrical Industry

ODS, First Hybrid Conference, Rome, Italy, September 14-17, 2021

The Fall of Pacific Gas and Electric--and What It Means for America's Power Grid

The Electrical World and Engineer

Advanced Simulation for Analysis of Critical Infrastructure

Advances in Energy System Optimization

This edited monograph offers a summary of future mathematical methods supporting the recent energy sector transformation. It collects current contributions on innovative methods and algorithms. Advances in mathematical techniques and scientific computing methods are presented centering around economic aspects, technical realization and large-scale networks. Over twenty authors focus on the mathematical modeling of such future systems with careful analysis of desired properties and arising scales. Numerical investigations include efficient methods for the simulation of possibly large-scale interconnected energy systems and modern techniques for optimization purposes to guarantee stable and reliable future operations. The target audience comprises research scientists, researchers in the R&D field, and practitioners. Since the book highlights possible future research directions, graduate students in the field of mathematical modeling or electrical engineering may also benefit strongly. .

Electric transmission networks are among the largest human-made engineering systems: For example, the transmission network in the United States covers over 300,000 km of lines and is served by 500 companies (electric utilities). In sharp contrast to the very incremental developments of the last century, transmission and control technologies experienced a major breakthrough at the beginning of the 21st century. The rapid growth of new energy generation technologies (renewables), significant advances in information processing applied to system monitoring, planning, operation, control, and protection, radical changes in distribution networks, and key shifts in end user behavior (advanced metering and control of demand response) have combined to produce the modern integrated electrical infrastructure commonly referred to as the smart grid. Featuring state-of-the-art, peer-reviewed entries from the Encyclopedia of Sustainability Science and Technology, this book provides a detailed introduction to select key topics which span energy technology, engineering, and urban planning. Worldwide experts discuss the integration of electric energy infrastructure into the broader critical infrastructures of the modern world and their various interdependencies. Dedicated chapters cover specific topics ranging from underground transmission and distribution, to energy and water interdependence, and their implications for urban areas. Coverage also includes the key role of new policy initiatives as catalysts of change.

Volume 1 Proceedings The 7th International Conference on Complex Networks and Their Applications COMPLEX NETWORKS 2018

Industrial Arts Index

Computer Safety, Reliability, and Security

Engineering News

Practical Methods for Optimal Control Using Nonlinear Programming, Third Edition

Trophic cascades—the top-down regulation of ecosystems by predators—are an essential aspect of ecosystem function and well-being. Trophic cascades are often drastically disrupted by human interventions—for example, when wolves and cougars are removed, allowing deer and beaver to become destructive—yet have only recently begun to be considered in the development of conservation and management strategies. Trophic Cascades is the first comprehensive presentation of the science on this subject. It brings together some of the world ' s leading scientists and researchers to explain the importance of large animals in regulating ecosystems, and to relate that scientific knowledge to practical conservation. Chapters examine trophic cascades across the world ' s major biomes, including intertidal habitats, coastal oceans, lakes, nearshore ecosystems, open oceans, tropical forests, boreal and temperate ecosystems, low arctic scrubland, savannas, and islands. Additional chapters consider aboveground/belowground linkages, predation and ecosystem processes, consumer control by megafauna and fire, and alternative states in ecosystems. An introductory chapter offers a concise overview of trophic cascades, while concluding chapters consider theoretical perspectives and comparative issues. Trophic Cascades provides a scientific basis and justification for the idea that large predators and top-down forcing must be considered in conservation strategies, alongside factors such as habitat preservation and invasive species. It is a groundbreaking work for scientists and managers involved with biodiversity conservation and protection.

The papers presented in this open access book address diverse challenges in decarbonizing energy systems, ranging from operational to investment planning problems, from market economics to technical and environmental considerations, from distribution grids to transmission grids, and from theoretical considerations to data provision concerns and applied case studies. While most papers have a clear methodological focus, they address policy-relevant

questions at the same time. The target audience therefore includes academics and experts in industry as well as policy makers, who are interested in state-of-the-art quantitative modelling of policy relevant problems in energy systems. The 2nd International Symposium on Energy System Optimization (ISESO 2018) was held at the Karlsruhe Institute of Technology (KIT) under the symposium theme "Bridging the Gap Between Mathematical Modelling and Policy Support" on October 10th and 11th 2018. ISESO 2018 was organized by the KIT, the Heidelberg Institute for Theoretical Studies (HITS), the Heidelberg University, the German Aerospace Center and the University of Stuttgart.

Electrical Engineering

Optimization in Artificial Intelligence and Data Sciences

California Burning

Pacific Service Magazine

Infranomics

Engineering Journal

"Index of current electrical literature," Dec. 1887- appended to v. 5-

Large blackouts with significant societal and economic impacts result from cascade of failures in the transmission network of power grids. Understanding and mitigating cascading failures in power grids is challenging due to the large number of components and their complex interactions, wherein, in addition to the physical topology of the system, the physics of power flow and functional dependencies among components largely affect the spatial distribution and propagation of failures. In this dissertation, data-driven interaction graphs, which help in capturing the underlying interactions and influences among the components during cascading failures, are used for capturing the non-local nature of propagation of failures as well as for simplifying the modeling and analysis of cascades. Particularly, influence and correlation graphs are constructed for revealing and comparing various types of interactions/influences during cascades. In addition, as a step towards analyzing cascades, community structures in the interaction graphs, which bear critical information about cascade processes and the role of system components during cascades are identified. The key idea behind using community structures for analyzing cascades is that a cascade entering a community is likely to reach to most of the other members of the same community while less likely to reach to other communities. Thus, community structures significantly impact cascade behavior by trapping failures within communities. Further, a centrality measure based on the community structures is proposed to identify critical components of the system, which their protection can help in containing failures within a community and prevent the propagation of failures to large sections of the power grid. Various criticality evaluation techniques, including data-driven, epidemic simulation-based, power system simulation-based and graph-based, have been used to verify the importance of the identified critical components in the cascade process and compare them with those identified by traditional centrality measures. Moreover, it has been shown that the loading level of the power grid impacts the interaction graph and consequently, the community structure and criticality of the components in the cascade process. Furthermore, a Markov chain model is designed based on the community structures embedded in the data-driven interaction graphs of power grids. This model exploits the properties of community structures in interactions to enable the probabilistic analysis of cascade sizes in power grids. The trapping property of communities is extensively used to show that the probability distribution of cascade sizes exhibit power-law behavior as observed in previous studies and historical data. Finally, an integrated framework based on the influence model, a networked Markov chain framework, is proposed for modeling the integrated power grid and transportation infrastructures, through one source of their interdependency i.e., electric-vehicle (EV) charging stations. The interactions based on the rules and policies governing their internal and interaction dynamics is captured. Particularly, the proposed integrated framework is used to design an algorithm for assigning dynamic charging prices for the EV charging infrastructure with the goal of increasing the likelihood of having balanced charging and electric infrastructures. The proposed scheme for charging prices is traffic and power aware as the states and interactions of transportation and power infrastructures are captured in the integrated framework. Finally, the critical role of cyber infrastructure in enabling such collaborative solutions is also discussed.

Proceedings of the Conference, September 9-September 12, 2002, Omaha, Nebraska

Electrical News. Generation, Transmission and Application of Electricity

Manual of Electrical Undertakings and Directory of Officials

26th International Conference, SAFECOMP 2007, Nurmberg, Germany, September 18-21, 2007, Proceedings

Subject Index to a Selected List of Engineering, Trade and Business Periodicals

Mining Reporter

Critical Infrastructures are formed by a large number of components that interact within complex networks. As a rule, infrastructures contain strong feedbacks either explicitly through the action of hardware/software control, or implicitly through the action/reaction of people. Individual infrastructures influence others and grow, adapt, and thus evolve in response to their multifaceted physical, economic, cultural, and political environments. Simply put, critical infrastructures are complex adaptive systems. In the Advanced Modeling and Techniques Investigations (AMTI) subgroup of the National Infrastructure Simulation and Analysis Center (NISAC), we are studying infrastructures as complex adaptive systems. In one of AMTI's efforts, we are focusing on cascading failure as can occur with devastating results within and between infrastructures.

Over the past year we have synthesized and extended the large variety of abstract cascade models developed in the field of complexity science and have started to apply them to specific infrastructures that might experience cascading failure. In this report we introduce our comprehensive model, Polynet, which simulates cascading failure over a wide range of network topologies, interaction rules, and adaptive responses as well as multiple interacting and growing networks. We first demonstrate Polynet for the classical Bac, Tang, and Wiesenfeld or BTW sand-pile in several network topologies. We then apply Polynet to two very different critical infrastructures: the high voltage electric power transmission system which relays electricity from generators to groups of distribution-level consumers, and Fedwire which is a Federal Reserve service for sending large-value payments between banks and other large financial institutions. For these two applications, we tailor interaction rules to represent appropriate unit behavior and consider the influence of random transactions within two stylized networks: a regular homogeneous array and a heterogeneous scale-free (fractal) network. For the stylized electric power grid, our initial simulations demonstrate that the addition of geographically unrestricted random transactions can eventually push a grid to cascading failure, thus supporting the hypothesis that actions of unrestrained power markets (without proper security coordination on market actions) can undermine large scale system stability. We also find that network topology greatly influences system robustness. Homogeneous networks that are 'fish-net' like can withstand many more transaction perturbations before cascading than can scale-free networks. Interestingly, when the homogeneous network finally cascades, it tends to fail in its entirety, while the scale-free tends to compartmentalize failure and thus leads to smaller, more restricted outages. In the case of stylized Fedwire, initial simulations show that as banks adaptively set their individual reserves in response to random transactions, the ratio of the total volume of transactions to individual reserves, or 'turnover ratio', increases with increasing volume. The removal of a bank from interaction within the network then creates a cascade, its speed of propagation increasing as the turnover ratio increases. We also find that propagation is accelerated by patterned transactions (as expected to occur within real markets) and in scale-free networks, by the 'attack' of the most highly connected bank. These results suggest that the time scale for intervention by the Federal Reserve to divert a cascade in Fedwire may be quite short. Ongoing work in our cascade analysis effort is building on both these specific stylized applications to enhance their fidelity as well as embracing new applications. We are implementing markets and additional network interactions (e.g., social, telecommunication, information gathering, and control) that can impose structured drives (perturbations) comparable to those seen in real systems. Understanding the interaction of multiple networks, their interdependencies, and in particular, the underlying mechanisms for their growth/evolution is paramount. With this understanding, appropriate public policy can be identified to guide the evolution of present infrastructures to withstand the demands and threats of the future.

This collection contains 46 papers discussing electrical transmission line engineering presented at the Electrical Transmission in a New Age Conference, held in Omaha, Nebraska, on September 9-12, 2002.

Practical Methods for Optimal Control and Estimation Using Nonlinear Programming

Predators, Prey, and the Changing Dynamics of Nature

Transactions of the American Institute of Electrical Engineers

Power System Control Under Cascading Failures

Electrical Transmission System Cascades and Vulnerability: An Operations Research Viewpoint

Selected Entries from the Encyclopedia of Sustainability Science and Technology

How do you fly an airplane from one point to another as fast as possible? What is the best way to administer a vaccine to fight the harmful effects of disease? What is the most e?cient way to produce a chemical substance? This book presents practical methods for solving real optimal control problems such as these. Practical Methods for Optimal Control Using Nonlinear Programming, Third Edition focuses on the direct transcription method for optimal control. It features a summary of relevant material in constrained optimization, including nonlinear programming; discretization techniques appropriate for ordinary differential equations and differential-algebraic equations; and several examples and descriptions of computational algorithm formulations that implement this discretize-then-optimize strategy. The third edition has been thoroughly updated and includes new material on implicit Runge-Kutta discretization techniques, new chapters on partial differential equations and delay equations, and more than 70 test problems and open source FORTRAN code for all of the problems. This book will be valuable for academic and industrial research and development in optimal control theory and applications. It is appropriate as a primary or supplementary text for advanced undergraduate and graduate students.

The power grid can be considered one of twentieth-century engineering?s greatest achievements, and as grids and populations grow, robustness is a factor that planners must take into account. Power grid robustness is a complex problem for two reasons: the underlying physics is mathematically complex, and modeling is complicated by lack of accurate data. This book sheds light on this complex problem by introducing the engineering details of power grid operations from the basic to the detailed; describing how to use optimization and stochastic modeling, with special focus on the modeling of cascading failures and robustness; providing numerical examples that show ?how things work?; and detailing the application of a number of optimization theories to power grids.÷

Mining American

Electric Power Principles

Electrical Review and Western Electrician with which is Consolidated Electrocraft

Journal of Electricity

Reliability Analysis of Power Grids and Its Interdependent Infrastructures

Energy Markets and Responsive Grids