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Content of Abstract

Section RaST1: Reliability and Safety Technologies

Smoothed Bootstrap for Survival Function Inference

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A new generalized smoothed bootstrap technique is presented for data including right-censored observations. The method is based on Banks' bootstrap (Banks, 1988) and the right censoring A(n) assumption introduced by Coolen and Yan (2004), which is a generalization of Hill's A(n) assumption (Hill, 1968).
We use two examples to show how the smoothed bootstrap is applied to make inferences about a survival function, namely an estimate of the survival function and corresponding bootstrap based point-wise confidence intervals. We compare the inferences to the Kaplan-Meier estimates and we apply two further methods, presented in the literature, for creating pointwise confidence intervals for a survival function at a fixed time t.

Keywords: Banks' bootstrap, Kaplan-Meier estimator, nonparametric predictive inference, quantile confidence interval

Comparison of the genetic algorithms to build a diagnostic tree for diagnosing single stuck-at failures

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FPGAs are used in various areas of human activity. It is necessary to quickly identify failures for their correct operation. FPGAs are diagnosed to detect failures, finding a place of its occurrence and determining its type. This paper is devoted to algorithms for constructing diagnostic sequences for diagnosing single stuck-at failures. Two genetic algorithms are considered in the paper: GA for constructing a simple diagnostic tree and GA for constructing a diagnostic tree with feedback. The diagnostic feedback tree allows partitioning the set of function classes more efficient. Also, a comparison of the work of two genetic algorithms was made.

Keywords — FPGA, single stuck-at failures, genetic algorithm, diagnosing.

Toward generation of dependability assessment models for industrial control system

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This article focuses on the development of a tool-based approach for the assessment of industrial control IT systems. The originality of the approach relies in two main points. First of all, the underlying formal models for dependability assessment must cover dynamic behaviour of the IT architectures to take into account reparation, reconfiguration and modes in the life cycle of the architecture. Secondly, these formal models must be automatically established and hidden to the architecture designers to reduce time consumption when dealing with a large amount of candidate architectures evaluated during the engineering phase.
This work is a first step towards such an objective by defining a structured UML (Unified Modelling Language) modelling framework for identifying and structuring the key objects of an architecture with regard to dependability.

Keywords—UML diagrams, dependability assessment, industrial control system architecture, automatic generation model, Petri nets

Are events with different significance correlated?

Quantitative analysis of the correlation between events with different safety significance.

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Events from operating experience are collected in order to serve as source of lessons to be learned. The underlining assumption is that there is causality between events and risk. While this is obvious when accidents happen it is less clear how precursor and other less risk relevant events are connected to causes of accidents. Confirmation of the causation assumption is important to optimize operating experience feedback programs and to better maintain safety. This paper is analysing correlation between the rates and numbers of

events with different safety significance. Events rates from two nuclear energy related databases are considered. Preliminary findings are that correlation exists but not as large as expected. Future work is to restrict correlation analysis only between events, which have similar causes and investigate potential to use results to improve operating experience program.

Practical Applicability of Advanced Implementations of Priority Queues in Finding Shortest Paths

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A priority queue belongs to most useful abstract data types. It plays a key role in graph algorithms, such as Dijkstra's or Prim's algorithm, in data mining algorithms, such as OPTICS, in discrete-event simulation, or in CPU scheduling. Various implementations of priority queues have been proposed during years. Most powerful ones are based on heap data structure that allows performing inserts and removals in O(log n) time. Using specialized heaps, such as pairing or Fibonacci, inserts can be done in O(1) time. Furthermore, Fibonacci heap or more complex heaps, such as Brodal queue or strict Fibonacci heap, support execution of another operation that is increment of priority of any element stored in the priority queue in O(1) time. This fact can be used to decrease time complexity of various algorithms that use priority queues. On the other hand, the constant factors hidden behind O notation of most of the operations can be really big what can significantly decrease practical applicability of these advanced implementations of priority queues. In this paper, we focus on three implementations of priority queues that are Fibonacci heap, Brodal queue, and strict Fibonacci heap, and we try to investigate their applicability in Dijkstra's algorithm implemented in C++ programing language.

Simulation verification of location of charging stations for electric buses

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The paper describes the usage of simulation model of public city transport to evaluate the results of the mathematical model for the electric infrastructure design for battery electric buses in public city transport. Proposed mathematical model solves the problem of optimal locations of charging stations for electric buses in public transportation. Possible location of charging stations are on terminal stops and depots of electric buses. Mathematical model of the problem is solved using general IP-solver Xpress and can provide results for large-scale problems.

The simulation model is used for verification of location of charging stations proposed by mathematical model. Simulation model is created in Any-logic simulation tool. In the paper we describe mathematical model, simulation model, extension of simulation model for ability to simulate operation of electric buses in everyday use, and results of experiments with the simulation and optimization model on the test datasets created from operational data of the city of Žilina.

Keywords— simulation and optimization model

Reliability Analysis of Cognitive Radio Networks

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The current paper deals with the simulation of a queuing model developed to evaluate the performance of a cognitive radio network and its reliability. We take into consideration two interconnected subsystems, the first one is dedicated to primary users (PU). The number of sources is finite, and each source generates a primary request after an exponentially distributed

interval of time, these requests then are then sent to a single server called Primary Channel Service (PCS), under the assumption that the service times are distributed exponentially as well. The service is carried out in the order of the arrivals of primary calls. The second part of the model is associated to secondary users (SU), which has also a finite source with exponentially distributed request generation time and it is assumed that the service time at the Secondary Channel Service (SCS) with a single server is exponentially distributed. However, the two subsystems operate in the following way. Each generated primary request is directed to the primary server in order to check its accessibility, in case that the service unit is free, the service starts instantly. If the primary unit is already busy with another primary request, the call joins a FIFO queue. However, if the primary unit is busy by processing a service for a secondary user, this latter service stops immediately and should be sent back to the (SCS), based on the availability of the secondary server this postponed task either starts the service again or joins the orbit.

In the other hand, the secondary requests are directed to the secondary server to verify its availability, if the aimed server is accessible, the service starts immediately, otherwise these secondary requests try to join the (PSU) and if it is idle the service starts. If not, they join to the orbit at SCS. Postponed requests in the or bit retry to be served after an exponentially distributed interval of time.

In the current work both service units are subject to some random breakdowns, in such case the interrupted requests are sent either to the queue or to the orbit, respectively. It is assumed that the operation and repair times of the given server are generally distributed. We use Hypo-Exponential, Hyper- Exponential and Gamma distributed times because by assuming the same means and variances the effect of the distribution could be analysed. Due to the page limitations, we deal with the effect of the distribution of operation and service time distributions, only on the mean response time of the secondary server.

Quality of Service Protection Scheme under Fast ReRoute and Traffic Policing Based on Tensor Model of Multiservice Network

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In the paper, a Quality of Service protection scheme under Fast Re-Route and Traffic Policing based on the tensor model of multiservice networks is proposed. The model considers the set of parameters that have to be protected: the bandwidth, the probability of packet loss, and the average end-to-end delay. In the course of solving the formulated task in accordance with the presented model, a result was obtained while ensuring a given level of Quality of Service and Quality of Resilience over both the primary and backup routes in terms of the bandwidth, the probability of packet loss, and the average end-to-end delay in the multiservice network.

Keywords—Quality of Service; Quality of Resilience; Fast Re-Route; Traffic Policing; Tensor Model; Protection; Bandwidth; Packet Loss; End-to-end Delay

Selection of Energy Storage Units by Genetic Algorithm for Mitigating Voltage Deviations

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In recent years, energy storage units have become very popular. They are applied both for economic and technical purposes. Unfortunately, the cost of such devices is still high and selecting their proper location and rated power have to be performed precisely. In this paper, a Genetic-Algorithm-based optimization method for selecting the best configuration of energy storage units in the power network is proposed. The presented algorithm takes into account the utilization of energy storages, which can be used for improving the power network voltage stability in abnormal state of operation of the power network.

Keywords—energy storage, genetic algorithm, reactive power control, storage units location, storage units sizing

Power Management and Control for a Photovoltaic Electricity Station

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This paper presents a command and control solution applied for an existing photovoltaic station, which has no automation system. The solution proposed consists in a SCADA system used in order to control some parameters like rated active/reactive power, power factor, voltage waveform and values, current limits. This newly conceived SCADA system will be used for the refurbishment of the existing 0.8 MW photovoltaic station, located in the Giroc Area, near Timisoara Romania. It will be structured on 3 levels. Level 0 will be the connection with the process inverters, level 1 will consist in the communication area and level 2 is dedicated to the dispatcher area. All parameters will be in direct relation to the inverters.

Keywords—SCADA, Photovoltaic Station, Power Control

Analysis of data reliability based on importance analysis

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The quality and accuracy of many decision problems can be affected by the reliability of initial data. Nowadays, a different interpretation of the conception of data reliability exists. In this paper, the reliability of initial data is interpreted as the reliability of complex system according to conceptions of reliability analysis. This interpretation allows using the approach of reliability analysis for the examination of initial data. In particular, in this paper, the importance analysis of the system is used for data reliability evaluation. The importance analysis is part of reliability analysis and allows evaluate the influence of some system component to the system reliability modification. In case of the analysis of initial (input) data, the importance analysis permits to evaluate the importance (influence) of every data attribute. A new algorithm for the initial data analysis based on importance analysis is proposed in this paper. This algorithm is approbated for evaluation of data for the comparison of two methodologies in the education of pupils.

Keywords— Decision Tree, Multi-State System, Structure Function, Importance Measures

Reliability Analysis of a Two-Way Communication System with Searching for Customers

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In this paper a special two-way communication system is modelled by the help of finite and infinite sources queueing system with retrial. An unreliable system is considered. The server may subject to random breakdowns. Customers from the finite source are the first order or regular customers, while the customers from the infinite source are the second order or the invited customers. The novelty of this paper is to investigate and model of a non-reliable two-way communication system with this special case of searching for the customers. The first order customers reach the server according to an exponentially distributed request generation time. In case of a busy server, they are able to retry their requests. In case of an idle server, the second order customers are called for service. Their inter-arrival times also subject to the exponential distribution. The effect of the breakdown and repair intensities are also investigated. From the system balance equations the steady state probabilities can be obtained. The MOSEL-2 tool is used for these calculations. By the help of these probabilities the common performance measures are calculated and displayed.

A Time based Maintenance Policy Model for Unavailability Analysis of Dormant Systems

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Repairable systems with latent failures are systems where special inspections are realized regularly, with a fixed period, to reveal a failure. If a

failure is revealed, the renewal procedure is started at the earliest possible inspection time.

Maintenance policies for such systems can be categorized into two main classes: age based and calendar based policies. In the age based policy we suppose that maintenance actions are realized at a given time interval starting from the latest time of maintenance, whereas in the calendar based policy, the system inspections and maintenance are realized periodically at planned times known in advance. In the age based policy, real calendar time of maintenance actions is unknown in advance, due to random times of failures and random times necessary for restorations. Relevant issue of the paper is to formulate reliability mathematics describing the time based maintenance policy model, here denoted as Model III. The paper results from innovative stochastic reliability models, recently developed and used for unavailability quantification of repairable and maintained systems with latent failures. Models are transformed into numerical codes to be demonstrated on both a referenced simple system with the Weibull ageing and real complex system from practice. For the reason of system unavailability analyses, the directed acyclic graph was used in this study, which showed to be a suitable system representation of complex systems.

Keywords—age based maintenance model, unavailability quantification; alternating renewal process; directed acyclic graph

New algorithm for Multi-Valued Decision Diagram construction

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In reliability analysis, the system mathematical representation development is an important step. All mathematical models can be divided into two groups depending on a number of analyzed system performance levels in point of view of reliability analysis: Binary-State System (BSS) and Multi-State System (MSS). Only two performance levels as failure and functioning are considered in BSS. MSS allows considering and evaluation more than only two states. The representation of the system as MSS permits to implement reliability examination in more details but has higher complexity. There are various types of the mathematical representation of a system for BSS and MSS that depends on the mathematical approach used for system reliability

evaluation (i.e. mathematical approach for the calculation of reliability indices and measures). The structure function is one of the possible mathematical representations of MSS. New algorithm for structure function construction is considered in this paper. This algorithm is based on the minimization of the structure function truth table, taking into account the principle of orthogonalization. The formed minimal truth table is transformed into Multi-Valued Decision Diagrams (MDD) directly. MDD is used for analysis of extensive dimension data in Algebra Logic (Multiple-Valued Logic). MDDs have been successfully used in reliability computation due to their compact and easy representation of structure function.

Hamiltonian Monte Carlo method for parameterestimation of the additive Weibull distribution

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The additive Weibull distribution published in reliability literature is a simple model based on adding two Weibull survival functions. This four-parameter model seems to be flexible enough for modeling lifetimes possessing bathtub shaped failure rate. Most research publications, however, have provided poor results when fitting this model to real data sets that exhibit bathtub-shaped failure rate. In this study, we exploit the Hamiltonian Monte Carlo and cross-entropy methods in order to reinforce and strengthen the traditional methods of statistical estimation. Our results show the superiority of the recommended estimation methods over the others when fitting additive Weibull model to a real data set.

On Robust Markov Analysis for Reliability Assessment of Complex Systems using Imprecise Markov Chains

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Markov analysis is a wide-spread tool for modelling interactions among components in complex systems. It is based on modelling the evolution of system's component states by Markov Chains. But, as in many other uncertainty models, it might often be overly optimistic to assume that we can construct a precise stochastic model which properly captures the uncertainties present in the investigated system. This issue is addressed by the theory of Imprecise Probabilities and, specifically for stochastic processes, by the theory of Imprecise Markov Chains. In this paper, we will demonstrate how Imprecise Markov Chains can not only serve as a robust alternative to classical stochastic models, but also how they can facilitate analyses by the means of problem dimension reduction and also, by the means of deliberate model construction, enable analyses which would not be possible by using solely precise probability models.

Keywords: System Reliability, Imprecise Markov Chains, Survival Signatures, Robust Bayesian Inference.

Improvement of production process parameters on the surface treatment line by using TX Plant Simulation software tool

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The paper deals with the evaluation of properties and improvement of parameters on the steel surface treatment line. Using the Tecnomatix Plant Simulation simulation module, we processed the production process in the original line condition. We focused on production problems and customer requirements that the company is currently unable to meet flexibly. For better line flexibility, we have designed and simulated the unification of the manufacturing process of two finishes into one concurrent process. The proposal consists of a handling crane expansion at the production line about for next track and hoist. Each hoist would thus concurrently serve at one manufacturing process, thus maintaining continuity both production processes. Moreover, it has increased its daily production of processed batches on the line.

Keywords— Surface Treatment, Alkaline Blackening, Phosphating of zinc, Simulation, Flexibility, Plant Simulation

Section RaST3: Reliability and Safety Technologies

Performance, Reliability and Scalability for IoT

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So-called IoT, based on use of enabling technologies like 5G, Wi-Fi, BT, NFC, RFID, IPv6 as well as being widely applied for sensor networks, robots, Wearable and Cyber-PHY, invades rapidly to our every day.

There are a lot of apps and software platforms to IoT support. However, a most important problem of QoS optimization, which lays in Performance, Reliability and Scalability for IoT, is not yet solved. The extended Internet of the future needs these solutions based on the cooperation between fog and clouds with delegating of the analytics blocks via agents, adaptive interfaces and protocols.

The next problem is as follows: IoT can generate large arrays of unmanaged, weakly-structured, and non-configured data of various types, known as "Big Data". The given papers deals with the both problems. A special problem is Security and Privacy in potentially "dangerous" IoTscenarios. Anyway, this subject needs as special discussion for risks evaluation and cooperative intrusion detection. Some advanced approaches for optimization of Performance, Reliability and Scalability for IoT-solutions are offered within the paper. The paper discusses the Best Practises and Case Studies aimed to solution of the established problems.

Keywords — Performance, Reliability and Scalability, QoS for IoT, Cloud and Fog, Robotics, Industry 4.0, 5G, Big Data Analytics, Machine Learning.

Estimating the reliability of mechatronic devices and systems with fixed and variable working structure

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The study presented the methodology for estimating the reliability of mechatronic devices and systems with fixed and variable working structure.

It assumed a parametric and catastrophic nature of damages in the system's elements. The analysis of the reliability of mechatronic structure with fixed and variable working structure took into account system's elements with exponential damage distribution and Weibull's damage distribution. The further part of this article described the reliability characteristics for two-component parallel mechatronic systems. It particularly considered cases, when the up time of technical system's elements have the following distributions: exponential, Weibull, normal, logarithm-normal, and the system consists of two components with parallel structure of reliability and different types of distribution for elements' up times. The order of elements in the analysis does not matter. The following reliability characteristics for the system with two components connected in parallel were presented: system's up time distribution function, reliability of the system, density of probability for system's up time, intensity of system's damages.

Keywords—Mechatronic system, Distributions of elements' damages, Distribution of damages for technical systems, Estimation of reliability

Importance Analysis of Multi-State System Based on Incompletely Specified Data by Multi-Valued Decision Diagrams

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The evaluation of system reliability is implemented by the set of reliability indices and measures. Every of them reflects specific properties of system reliability. Importance measures are group of reliability indices that show influence of state change of fixed component to system reliability. There are many algorithms to calculate these indices. These algorithms are developed for completely specified data. In many cases, not all information about analyzed system is available. In this paper new method for calculation of Importance Measures based on incompletely specified data. This method is based on the definition of analyzed system mathematical model in form of structure function that defines the correlation of system reliability and its components states. The structure function is represented by Multi-Valued Decision Diagram (MDD). MDD is inducted by the algorithm that is used for the decision tree induction based on incompletely specified data. Available data of system are used in order to build decision tree. The decision tree is

transformed into MDD. MDD allows calculation Importance Measures. In this paper the developed method is used to analyze dataset of patients with hepatitis in reliability point of view, specifically Structure Importance was calculated for each component.

A Method for Determining Priorities Between Competing Interval-Valued Estimates of Experts

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Experts may differ in their estimates while making a decision. Therefore, how to aggregate opinions of different experts is still an open issue. The paper deals with the problem of priorities for competing interval-valued estimates made by different experts. The simple method of determining priorities is proposed. The procedure of the method includes separate aggregation of estimates of probabilities of opposite hypotheses and subsequent comparison of aggregated estimates. An aggregation is performed by solving an optimization task. A numerical example is used to illustrate proposed method.
Keywords—expert, decision-making, interval number, distance metric, aggregation

Sections D2. Dynamical Systems and Real World Applications

Energy Losses Reduction in the Medium VoltageCable Line – Case Study

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The paper presents an analysis of energy losses in a power cable system, which is composed of two 30 kV cable lines. This cable system is located at the seaside holiday area, so the load profile during a year is specific. Energy losses related to reactive power transmission, as well as to currents induced in the sheaths of the cables, are subject to analysis. Measurements were made in the system in order to prepare a computer model for calculation of current flow in the cable cores and the metallic sheaths, as well as to calculate power and energy losses. As a result of the conducted analyzes, the methods leading to the reduction of energy losses are shown, and potential savings related to them are revealed.

Keywords—cable line, energy losses, induced sheath currents, shunt reactor

Accelerated Exhaustive Algorithm Implementation for Channel Assignment in 802.11 Networks

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The 2.4 GHz band is still heavily used for domestic wireless networks. As the band offers only three non-overlapping channels, in crowded environments, users can suffer from high interference level. To minimize the total interference, an exhaustive channel assignment algorithm, able to find the optimal assignment, can be considered. However, its exponential complexity makes it impractical for sets larger than just several access points (APs). In this paper, a few modifications are introduced which speed up the basic algorithm execution without deteriorating its optimality. The modifications

are divided into implementation-related and algorithm-related. Introduced improvements result in over 20 times speed-up of the algorithm execution making it possible to find the optimal channel assignments for over 20-AP sets in minutes instead of hours.

Keywords—802.11 home networks, channel assignment, exhaustive algorithm

Testing of a prototype of a two-segment low-speed generator with permanent magnet for a lower-power wind farm

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Development and growth and the popularity of low power wind turbines makes us pay attention to this alternative way of obtaining electricity. The article presents the first results of testing for a prototype of a two-segment low-speed generator with neodymium magnets cooperating with a wind turbine with a vertical axis of rotation. Experimental studies have been carried out in order to determine the generator's parameters based on the characteristics of an idle speed and the external characteristics of the generator. The generator's energy properties have been presented in the analytical and simulation studies. The article presents the results of researches, which enable to determine in which acceptable limits the generator can operate, maintaining the required electrical power.

Keywords—wind energy; permanent magnet synchronous generator; vertical wind turbine; active rectifier.

Properties of Bent Functions in the Truth Domain

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In this paper, we study bent functions in the truth vector domain. While in general bent functions are defined on the Walsh basis [−1, 1] we look on their properties and classification in the standard Boolean basis [0, 1]. We show that applying the Welsh transform to Boolean functions of n variables in the

truth domain, results in a classification that allows to rank bent functions. We investigate the classification of bent vs non bent functions using standard machine learning and compare the performance difference. Finally, we extend our search for efficient classification criteria to functions with smaller amount of variables and show the amount of classification possible.

Moving Image Scene Recognition and Its Application to Highly-Safe Intelligent Systems

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High-accuracy recognition of dangerous scenes from the input image information, is essential to realize a highly safe intelligent system which autonomously makes danger avoidance in the real-world environment where human lives. There are many kinds of dangerous scenes which can be recognized by using moving images such as a violence scene. In this paper, optical flow between adjacent frames for an input moving image is represented by an RGB image. A still image obtained by converting a frame at a certain time into grayscale is superposed with the RGB optical flow image. For the superposed image at each time, a scene recognition result can be obtained by combining a convolutional neural network for extracting features and a support vector machine for classification. By taking majority of these scene recognition results, high-accuracy scene recognition for a moving image can be achieved.

Remarks on the Subject of Back-Up Protection of Residual Current Devices

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Residual current devices without integral overcurrent protection (RCCBs) are back-up protected by fuses or miniature circuit-breakers (MCBs). If the latter are used, special attention must be given to the coordination between an RCCB and an MCB. This paper indicates probable cases of the aforementioned devices coordination, in which back-up protection of the RCCB is not adequate. A laboratory test has shown that depending on the used type of the MCB, in case of value of short-circuit current close to the making and breaking capacity of an RCCB, excessive arc stress of the RCCB may occur. In case of short-circuit current of value close to the rated conditional short-circuit current of the RCCB, permissible values of peak current and Joule integral for the RCCB may be exceeded. All these stresses may limit electrical endurance of RCCBs.

Keywords—back-up protection, circuit-breaker, RCCB, shortcircuit

Voltage Control in a Power System with Renewable Sources of Energy

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Intensive development of distributed generation in power systems, caused by the European Union energy policy, gives possibility for improving safety in power delivery as well as optimizing the costs of the systems functioning. In this context, distributed generation can be used for voltage control in power systems – it can be performed by the control of reactive power of each source of energy or a group of energy sources. This paper presents a method

of renewable energy sources control, with the use of a supervisory control system, which operation utilizes fuzzy logic. This control system allows to improve the voltage in the power system – analyzes voltage levels at selected points of this system and affects a group of renewable energy sources.

Keywords—fuzzy logic, power system, reactive power control, renewable sources of energy, voltage control

Reliability Analysis of Finite-Source Retrial Queues with Outgoing Calls Using Simulation

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The aim of this paper is to create a simulation program in order to examine systems of two-way communication by the help of retrial queuing systems with finite source. Primary customers arrive from a finite source to the server according to exponential distribution. If an incoming customer discovers the server in an idle state then its service begins right away. Otherwise, if the server is busy or in failed state arriving primary customers move into the orbit and after some random time they try to reach the server. Whenever the server becomes idle it produces an outgoing call after an exponentially distributed time from the infinite source. If no primary customer arrives either from the finite source or from the orbit and the server functions until its arrival then it enters to the system. Otherwise, the outside call is cancelled. Several scenarios are distinguished when the server is in failed state and in this work we concentrate on comparing various distributions of service time of primary customers and failure probability of the server. The novelty of the investigation is to analyze such system with non-reliable server. Various figures illustrate comparison of using different scenarios showing the mean waiting time of primary customers and the Utilization of the server obtained by simulation.

Keywords —retrial queues, finite-source queuing system, server breakdowns and repairs, simulation, two-way communication.

Human Machine Interface for a PhotovoltaicElectricity Station

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This paper presents a Human Machine Interface (HMI) applied for a command and control system used for an existing 0.8 MW photovoltaic station, which has no automation system before, located in the Giroc Area, near Timisoara Romania. The solution proposed consists in a SCADA system used in order to control some parameters like rated active/reactive power, power factor, voltage waveform and values, current limits. The refurbishment of this power station imposed the existence of a friendly and easy to use HMI, based on the existing specific data bases which could provide more info, at the dispatcher level of the implemented SCADA system. This interface was conceived using Visual C and provides synoptic maps, time evolution graphs, alarm windows or event reports.

Keywords—SCADA, Photovoltaic Station, Human Machine Interface

Digital Mapping of Electric Field inside High VoltagePower Stations

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In the vicinity of each high voltage overhead line or high voltage power equipment, placed or not inside power stations, high values of the electric field intensity (and/or magnetic field induction) could appear sometimes, too. A lot of preventive safety activities, both for the environment, as well as for the human operators, are necessary. A true and fair assessment of the electric field intensity in the proximity of these facilities is mandatory, before adopting some new design features or limiting the human exposure. This paper will present a few measurements of the electric field intensity, performed by our team at the Fantanele 220 kV/110 kV/20 kV Power

Station, located in Central Transylvania, Romania, belonging to the National Romanian Power Grid Operator, TRANSELECTRICA S.A. Our case study will also be completed with some electric field measurements, for a better perspective on the electromagnetic field parameters. Data will also be used for the refurbishment of the existing power facilities across Romania and for a future digital mapping of this high-risk power objectives.

Section C: *Computer-aided Modelling*

Computer-Aided Analysis of Mechanical Safety of Stadiums for the World Cup 2018 in Russia

Part 1: Introduction, Creation of Finite Element Models, Structural Analysis at Basic Combinations of Loads and Impacts

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The presented series of papers deal with theoretical foundations and the results of numerical simulation of the state of football stadiums built for the World Cup 2018, which was held in Russia. In particular, stress-strain state determination, strength analysis and stability analysis of the corresponding objects are under consideration. The distinctive paper describes some features of the creation of appropriate correct computational models and some problems and achievements in the field of structural analysis at basic combinations of loads and impacts.

Keywords—mathematical modelling, numerical modelling, computer-aided modelling, numerical methods, finite element method, mechanical safety, finite element models, football stadium

Computer-Aided Analysis of Mechanical Safety of Stadiums for the World Cup 2018 in Russia

Part 2: Structural Analysis at Special Combinations of Loads and Impacts, Structural Health Monitoring

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The presented series of papers is devoted to the theoretical foundations and the results of numerical simulation of the state of football stadiums built for the World Cup 2018, which was held in Russia. In particular, stress-strain state determination, strength analysis and stability analysis of the corresponding objects are under consideration. The distinctive paper describes some problems and achievements in the field of structural analysis at special combinations of loads and impacts. Besides, original approach to structural health monitoring (SHM) of such unique buildings is presented

Keywords—mathematical modelling, numerical modelling, computer-aided modelling, numerical methods, finite element method, mechanical safety, finite element models, football stadium, structural health monitoring

Performance Analysis for Statistical Testing of Random and Pseudorandom Generators by Entropy Statistics

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The topical problem of performance analysis for statistical testing of "pure randomness" for random and pseudorandom cryptographic generators is considered. Statistical tests based on statistical estimators of Rényi and Tsallis entropy functionals for the observed output sequences with some fixed asymptotic significance level are used. To evaluate asymptotic values of power for these tests we consider two useful in practice families of "pure randomness" alternatives. The first one describes the mathematical model of a pseudo-random sequence generator that is close in its probabilistic properties to the "pure random" sequence. The second one is the Markovian alternative. For the alternative hypotheses, asymptotic probability distributions of entropy estimators are also found. Estimates of the power of the developed tests are calculated.

Keywords—Rényi entropy, Tsallis entropy, cryptographic generator, hypotheses testing, family of alternatives, power of a statistical test, Markov chain.

Section RaST5: Reliability and Safety Technologies

An Approach to Longtime Safety and Resilience Prediction of Critical Infrastructure Influenced by Weather Change Processes

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The article is created in aim to presented the weather hazard impacts on the critical infrastructure resilience and safety. The base of the introduced model is a critical infrastructure multistate safety modeling joined with a semi-Markov model of the weather change processes and the approximation of future proportions of the weather change processes sojourn times considering the climate change. Using the proposed model to predict the safety and resilience of critical infrastructures affected by the weather hazards is recommended.

Keywords—climate change; critical infrastructure; resilience; safety; weather hazards influence; resilience and safety indicies; long-time forecasting

Evaluating Reliability of a Multi-fleet with a Reserve Drone Fleet: an Approach and Basic Model

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A matrix of drone fleet reliability assessment attributes is presented. Policies of failed drone recovery by redundant drones are formulated. A structure of a multi-fleet, consisting of main drone fleets and a reserve drone fleet, is suggested and described by means of the matrix attributes. A reliability block diagram for the multi-fleet is built. Based on the diagram, equations for probability of the multi-fleet failure-free operation, taking into account the reserve drone fleet structure, is obtained. Using the obtained recurrent equations, reliability models for the multi-fleet with the reserve drone fleet are developed and examined.

Keywords—multi-fleet; main drone fleet; reserve drone fleet, reliability; matrix; monitoring; multi-state system

Monte Carlo Simulation Based Optimization of Port Grain Trasportation System Reliability

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In this paper, there is presented a simulation technique which is related to a system reliability under operation conditions that varies over time. The Monte Carlo (MC) simulation is implemented and as a consequence, the parameters that are unknown for port grain transportation system (PGTS) operation process (OP) and there are identified its crucial reliability characteristics. There are also determined transient probabilities which are optimal for this OP at its distinct states and an optimal unconditional reliability function (OURF). At last, there are proposed several suggestions concerned with an OP modification to improve the reliability.

Keywords— optimization, operation process, simulation, reliability

Stochastic Determination of Oil Spill Domain at Gdynia Port Water Area

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The paper is devoted to determination of oil spill domain at the sea water areas in changing hydro-meteorological conditions. The method based on a probabilistic approach to oil spill domain determination and a semi-Markov modelling of the process of changing hydro-meteorological conditions at the port and sea water areas is proposed to the determination and prediction of oil spill domain and its movement at Gdynia Port water area.

Keywords—accident, oil spill, oil spill drift, oil spill domain, hydro-meteorological conditions, impact, stochastic prediction, Gdynia Port

The Longtime Safety and Resilience Prediction of the Baltic Oil Terminal Critical Infrastructure Impacted by Weather Changes

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The paper is concerned with an application of the weather change processes impact model of the critical infrastructure safety and resilience considering the climate change to safety and resilience prediction for the Baltic Oil Terminal critical infrastructure operating at the variable weather conditions. There are presented main Baltic oil terminal safety parameters and there is prepared the prediction of the weather change processes future characteristics. Finally, using coefficients of the weather impact on the Baltic oil terminal assets intensities of ageing evaluated by experts, there are evaluated various safety and resilience indicators of the Baltic Oil Terminal critical infrastructure impacted by the weather changes processes.

Keywords—resilience; safety; weather hazards impact; safety and resilience indicator; longtime prediction; Baltic Oil Terminal critical infrastructure

Monte Carlo Simulation Applied to Oil Spill Domain at Gdynia Port Water Area Determination

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The paper is devoted to oil spill domain determination in changing hydro-meteorological conditions. A semi-Markov model of the process of changing hydro-meteorological conditions is assumed and the Monte Carlo simulation method is proposed to the determination of oil spill domain prediction. There are presented appropriate formulae for generating states of the process of changing hydro-meteorological conditions and the formulae to determine the realizations of the empirical conditional sojourn times. Next, the oil spill domain in varying hydro-meteorological conditions and its movement are modelled generally and particularly predicted for the Gdynia Port water area.

Keywords— Gdynia Port, accident, oil spill, oil spill drift, oil spill domain, hydro-meteorological conditions, impact, Monte Carlo simulation