State estimation in electric power systems

State estimation for power systems was first formulated as a weighted least-squares problem by Schweppe [] in early 70s and has become an integral part of power system monitoring and operation .State estimation is a mathematical procedure to process the set of real-time measurements to come up with the best estimate of the current state of the system.

Offering an up-to-date account of the strategies utilized in state estimation of electric power systems, this text provides a broad overview of power system operation and the role of state estimation in overall energy management.

Index Terms--state estimation, graph neural networks, ma- chine learning, power systems, real-time I. INTRODUCTION The state estimation (SE), which estimates the set of power system state variables based on the available set of mea- surements, is an essential tool used for the power system"s monitoring and operation [1].

Deregulation of energy markets, penetration of renewables, advanced metering capabilities, and the urge for situational awareness, all call for system-wide power system state estimation (PSSE). Implementing a centralized estimator though is practically infeasible due to the complexity scale of an interconnection, the communication bottleneck in real-time monitoring, ...

Increasing concern about system reliability and security has resulted into greater relevance of power system state estimation. The power system state estimation has broadened due to improvisations in techniques; revision of states from static to dynamic; inclusion of system components like FACTS, etc. A review of various state estimation techniques vis-à-vis ...

State estimation is a key function for real-time operation and control of electrical power systems since its role is to provide a complete, coherent, and reliable network real-time model used to set up other real-time operation and control functions.

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This paper proposes a new method for the state estimation of electric power distribution system conditions oriented towards working with minimum number of remote measurements available in the network. This approach will require information concerning the network reconfiguration, remote measurements of voltages, real and reactive power as well as feeder currents in ...

This paper contains six sections altogether. In Section 2, the probabilistic model of electric vehicles and the charging power model of cluster electric vehicles are established. Section 3 constructs a probabilistic model

for photovoltaic power generation and a probabilistic model for wind power generation. In Section 4, the power system state estimation objective function is ...

A. State Estimation in Electric Power Systems The main SE routines comprise the SE algorithm, network topology processor, observability analysis and bad data analysis. The core of the SE is the SE algorithm which provides a state estimate of the system, i.e., the set of all

This paper summarizes a review of the distribution system state estimation (DSSE) methods, techniques, and their applications in power systems. In recent years, the implementation of a distributed generation has affected the behavior of the distribution networks. In order to improve the performance of the distribution networks, it is necessary to implement state ...

Existing state estimation efforts for power systems can be categorized into model-based and machine learning based approaches [3], [4], [5], [6] the domain of model-based state estimation, two directions have emerged as key areas of focus: (1) static state estimation (SSE) and (2) dynamic state estimation (DSE) [7].SSE determines the unknown states of a power ...

NREL is develop estimation and forecasting methods by leveraging data-driven approaches and physical models to provide real-time and predictive situational awareness and inform decision-making in electric power systems. Capabilities. State estimation with limited measurements; Machine learning for short-term state forecasting; Predictive state ...

This paper introduces a novel hybrid filtering algorithm that leverages the advantages of Phasor Measurement Units (PMU) to address state estimation challenges in power systems. The primary objective is to integrate the benefits of PMU measurements into the design of traditional power system dynamic estimators. It is noteworthy that PMUs and Supervisory ...

POWER SYSTEMS STATE ESTIMATION A Project Presented to the faculty of the Department of Electrical & Electronic Engineering California State University, Sacramento ... Presently, many electric power systems around the world are experiencing crucial operational changes. Numerous participants in the electric power industry are leaning

State estimation is one of the most important functions in power system operation and control. This area is concerned with the overall monitoring, control, and contingency evaluation of power systems. It is mainly aimed at providing a reliable estimate of system voltages. State estimator information flows to control centers, where critical decisions are made concerning power ...

of electric power systems. An e cient, timely and accurate state estimation is a prerequisite for a reliable operation of modern power grids. ... culations of power system state estimation studies, a more accurate load modeling can be developed and integrated into the dynamic state estimation process of power

State estimation in electric power systems

State estimation is an important tool for system operators. The state of the power system is defined by the voltage magnitudes and phase angles at all buses. The state estimator (SE) determines this state based on a set of redundant measurements. The classic steady-state estimator is widely used. Attempts to formulate a dynamic-state estimator have also been ...

Cyber-Physical Power System State Estimation updates classic state estimation tools to enable real-time operations and optimize reliability in modern electric power systems. The work introduces and contextualizes the core concepts and classic approaches to ...

State estimation (SE) is an essential tool of energy management systems (EMS), providing power system operators with an overall grasp of the actual power system operating conditions and aiding them in sustaining ...

Power system state estimation (PSSE) Problem: given meter readings and grid parameters, nd actual state v. Figure: Left: actual state. Right: Measurements in red; use only fP12;P32g to. ...

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In this work, the state estimation problem of electric power systems is represented through a mathematical programming approach. Initially, a non-linear mathematical model based on the classical ...

We propose a fast real-time state estimator based on the belief propagation algorithm for the power system state estimation. The proposed estimator is easy to distribute and parallelize, thus alleviating computational limitations and allowing for processing measurements in real time. The presented algorithm may run as a continuous process, with each new measurement being ...

state of an electric power system". o Today, state estimation is an essential part in almost every energy management system throughout the world. Felix F. Wu, "Power system state estimation: a survey", International Journal of Electrical Power & Energy Systems, Volume 12, Issue 2, April 1990, Pages 8

State Estimation in Electric Power Systems: A Generalized Approach crystallizes thirty years of WLS state estimation theory and practice in power systems and focuses on techniques adopted by state estimation developers worldwide. The book also reflects the experience of developing industrial-grade state estimation software that is used in the ...

The exact fit points of the Least Median of Squares (LMS) and the Least Trimmed Squares (LTS) estimators in electric power systems are investigated. The expression of the maximum possible exact fit point /spl

delta/*/sub max/ is derived, and the corresponding quantile index /spl nu/ of the ordered squared residual is determined. It is found that /spl delta/*/sub max/ as well as /spl nu/ ...

This paper presents a mathematical modeling approach by which to solve the power flow and state estimation problems in electric power systems through a mathematical programming language (AMPL). The main purpose of this work is to show the advantages of representing these problems through mathematical optimization models in AMPL, which is a ...

State estimation is one of the most important functions in power system operation and control. This area is concerned with the overall monitoring, control, and contingency evaluation of ...

Power system may be a quasi-static system and thus changes slowly with time. Since state estimation is computationally valuable, it''s difficult to execute it repetitively at short intervals to understand the real time monitoring of such a dynamic system. The state of an electrical power system is characterized by the voltage magnitudes and ...

State Estimation (SE) in power systems. While covering some works related to SE in transmission systems, the main focus of this paper is Distribution System State Estimation (DSSE). ... The measurement units distributed across the electric power system are the main sources of the information for running the monitoring and control systems. In ...