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LIST OF AUTHORS AND CONTRIBUTIONS WITH ABSTRACTS

1. Recent soft computing methods in software reliability engineering

Albeanu Grigore, Duda Gheorghe

Keywords

fuzzy sets, intuitionistic fuzzy sets, intuitionistic fuzzy numbers, subjective data analysis

Abstract

This paper presents recent approaches in soft computing to manage imprecision and uncertainty which appear in software reliability engineering. Firstly, recent approaches like imprecise probabilities, generalized intervals, fuzzy sets and intuitionistic-fuzzy sets are shortly described, and the usage of intuitionistic fuzzy numbers for system reliability computation is shown. Intuitionistic-fuzzy approaches for software reliability growth models are proposed and experimental results are given.

2. Safety and reliability models of time-dependent systems

Babczyński Tomasz, Kowalski Marcin, Łukowicz Mirosław, Magott Jan, Skrobaneek Paweł

Keywords

dynamic reliability, maintenance process, fault tree with time dependencies, activity diagram

Abstract

The paper concerns models with time dependencies that can be used in modelling dynamic reliability and complex maintenance processes. Emphasis is put on models that have been elaborated with authors participation. The following models are presented: fault trees with time dependencies, probabilistic fault trees with time dependencies, reliability enhanced activity diagrams. The above models are illustrated by examples. Both types of fault trees are used in modelling the time coordination of distance protections in high voltage transmission line. Then reliability enhanced activity diagrams that express the maintenance process of computer system with redundant components. Components are submitted to failures and repairs.

3. Assessing external explosions and their probabilities

Berg Heinz-Peter, Hauschild Jan

Keywords

external explosion, explosion pressure waves, Monte Carlo simulation, probabilistic safety assessment

Abstract

External hazards such as explosions can be safety significant contributors to the risk in case of operation of industrial plants. The procedure to assess external hazard explosion pressure waves within probabilistic safety assessment starts with a screening procedure in order to determine scope and content of the assessment. The second step is to choose an appropriate approach in case that a full scope analysis has to be performed. Several methods can be applied to evaluate the probability of occurrence of an external explosion event. The presented results indicate that the probability of occurrence of external explosion pressure waves can be successfully assessed by means of the Monte Carlo simulation, in particular in difficult site-specific conditions.

4. Computer-aided identification of complex technical systems operation processes

Blokus-Roszkowska Agnieszka, Guze Sambor, Kołowrocki Krzysztof, Soszyńska-Budny Joanna

Keywords

operation processes, statistical identification, complex systems, transport system

Abstract

In the paper, the procedures of the identification of complex technical system operation process and identifying the distributions of the system conditional sojourn times in the operation states are described. Furthermore, the computer program for identification of the operations processes capabilities with description are presented. As the application of this computer program, the identification of the ferry technical system operation process is shown.

5. Computer-aided characteristics prediction of complex technical systems operation processes

Blokus-Roszkowska Agnieszka, Guze Sambor, Kołowrocki Krzysztof, Soszyńska-Budny Joanna

Keywords

operation processes, prediction, complex systems, transport system

Abstract

In the paper, the procedures of the prediction of complex technical system operation process' characteristics are described. Furthermore, the computer program for prediction of the operations processes capabilities with

description are presented. As the application of this computer program, the characteristics' prediction of the port oil transportation technical system operation process is shown.

6. Computer-aided prediction of the renewal and availability characteristics of complex technical systems

Blokus-Roszkowska Agnieszka, Guze Sambor, Kołowrocki Krzysztof, Soszyńska-Budny Joanna

Keywords

reliability, large system, availability, renewal , prediction

Abstract

The procedures of defining the parameters of the availability of the multistate systems in variable operation conditions are shown. Furthermore, the renewal and availability characteristics of the complex technical system are defined. The computer program for prediction of these characteristics capabilities with description are presented. As the application of this computer program, the prediction the renewal ad availability characteristics of the exemplary complex technical system is shown.

7. Computer aided prediction of improved complex technical systems reliability

Blokus-Roszkowska Agnieszka, Kołowrocki Krzysztof

Keywords

reliability analysis, system improvement, reserved components, reduced intensities, computer program

Abstract

In the paper there is presented the computer program for reliability analysis of complex technical systems with reserved and improved components along with computer program description and application. The computer program allows for automatic reliability characteristics prediction of the improved complex technical systems with hot and cold single reservation of their components and of the improved complex technical systems with reduced intensities of departure from the reliability state subsets of their components. Under the assumption that system components have exponential reliability functions, the unconditional reliability function, the mean values and standard deviations of the unconditional lifetimes in the reliability state subsets and in particular reliability states, the system risk function and the moment when the system risk exceeds a permitted level of the complex technical systems before and after their improvement are determined.

8. Integrated software tools supporting decision making on identification, prediction and optimization of complex technical systems operation, reliability and safety - Part 1- Integrated software tools description

Blokus-Roszkowska Agnieszka, Kołowrocki Krzysztof, Fu Xiuju

Keywords

reliability, identification, prediction, optimization, technical systems, software tools

Abstract

The paper is composed of six parts and presents the software tools created in the scope of the Poland-Singapore Joint Research Project, the Integrated Safety and Reliability Decision Support System - IS&RDSS. In the paper first part, there are briefly described all computer programs with pointed aims. Dependencies between computer programs and possible transitions using this integrated package of software tools are presented at the scheme-algorithm. In the remaining paper parts, there is presented the application of the computer programs, being in the package of software tools, to the reliability analysis of an exemplary complex technical system.

9. Integrated software tools supporting decision making on identification, prediction and optimization of complex technical systems operation, reliability and safety- Part 2 - Integrated software tools application – Exemplary system operation and reliability unknown parameters identification

Blokus-Roszkowska Agnieszka, Kołowrocki Krzysztof, Fu Xiuju

Keywords

system operation process, reliability parameters, identification, software tools

Abstract

There is presented the application of the integrated software tools to the operation and reliability models of an exemplary complex technical system unknown parameters identification. There are performed in the paper, the exemplary system operation and reliability analysis and modelling. The identification of the probabilities of transitions this system operation process between the operation states and the conditional mean values of this process sojourn times at the particular operation states because of the lack of statistical data is performed through the arbitrary fixing their values assumption. Next using the computer program CP 8.3 the automatic evaluation of the system components unknown intensities of departures the reliability state subsets and the identification of the exponential forms of their multistate reliability functions on the arbitrarily fixed statistical data coming from the system components states changing processes are performed as well.

10. Integrated software tools supporting decision making on identification, prediction and optimization of complex technical systems operation, reliability and safety - Part 3 - Integrated software tools application – Exemplary system operation and reliability characteristics prediction

Blokus-Roszkowska Agnieszka, Kołowrocki Krzysztof, Fu Xiuju

Keywords

system operation process, reliability characteristics, availability, prediction, software tools

Abstract

There is presented the application of the integrated software tools to the operation and reliability of an exemplary complex technical system prediction. The computer program CP 8.5 is used to determine the unconditional mean sojourn times and the limit transient probabilities of the exemplary system operation process at the particular operation states evaluations. Using the computer program CP 8.6 there are performed the evaluations of the exemplary system unconditional multistate reliability function, the expected values and the standard deviations of its unconditional lifetimes in the reliability state subsets and the mean values of its lifetimes in the particular reliability states. Finally, in the case when the system is repairable, its renewal and availability characteristics are estimated from the results of computer program CP 8.8.

11. Integrated software tools supporting decision making on identification, prediction and optimization of complex technical systems operation, reliability and safety - Part 4 - Integrated software tools application – Exemplary system operation and reliability optimization

Blokus-Roszkowska Agnieszka, Kołowrocki Krzysztof, Salahuddin Habibullah Mohamed

Keywords

operation process optimization, optimal characteristics, reliability, availability, renewal, software tools

Abstract

There is presented the application of the integrated software tools to the operation and reliability of an exemplary complex technical system optimization. First using the computer program CP 8.9 there are determined the optimal limit transient probabilities of the exemplary system operation process at the particular operation states maximizing the system lifetime in the reliability states not worse than the critical reliability state and its optimal sojourn times at the particular operation states. Program CP 8.9 allows also for automatic evaluation of the exemplary system optimal unconditional multistate reliability function, the optimal expected values and standard deviations of its unconditional lifetimes in the reliability state subsets and the optimal mean values of its lifetimes in the particular reliability states. Moreover, in the case when the system is repairable, its optimal renewal and availability characteristics are obtained using the computer program CP 8.11.

12. Integrated software tools supporting decision making on identification, prediction and optimization of complex technical systems operation, reliability and safety - Part 5 - Integrated software tools application – Improved exemplary system operation and reliability characteristics prediction

Blokus-Roszkowska Agnieszka, Kołowrocki Krzysztof, Salahuddin Habibullah Mohamed

Keywords

system improvement, reliability characteristics, availability, software tools

Abstract

There is presented the application of the integrated software tools to the reliability of the improved exemplary complex technical system prediction. There are considered three ways of the exemplary system reliability improvement, i.e. a hot single reservation of its components, a cold single reservation of its components and replacing its components by the improved components with reduced intensities of departure from the reliability state subsets. Automatically obtained, using the computer program CP 8.16, the evaluations of these ways improved exemplary system unconditional multistate reliability function, the expected values and the standard deviations of its unconditional lifetimes in the reliability state subsets and the mean values of its lifetimes in the particular reliability states are presented. Moreover, in the case when the improved system is repairable, its renewal and availability characteristics are estimated using the computer program CP 8.8 with appropriately given data.

13. Integrated software tools supporting decision making on identification, prediction and optimization of complex technical systems operation, reliability and safety - Part 6 - Integrated software tools application – Exemplary system operation cost analysis and maintenance optimization

Blokus-Roszkowska Agnieszka, Kołowrocki Krzysztof, Salahuddin Habibullah Mohamed

Keywords

system operation process, optimization, cost analysis, corrective and preventive maintenance, software tools.

Abstract

The integrated software tools are applied to the exemplary system operation cost analysis and maintenance optimization. Using the computer program CP 8.12 there is obtained the evaluation of the cost before and after

the exemplary system operation process optimization and next the computer program CP 8.13 is applied for operation cost analysis of the improved exemplary system. The methods of corrective and preventive maintenance policy maximizing availability and minimizing renovation cost of the complex technical systems in variable operation conditions are illustrated for the analyzed exemplary system using equivalently the computer program CP 8.14 for maintenance policy maximizing system availability and CP 8.15 for minimizing system renovation cost.

14. Survival analysis on data of different surgery techniques to evaluate risk of postoperative complications

Briš Radim, Praks Pavel, Janurová Kateřina, Martínek Lubomír

Keywords

colectomy, censored medical survival data, comparison of surgery techniques

Abstract

Medical survival censored data of about 850 patients are evaluated to compare two basic surgery techniques. Data comes from patients who underwent colectomy in the University Hospital of Ostrava. The data has been screened into three general groups: all patients (data from both rectum and colon operations), data from rectum operations, data from colon operations. Two basic surgery techniques are used for the colectomy: either classical (open) or laparoscopic operation. Basic question which arises at the colectomy operation is which type of operation to choose to guarantee longer overall survival time. Two methodological approaches have been used to answer this relevant question. First is the non-parametric approach which results from Kaplan-Meier estimates of the survival function. For each data group two survival curves are constructed, i.e. for both open and laparoscopic type of operation. Final survival curves are compared and evaluated using advanced methods of statistical inference (e.g. log-rank test). Second is parametric approach which results from modelling of survival time. It is based on Maximum Likelihood Estimation method to estimate parameters of probability distribution of overall survival time. Moreover, two Weibull models are used to compare the two surgery techniques. Mean survival times assigned to particular types of operation are compared.

15. Nonparametric predictive inference in reliability and risk: recent developments

Coolen Franc

Keywords

competing risks, imprecise reliability, lower and upper probability, nonparametric predictive inference, system reliability, unobserved or unknown failure modes

Abstract

During the last two decades, statistical methods using lower and upper probabilities have become increasingly popular. One such method is Nonparametric Predictive Inference (NPI), which makes relatively few modelling assumptions. Due to the specific nature of many reliability and risk scenarios, NPI provides attractive new solutions to many problems in these fields. This paper provides an introductory overview to this area, including examples on competing risks, system reliability and prediction of unobserved or even unknown failure modes.

16. Nash-lambda algorithm with applications in safety and reliability

Cui Yanhong, Guo Renkuan

Keywords

lambda algorithm, Nash equilibrium, genetic algorithm, safety, reliability, terrorist threat

Abstract

In this paper, a new algorithm, named as Nash-lambda algorithm by merging Nash equilibrium solution and the lambda algorithm, is proposed. The lambda algorithm, a new global optimization algorithm, is created by imitating ancient Chinese human body system model, which has already demonstrated its simplicity in searching scheme, codes and efficiency in computation comparing to the genetic algorithm. The non-corporative game environments determine the optimization problems which are different from those of the traditional safety and reliability optimizations because of the engagement of the Nash equilibrium for seeking the best strategy. The lambda algorithm serves the searching the Nash equilibrium solution efficiently. In other words, the Nash-lambda algorithm is just developed to address the optimization problems of the multiple objective functions representing non-corporative players' interests.

17. Lambda algorithm and maximum likelihood estimation

Cui Yanhong, Guo Renkuan, Guo Danni

Keywords

lambda algorithm, genetic algorithm, reliability, repairable system, likelihood-lambda procedure, reliability

Abstract

In this paper, a new global optimization algorithm by imitating ancient Chinese human body system model,

named as lambda algorithm, is introduced. The lambda algorithm utilizes five-element multi-segment string to represent the n -dimensional Euclidean point and hence the string based operation rules for expansion, comparison and sorting candidate strings. The algorithm enjoys the simplest mathematical operations but generates highest searching speed and accuracy. We furthermore explore to merge the lambda algorithm with maximum likelihood procedure for creating a non-derivative scheme - likelihood- lambda procedure. A illustrative example is given.

18. Apply FMEA modeling to a floating ecological desalination unit

Dagkinis Ioannis, Lilas Theodoros, Nikitakos Nikitas

Keywords

FMEA, reliability block diagram, floating autonomous desalination

Abstract

Water scarcity in small Aegean islands is considered a major problem for their development. On the other hand high potential renewable energy sources are available. Therefore a floating desalination unit was developed in order to treat the problem in an ecological manner. The floating unit has been operating for four years at sea close to a small island. Marine environment and autonomous remote operation led to a more complex design with several sensors and safety mechanisms. This paper illustrates and applies Failure Modes and Effects Analysis (FMEA) modeling to Floating Ecological Desalination Unit. FMEA is based on monitoring data and also taking into account failure dependencies between components during the assessment of desalination system reliability. Then two systems, one with safety mechanisms and one without are analyzed by Reliability Block Diagrams (RBD) and the reliability of each system is computed. The comparison between a simple system and the remote autonomous system illustrates the implications of the additional monitoring mechanisms and the impact of these mechanisms to reliability and risk assessment on the floating wind powered offshore desalination unit.

19. Time-dependant modelling of systems: some open questions

Eid Mohamed

Keywords

system, reliability, failure, state, critical, transition, Boolean, graph

Abstract

Time dependent modelling of complex system is one of the important topics in system reliability engineering. Although system complexity is increasing, the existing models are numerically satisfactory. However, some formal development is still lacking in reliability theory. A full system time-dependency modelling and analysis is not possible without some formal answers on critical transitions and related issues. This is still one of the open questions in system reliability theory. Some promising development relative to critical states is given in this paper with an application case.

20. Monitoring/detection systems: reliability based performance assessment

Eid Mohamed

Keywords

monitoring, detection, system, modelling, performance, reliability, assessment

Abstract

Monitoring & Detection (M&D) systems are introduced in almost all daily life aspects. Today, it is unlikely to find out a system that is not equipped with a sort of M&D apparatus, even the most ordinary and uncritical systems. Objective assessments of the performances of M&D systems are increasingly needed. Performance assessment may be motivated by commercial interests or by certification concerns if the application field is ordinary or uncritical. While, if the application field is critical, safety and security aspects may become the major focus. The paper classifies in three classes the models that are the most-frequently used to describe M&D systems. The author proposes for each class a suitable indicator of performance based on M&D-systems reliability targets.

21. Semi-Markov model of system damage process

Grabski Franciszek

Keywords

reliability, multi-state, semi-Markov, damages processes

Abstract

The reliability characteristics and parameters of multi-state systems modelled by the finite states regress characteristics and parameters of multi-state systems modelled by the finite states regress semi-Markov processes are investigated in the paper. Presented here models deal with un-repairable systems. The essential concepts of discrete states and continuous time semi-Markov process theory deliver. Mathematical apparatus for

models constructions and analysis. Multi-state reliability functions and corresponding expectations, second moments and standard deviations are calculated for the presented systems.

22. Navigational risk management with under-keel clearance consideration

Gucma Lucjan, Schoeneich Marta

Keywords

risk management, under-keel clearance, decisionmaking, Monte Carlo model

Abstract

The paper presents idea of the safety management system established for safety UKC (under-keel clearance) for ships entering to ports. System consists of three components which can be used for navigational risk management during decision making in port. Application of newly system was presented for example research which carried out by Marine Traffic Engineering team for Ystad port.

23. Lifetime distributions with wave-like bathtub hazard

Guo Renkuan, Thiart Christrien, Cui Yanhong, Guo Danni

Keywords

lifetime distribution, hazard, bathtub hazard, likelihood function, maximum likelihood estimation

Abstract

In this paper, we argue the necessity of dealing with lifetime distributions with wave-like bathtub hazard function. Four classes of wave-like bathtub hazards are investigated. For preparing maximum likelihood estimation of the hazard parameters, the first-order and second-order partial derivatives are derived.

24. Methods for risk minimizing in the process of decision-making under uncertainty

Guze Sambor, Smolarek Leszek

Keywords

risk, optimization, decision process, uncertainty

Abstract

The sources of the uncertainty in the maritime transport system are described. Furthermore, the two models for human factor reliability are presented. The possibilities of mixed these two methods as the estimators for the probability of correct performance of the navigator are given. The analysis of decision-making process under uncertainty has been done. Finally, the optimization task and his possible solution are shown.

25. The model of reusability of series system product

Jodejko-Pietruczuk Anna, Plewa Marcin

Keywords

reliability, reverse logistics, reuse

Abstract

The main goal of this paper is to create the reverse logistics model that uses reliability theory to describe reusability of product parts with assumption that recovered components are used in production process but they aren't as good as new ones. The model allows to estimate the potential profits of the reusing policy in a production and gives the base to optimize some of the process parameters: the threshold work time of returns or the warranty period for products containing reused elements.

26. Computer aided prediction of complex technical systems operation cost

Kołowrocki Krzysztof, Mazurek Jolanta, Soszyńska-Budny Joanna

Keywords

complex technical system, operation process optimization, operation cost analysis, transportation system

Abstract

There is presented the computer program is based on methods and algorithms for prediction of the operation cost of the complex technical system in variable operation conditions. The program allows to determine of the costs of the non-repairable and repairable complex technical systems before and after their operation processes optimization. The procedure of the computer program use and its application to operation cost analysis of the port oil transportation system are given.

27. Computer aided operation cost prediction of complex technical systems with reserve and improved components

Kołowrocki Krzysztof, Mazurek Jolanta, Soszyńska-Budny Joanna

Keywords

complex technical system, operation process optimization, operation cost analysis, improved system

Abstract

There is presented the computer program based on methods and algorithms for prediction of the operation cost of the complex technical system in variable operation conditions. The program allows to determine of the costs of the non-repairable and repairable improved complex technical systems before and after their operation processes optimization. The procedure of the computer program use and its application to operation cost analysis of the exemplary complex technical system.

28. Testing the integrated package of tools supporting decision making on identification, prediction and optimization of complex technical systems operation, reliability and safety - Part 1- Integrated Safety and Reliability Decision Support System – IS&RDSS

Kołowrocki Krzysztof, Soszyńska-Budny Joanna, Ng Kien Ming

Keywords

reliability, safety, operation processes, availability, optimization

Abstract

The paper is composed of six parts and presents the main practical tool created in the scope of the Poland-Singapore Joint Research Project, the Integrated Safety and Reliability Decision Support System - IS&RDSS. In the paper first part, there are presented the procedure of the IS&RDSS usage in the form of detailed and clear scheme-algorithm and the list of the project final reports and these reports supporting bibliography. In the remaining paper parts, there is presented the IS&RDSS application to the reliability analysis of an exemplary complex technical system.

29. Testing the integrated package of tools supporting decision making on identification, prediction and optimization of complex technical systems operation, reliability and safety - Part 2 -IS&RDSS Application – Exemplary system operation and reliability unknown parameters identification

Kołowrocki Krzysztof, Soszyńska-Budny Joanna, Ng Kien Ming

Keywords

reliability function, operation processes, estimating

Abstract

There is presented the IS&RDSS application to the operation and reliability models of an exemplary complex technical system unknown parameters identification. There are performed in the paper, the exemplary system operation and reliability analysis and modelling. The identification of the probabilities of transitions this system operation process between the operation states and the conditional mean values of this process sojourn times in the particular operation states because of the lack of statistical data is performed through the arbitrary fixing their values. assumption. The evaluation of the system components unknown intensities of departures the reliability state subsets and the identification of the exponential forms of their multistate reliability functions on the arbitrarily fixed statistical data coming from the system components states changing processes are performed as well.

30. Testing the integrated package of tools supporting decision making on identification, prediction and optimization of complex technical systems operation, reliability and safety - Part 3 - IS&RDSS Application – Exemplary system operation and reliability characteristics prediction

Kołowrocki Krzysztof, Soszyńska-Budny Joanna, Ng Kien Ming

Keywords

reliability, operation process, prediction

Abstract

There is presented the IS&RDSS application to the operation and reliability of an exemplary complex technical system prediction. There are performed, the unconditional mean sojourn times and the limit transient probabilities of the exemplary system operation process at the particular operation states evaluations. The evaluations of the exemplary system unconditional multistate reliability function, the expected values and the standard deviations of its unconditional lifetimes in the reliability state subsets and the mean values of its lifetimes in the particular reliability states are performed as well. Moreover, in the case when the system is repairable, its renewal and availability characteristics are estimated.

31. Testing the integrated package of tools supporting decision making on identification, prediction and optimization of complex technical systems operation, reliability and safety - Part 4 - IS&RDSS Application – Exemplary system operation and reliability optimization

Kołowrocki Krzysztof, Soszyńska-Budny Joanna, Xie Min

Keywords

reliability, operation process, optimization

Abstract

There is presented the IS&RDSS application to the operation and reliability of an exemplary complex technical system optimization. There are determined, the optimal limit transient probabilities of the exemplary system operation process at the particular operation states maximizing the system lifetime in the reliability states not worse than the critical reliability state and its optimal sojourn times at the particular operation states. There are evaluated the exemplary system optimal unconditional multistate reliability function, the optimal expected values and the standard deviations of its unconditional lifetimes in the reliability state subsets and the optimal mean values of its lifetimes in the particular reliability states are. Moreover, in the case when the system is repairable, its optimal renewal and availability characteristics are found.

32. Testing the integrated package of tools supporting decision making on identification, prediction and optimization of complex technical systems operation, reliability and safety - Part 5 - IS&RDSS Application – Improved exemplary system operation and reliability characteristics prediction

Kołowrocki Krzysztof, Soszyńska-Budny Joanna, Xie Min

Keywords

complex system, reliability, improve

Abstract

There is presented the IS&RDSS application to the reliability of the improved exemplary complex technical system prediction. There are considered three ways of the exemplary system reliability improvement, a hot single reservation of its components, a cold single reservation of its components and replacing its components by the improved components with reduced intensities of departure from the reliability state subsets. The evaluations of this ways improved exemplary system unconditional multistate reliability function, the expected values and the standard deviations of its unconditional lifetimes in the reliability state subsets and the mean values of its lifetimes in the particular reliability states are performed. Moreover, in the case when the improved system is repairable, its renewal and availability characteristics are estimated.

33. Testing the integrated package of tools supporting decision making on identification, prediction and optimization of complex technical systems operation, reliability and safety - Part 6 - IS&RDSS Application – Exemplary system operation cost analysis and maintenance optimization

Kołowrocki Krzysztof, Soszyńska-Budny Joanna, Xie Min

Keywords

operation cost, complex systems, corrective maintenance, preventive maintenance

Abstract

The way of operation cost analysis of the complex technical system at the variable operation conditions and its application to the evaluation of the cost before and after the exemplary system operation process optimization is presented. The methods of corrective and preventive maintenance policy maximizing availability and minimizing renovation cost of the complex technical systems in variable operation conditions are presented and applied to the exemplary system.

34. Testing the integrated package of tools supporting decision making on identification, prediction and optimization of complex technical systems operation, reliability and safety - Part 7- IS&RDSS Application – Exemplary system operation and reliability new strategy

Kołowrocki Krzysztof, Soszyńska-Budny Joanna, Xie Min

Keywords

reliability, operation process, operation cost, complex systems, optimization, availability

Abstract

The paper presents the collection of the results concerned with the exemplary system operation, reliability, availability, maintenance and cost analysis, modelling, prediction and optimization coming from the Integrated Safety and Reliability Decision Support System - IS&RDSS application performed in its six previous parts. On the basis of the collected operation and reliability parameters and characteristics of the exemplary system before and after its operation process optimization, there is suggested its operation and reliability new strategy.

35. Logistic regression as a relevant statistical tool for medical data investigation and evaluation

Kuráňová Pavlína

Keywords

logistic regression, medical data, atopy, Phadiatop test, surgery, morbidity.

Abstract

This paper presents the usage of logistic regression for predicting the classification of patients into one of the two groups. Our data come from patients who underwent Phadiatop test examinations and patients who underwent colectomy in the University Hospital of Ostrava. As the predictor variables were chosen personal and family anamneses for Phadiatop test and the physiological and operative scores for colectomy. For Phadiatop

test, both of these anamneses were divided into four categories according to severity ranked by doctors. Scores for morbidity were based on the POSSUM system. The psychological score comprises 12 factors and the operative score comprises 6. The categorical dependent variable which we want to predict was Phadiatop test (respectively morbidity). The model for Phadiatop test was tested with the use of a medical database of 1027 clients and morbidity was tested upon a medical database of 364 clients. The developed models predict the right results with 75% probability for Phadiatop test and 70% probability for morbidity in surgery.

36. Dependability of discrete transport system - model, simulation, measures

Mazurkiewicz Jacek

Keywords

discrete transport system, system dependability, functional and dependability models, Monte-Carlo simulation

Abstract

The paper proposes a method of reliability and functional analysis related to discrete transport systems. The proposed analysis is based on modelling and simulating of the system behaviour. Monte Carlo simulation is used for proper reliability and functional parameters calculation. The simulator is built using Scalable Simulation Framework (*SSF*). No restriction on the system structure and on a kind of distribution is the main advantage of the method. The paper presents some exemplar system modelling. The authors stress the problem of influence of the reliability parameters for final functional measures (required time of delivery) – the key value to calculate the availability of the system. They also propose to measure the economic quality of discrete transport system by “profit function”. The presented problem is practically essential for defining an organization of vehicle maintenance and transportation system logistics.

37. Modelling of computer systems – an approach for functional and dependability analysis

Michalska Katarzyna

Keywords

dependability, modelling, computer systems, service

Abstract

The paper presents a method of analyzing dependability aspects of service oriented information systems based on functional and dependability modelling. Analysis approach is based on integrating different computer system models into one coherent model suitable for simulation. To simplify integration of the models author propose an automatic solution that is integrated with the tools chosen for system analysis. Analysis is done with a usage of open-source simulation environment that can be easily modified and extended for farther work. Based on the simulation results, with respect to defined dependability and functionality metrics, some alternatives can be chosen in case of system or service failure.

The paper presents developed software which implements described methodology and results of analysis for an exemplary business service oriented complex information system.

38. Methods to assess effects of cable failures caused by fire

Piljugin Ewgenij, Herb Joachim, Röwekamp Marina, Berg Heinz-Peter

Keywords

cable failure, fire, probabilistic risk assessment, FMEA

Abstract

It is state-of-the-art that a Level 1 PSA also includes a fire PSA for all plant operational states. In performing Fire PSA not only the malfunction of the components has to be assessed but also all supply systems and cables have to be traced for a given component. In the past it was assumed in the case of a fire in a compartment that all components and cables in that compartment are not functional anymore. However, this is in many cases a too conservative approach and could lead to overestimated fire induced core damage frequencies. Therefore, a method is necessary to assess in a more realistic manner the effects of cables failures caused by fire. Such a procedure requires a sound data base on equipment, list of cables and their properties as well as cable routing. Two methods are described which are currently developed. One of them is a cable failure mode and effect analysis which is easier to apply in practice.

39. Risk of morbidity in colorectal surgery

Rabasová Marcela

Keywords

colorectal surgery, morbidity, risk factors, laparoscopy, discriminant analysis

Abstract

This study examines the risk of morbidity for colorectal surgery undergoing patients. The main aim was to identify important risk factors that influence post-operative complications - morbidity, and to create a model to predict possible complications for a patient before surgery. The source data file contains information about 1177

patients who underwent colorectal surgery between 2001 and 2009 at the University Hospital Ostrava, Czech Republic. According to the surgeons' judgment the following seven independent variables were included in the analysis: Gender, BMI, American Society of Anaesthesiology (ASA) Classification, Stage of Disease, Number of Previous Operations, Surgical Technique and Operation Severity. Discriminant analysis was used for the data evaluation; statistical software SPSS 18 and NCSS 2004 were used for the calculations.

40. Reliability and risk evaluation of a container gantry crane at variable operation conditions

Soszyńska-Budny Joanna

Keywords

reliability function, risk function, system operation processes

Abstract

The joint model of the system operation process and the system multi-state reliability is applied to the reliability and risk evaluation of the container gantry crane. The container gantry crane is described and its operation process unknown parameters are identified on the basis of real statistical data. The mean values of the container gantry crane operation process unconditional sojourn times in particular operation states are found and applied to determining this process transient probabilities in these states. The container gantry crane different reliability structures in various its operation states are fixed and their conditional reliability functions on the basis of data coming from experts are approximately determined. Finally, after applying earlier estimated transient probabilities and system conditional reliability functions in particular operation states the unconditional reliability function, the mean values and standard deviations of the container gantry crane lifetimes in particular reliability states, risk function and the moment when the risk exceeds a critical value are found.

41. Probabilistic evaluation of deterioration processes with maintenance activities

Sugier Jarosław, Anders George J.

Keywords

deterioration modelling, probabilistic methods, maintenance policy, risk assessment.

Abstract

Reliable operation of contemporary complex systems depends on selecting efficient maintenance policy, which often must take into account not only the reliability, but also economic factors. In this work, we present an approach which allows evaluation of various possible maintenance scenarios with respect to these two areas. The method is based on the concept of a life curve and discounted cost used to study the effect of equipment aging under different maintenance strategies. The deterioration process is first described by a Markov model and then its various characteristics are used to develop the equipment life curve and to quantify other reliability parameters. Based on these data, effects of various "what-if" maintenance scenarios can be examined and their efficiency compared. Simple life curves are combined to model equipment deterioration undergoing diverse maintenance actions, while computing other parameters of the model allows evaluation of additional critical factors, such as probability of equipment failure. Additionally, the paper deals with the problem of the model adjustment so that the computed frequencies are close to the historical values, which is very important in practical applications of the method.

42. Failure risk analysis in the water supply sector management

Tchórzewska-Cieślak Barbara, Rak Janusz Ryszard, Pietrucha Katarzyna

Keywords

water supply, risk management, safety, critical infrastructure

Abstract

The subject and main purpose of this study is to develop risk analytic model for the design and operation of water supply sector. A water supply system belongs to the critical infrastructure of cities, and it should be a priority task for waterworks and even for the local authorities to ensure the suitable level of its safety. A water supply systems (WSS) ought to be high reliable continuous operating system. Failure factors in WSS should be identified and prioritized, for example, the causing factors in the most frequent failures in water-pipe network. Drinking water supply utilities are responsible for providing a safe and reliable supply of potable water to their customers. Risk priority helps asset manager to target and refine maintenance plans, capital expenditure plans, investigative activities, and deal with potential failure before it occurs. In this paper, we present a review of classic risk analyses, risk management and new methodology for water supply networks management. This paper presents a framework for the analysis of performance risk in water supply that can be applied to the entire system or to individual subsystems. It is expecting that the methodology for the water supply performance risk analysis would provide the city leadership for decision making support.

43. Simulation approach to Web system dependability analysis

Walkowiak Tomasz

Keywords

dependability, performance, availability, reliability, failures, Web system, simulation

Abstract

The paper presents an approach to dependability analysis of Web based systems. The analyzed system consists of tasks that use data, obtained in interaction with other tasks, to produce responses. During system exploitation, various incidents can occur due to software defects or security attacks. Also the system elements has to fulfill performance parameters (for example to give answers within given time limits). A software simulation software was developed based on the PRIME SSF framework. It allows to calculate dependability metrics: average user response time for different system configuration and different input load (number of users accessing the system at the same time). The system simulation takes into account the consumption of computational resources (host processing power). A case study with exemplar simulation results are given.

44. Critical situations and human resources in discrete transportation systems analysis

Walkowiak Tomasz, Mazurkiewicz Jacek

Keywords

discrete transportation system, system dependability, critical situations analysis, Monte-Carlo simulation

Abstract

The paper presents an approach to critical situations analysis related to discrete transportation systems (*DTS*). The critical situation is understood as sudden shortage of some system resources resulting in the transportation system performance degradation. The analysis is realized based on availability calculation of *DTS*. The system is described by the formal model, which includes reliability and functional parameters of *DTS* as well as human resources - drivers and management system. The availability and average availability of the system, defined in a functional way, is discussed as a function of different essential parameters of *DTS*. The proposed analysis is based on the modelling and simulating of the system behaviour using Monte-Carlo approach. The paper presents some exemplar systems – based on real Polish Post *DTS* - modelling and results.

45. Attempts at calculating chosen contributors with regard to the Semi-Markov process and the Weibull function distribution

Zajac Mateusz, Kierzkowski Artur

Keywords

Semi Markov process, exponential distribution, availability, transient probabilities.

Abstract

The main aim of this article is the presentation of the way of making calculation with the application of the semi-Markov processes, with the continuous time t , where non-exponential distribution function is going to be applied. These type of calculations were published but the time there was approaching infinity. Engineering practice proves that the lack of solutions of this issue leads to obtainment of solutions that are encumbered with errors. This article is the first attempt of the error analysis.

46. From reliability to system dependability – theory and models

Zamojski Wojciech, Mazurkiewicz Jacek

Keywords

system reliability, system dependability, networks, services, functional and dependability models

Abstract

The paper presents a novel approach to system dependability problem. The analysed systems and networks - characterised by different sets of features - are considered as a union of all their resources essential for the predicted tasks realisation. The system dependability is discussed with respect to the occurrence of incidents and treats that may cause to damage the system resources and - in consequence - to the collapse of the executed tasks. The maintenance policy system is based on two main concepts: detection of unfriendly events and system responses to them. The proposed analysis is realised from the user's point of view, focusing on functional features described by business services available in the system.

47. Current problems of technical systems reliability and safety

Kołowrocki Krzysztof, Soszyńska-Budny Joanna

Keywords

complex system, reliability, safety, operation process, evaluation, prediction, optimization

Abstract

Integrated Safety and Reliability Decision Support System - IS&RDSS is presented in the form of detailed and clear scheme-algorithm. There is also presented the methodology of IS&RDSS that is composed of the methods of complex technical systems operation processes modelling, their unknown parameters concerning operation, reliability, availability, safety models identification, their reliability, availability and safety evaluation and

prediction, their reliability, availability and safety improvement and their operation, reliability, availability, safety and cost optimization. The newest trends in the reliability and safety of complex technical systems analysis directed to the critical infrastructures and the nanosystems are describe as well.

48. Risk analysis and functional safety management

Kosmowski Kazimierz T.

Keywords

risk analysis, reliability and safety management, functional safety, cost-benefit analysis

Abstract

This article addresses current issues concerning the risk analysis and functional safety management. Some cost-benefit analysis methods (CBA) are presented oriented on optimizing the safety-related solutions on example of functional safety technologies reducing risk based on programmable systems E/E/PE (PN-EN 61508) and SIS (PN-EN 61511). The importance of safety-related criteria, such as tolerability of risk (TOR) in the context of cost-benefit analysis (CBA), is emphasized to reach rational decisions as regards safety-related solutions to be sufficiently reliable, safe and preferably economically justified.

49. Frequency of periodical inspections of safety-related control systems of machinery – practical recommendations for determining methods

Dźwiarek Marek, Hryniewicz Olgierd

Keywords

safety of machinery, safety functions, functional safety, periodical inspections

Abstract

In preventing the accidents due to improper operation of the control systems the periodical inspection of their functioning is of crucial importance. Therefore, the control system designer should specify how often the system should undergo the periodical inspection. The paper presents some recommendations for the determination of periodical inspection frequency of safety related control systems in machinery. The recommendations are based on simple and easy to use mathematical models which have been developed by adaptation and simplification of models used for the determination of maintenance policies of complex systems. Practical implementation of the proposed recommendation is illustrated on some actual case studies.

50. Computerized control and protection systems in technical objects and installations

Śmierchalski Roman, Kolendo Piotr

Keywords

control systems, computer technology, safety systems, industrial and naval installations

Abstract

The article presents some safety-related problems of the computer control systems and overall automation. The development of automation and information technology in recent years has forced to develop a number of new technologies and solutions for advanced process control and other technical installations. It seeks for automation of complex technical installations, conceived as means of controlling all subsystems and devices automatically, without human intervention. However, if we consider the economic aspects, the maintenance-free concept is not justified. The partial automation of selected systems is also of interest. This work considers some general aspects of control system design with emphasis on safety aspects. As an example of the protection system, the installation of diesel engine oil lubrication is presented.

51. Determining required safety integrity level

Barnert Tomasz

Keywords

functional safety, hazards identification, risk assessment, safety requirements, safety integrity level

Abstract

One of the most important stage of technical system functional safety analysis is defining the safety-related functions as well as determining a safety integrity level (SIL) for each defined function. A properly carried out hazard identification process is the necessary condition for correct definition of the safety-related functions. Determining the safety integrity level (SIL) is based on risk assessment taking into account risk acceptance criteria. It guarantees accurate results which means that the risk associated with technical system is under good control and the risk level can be reduced to acceptable one. There are several safety integrity level determination methods and techniques described in normative documents and many papers. This article is aimed at presentation of some of them and in addition a new approach are outlined.

52. Software quality and reliability management in safety-related systems

Porzeziński Michał

Keywords

software quality and reliability, functional safety, safety-related systems

Abstract

This article is concerned with the methods of ensuring the required quality and reliability of software in safety-related systems. The basic types of software reliability models and their specific properties are presented. The principles of managing the process of software development, based on the "Model V" life cycle, with particular emphasis on the role of inspection and testing processes are discussed. Also the methodology of quality management and reliability of the software recommended by the PN-EN 61508-3 are outlined. At the end the concept of application to support the process of assessing the quality and integrity of the safety-related software is described.

53. Human factors and functional safety analysis

Kosmowski Kazimierz T.

Keywords

human factors, human errors, functional safety, human reliability analysis, layers of protection

Abstract

In this article some issues concerning the safety management in computerized complex hazardous plant are presented in the context of human factors. It has been shown that the risk of losses can be significantly reduced using appropriate technical solutions in the form of a layer protection system, which includes a basic process control system, human-operator and protection automatics. The significance of appropriate designing of interfaces including functions of the alarm system is emphasized. It will contribute to reducing the human-operator error probability. The functional safety management, which includes the risk control in a life cycle of complex plant, should be carried out in relation to requirements associated with possible avoiding of software systematic failures in programmable systems and reducing the frequency of hardware random failures.

54. Determining diagnostic coverage of elements and analysis of subsystems' architectural constraints

Jacek Zawalich

Keywords

functional safety, diagnostics coverage, danger failure, architecture of subsystem

Abstract

Performing a safety related function by E/E/PE system requires proper operation of its subsystems. Its structure has to guarantee effective and fast detection of failure. The estimation of average probability of dangerous failure on demand (PFD_{avg}) requires the knowledge concerning the value of diagnostic coverage (DC) for all elements and/or subsystems. It is preferable when subsystems are of type A. In such case the failure modes of all components and their behavior in case of some faults are well defined. This is the reason why the design of safety-related systems should use the devices adapted to execution of diagnostic tests to detect majority of failures that lead to serious consequences. In the article some theoretical and practical aspects of determining diagnostic coverage are outlined.

55. Integrity level verification for safety-related functions

Śliwiński Marcin

Keywords

functional safety, safety integrity level verification

Abstract

This article describes methods for the safety integrity level (SIL) verification of safety-related functions with regard to probabilistic criteria given in international standards IEC 61508 and IEC 61511. These functions are realized using the electrical, electronic and programmable electronic (E/E/PE) systems or safety instrumented systems (SIS). Some methods are proposed for quantitative probabilistic modelling taking into account potential dependent failures in redundant systems with diverse channels within subsystems. The analyses of safety-related systems include testing and maintenance planning of subsystems, in particular the sensors and actuators with regard to the probabilistic criteria defined for given SIL. The methods are illustrated on some examples of systems from industrial hazardous plants.

56. Layer of protection analysis in industrial hazardous installations

Kacprzak Przemysław

Keywords

functional safety, layer of protection analysis, human factors, alarm system

Abstract

In this article the Layer of Protection Analysis (LOPA), as a technique for the risk evaluation relating to the hazardous industrial installations performance, is presented. The results of analyses are important in the terms of

the safety management process in such installations. Based on obtained estimations the decisions might be undertaken which solutions to apply in order to mitigate the risk of hazardous installations performance to a tolerable level. The risk mitigation is provided by properly designed layers of protection, particularly the alarm system, treated as a part of protection layer. The alarm system should be designed and implemented with comprehensive consideration of the human factors. The role of the operator in hazardous installations is crucial mainly during abnormal and alarm situations in order to provide and/or recover system to normal or safety state. In the article some selected aspects of alarm systems designing process with special treating of human operator are outlined. Moreover, an example of the LOPA analysis for the accident sequence within a reaction container with consideration of human reliability analysis (HRA) is carried out.

57. ProSIL software for computer aided functional safety management

Barnert Tomasz, Kacprzak Przemysław, Kosmowski Kazimierz, Kozyra Maciej, Porzeziński Michał, Śliwiński Marcin, Zawalich Jacek

Keywords

functional safety, computer aided management, safety-related functions, safety integrity

Abstract

In this article a prototype ProSIL software system for computer-aided functional safety management is described. The software consists of three modules for: determination of the required SIL level (ProSILen), verification of the SIL level (ProSILver), and layer of protection analysis (ProSIL/LOPA). In ProSIL the methods concerning functional safety analysis in the process of the design and operation of Safety Instrumented Systems (SIS) are implemented according to PN-EN 61508 and PN-EN 61511 standards, and some new methods, e.g. the calibrated risk graph method for determining required safety integrity level (SIL) based on the risk assessment. Moreover, methods of verifying the SIL level of SIS. The Layer of Protection Analysis (LOPA) method with regard to Human Reliability Analysis (HRA) are also included in the software.

58. Process modelling and simulation in industrial systems using FLOWNEX SE software

Waldemar Cieślakiewicz

Keywords

modeling of dynamic systems, simulation, industrial processes and systems

Abstract

The recent focus on reliability and safety of industrial systems has raised the need for system simulations and analysis. The intrinsic capabilities of modern computational software development have made it possible to predict trends in various system operations more exactly. The present simulation methodology also allows for the analysis of non-measurable numbers, like the Reynolds Number (Re), which hasn't been taken so often into consideration during past analyses. The main purpose of this article is to overview the system simulation methodology, focusing primarily on System Computer Fluid Dynamic (SCFD) method as the most effective approach to simulate the flow-thermal networks. This article makes use of system simulation models, which depict real industry problems.

59. Safety management in installations with explosion hazardous areas

Rogala Ireneusz

Keywords

ATEX, Ex areas, safety measures and technologies, risk reduction, explosion protection document

Abstract

The article presents the current state of knowledge on explosion protection based on ATEX EC Directives, as well as the processes occurring in Polish industry, which refer to the issue considered. The activities of different subjects operating on the Polish market exert diverse influences on the way of implementing the minimal level of ATEX requirements as well as on optimizing investments in the safety measures. On the basis of experience gained by the ASE company on Polish industrial market in the field of explosion protection equipment the design and delivery as well as experience in carrying out training programs, providing consulting services and expertise, it is possible to propose a comprehensive set of measures aiming at achieving a permanent state of the acceptable level of explosion protection.

60. Risk assessment of industrial plants' operation for insurance purposes

Gołębiewski Dariusz

Keywords

risk analysis, insurance, technical objects, plants

Abstract

The process of comprehensive insurance of technical objects/plants requires a deep knowledge of the insurer as regards the hazards and risk factors. Therefore, any insurance company uses a methodology of risk assessment

before undertaking the insuring decisions. The object/plant specific factors cause that each case should analyzed and assessed individually and appropriate insurance conditions should be offered. The article presents some fundamental parts of the risk assessment methodology of objects/plants for insurance purposes.

61. Certification system of persons responsible for functional safety

Wojas Marta, Kosmowski Kazimierz T., Kościelny Jan M.

Keywords

certification of persons, functional safety, training programmes, certification process, conformity assessment

Abstract

This article describes a certification system of persons responsible for functional safety developed by the Office of Technical Inspection (UDT-CERT) in Poland in cooperation with members of the Programme Committee No. 8 and representatives of two technical universities: in Gdansk and Warsaw. The system is consistent with standard ISO/IEC 17024 concerning the conformity assessment, and includes requirements of EN 61508 and some sector standards. The certification and training programs include two levels of qualification: I – general and II – expert, and four specializations in functional safety: A – hardware and software, B – process industry, C – machinery, and D – nuclear power plants.

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