SYSTEMS AND CONTROL PROCESSES

RESEARCH OF CORIOLIS VIBRATORY GYROSCOPE TRACKING SYSTEM FOR RESONANT FREQUENCY

page 4–7

In the article the new Coriolis vibratory gyroscope (CVG) that developed by PJSC «RPA «KAP n. a. G. Petrovsky» — the angular velocity sensor (AVS) of stability system of navigation complex of modern light armored vehicles. CVG is different from traditional electromechanical gyroscopes by high reliability and durability, as it contains no rotating parts, bandwidth and resistant to mechanical stress. These sensors have a broad scope, including — stabilization of the platform with measuring devices that standing on platforms and control systems of moving objects of different classes in measurement units for inertial navigation. Taking into account the results it is conducted the simulations of stabilizer operation with the introduction of AVS-CVG in the vertical channel of stabilizer, which are most intense effects. As the results of simulation, increase of bandwidth leads to better noise immunity system and ensures its rigidity requirements because reduces vibrations at very high gain ratio. An effective tracking system for CVG for resonant frequency is developed.

Keywords: Coriolis vibratory gyroscope, resonant frequency, angular velocity sensor.

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AUDIT OF CONTROL ALGORITHM QUALITY OF DRUM STEAM BOILERS AT DESIGN STAGE OF AUTOMATION SYSTEM

page 8–12

Investigation of complex engineering objects and improving the quality of their management in the classic version come to carry out the decomposition of the object into multiple control loops, which in turn imposes certain limitations in the practical application of research results, and leads to loss of information on the impact of parameters on each other. Therefore, the implementation in practice does not provide a research control facility as a whole.

Experimental and analytical complex model of dynamics of drum boiler for all areas of regulation is developed. Algorithm and logical-structural scheme of models allow studying a synthesis of control algorithm of the entire object, to analyze the results on the basis of the transients.

The physical implementation of the model assigned to the industrial freely programmable logic controller of module form factor. It is used as a base for the practical implementation of control algorithms.

The result is a closed self-contained control system and simulation modeling, which has the ability to interface with external controls on the physical or logical level.

Keywords: experimental and analytical model, control system, simulation modeling.

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ASSESSMENT OF ELASTICITY OF DEMAND FOR SERVICES OF SUBURBAN ROAD PASSENGER TRANSPORT

page 13–16

This article discusses the use of index of elasticity of demand for a suburban road passenger transport in solving problems of

organizing the transport of passengers in suburban traffic, and gives some of the results of our research in this area. The main aim of the study is to identify the impact of the fare on changes in demand for the services of a suburban road passenger transport. The use of statistical methods to assess complex objects allows consider the interests both carriers and passengers for the development of the transportation process of passengers in suburban traffic. This article discussed a way to assess the elasticity of demand for a suburban road passenger transport. The results of processing of field studies allowed estimating the amount of demand changes when you change the transportation fares. Identified fare limit that favorable to passengers of suburban transport takes into account interests both carriers and passengers during the organization of the transport process. This makes it possible to evaluate various design options of process parameters of the carriage of passengers in suburban traffic. The research results can be applied by transport specialists involved in the field of passenger transportation in suburban traffic.

Keywords: transport service, suburban traffic, traffic volume, fare, demand, elasticity.

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USING THE KNOWLEDGE BASE IN THE MANAGEMENT OF COMPLEX OF DISCONTINUOUS VACUUM DEVICES

The definition of new requirements for the management of the sugar production process reveals the problems of development and implementation of innovative management systems.

Solving these problems is fully possible only when using intelligent control systems. A promising direction is the development and implementation of case management systems.

It was developed a fragment of knowledge base of situational management system of vacuum device, which is integrated in the technological complex of similar devices. The structure of the knowledge base is defined in the format of a frame of category D. This structure of knowledge base eliminates the indexation of the knowledge base, and quickly makes changes to the knowledge base using the scripting engine.

Application of the knowledge base of frame type in case management systems (agent systems) allow more efficient, on a qualitative level, to lead the process of mass crystallization of sugar, allow building multi-level hierarchical control systems of technological systems, as well as the union of technological systems of the plant on the same network.

A promising area of application of frame knowledge bases is to use in knowledge bases and decision-making systems of administrative and technical management systems.

Keywords: technological system, vacuum device, knowledge base, frame model of knowledge.

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THE CHOICE OF THE OPTIMUM PUMP STATION AGGREGATES STRUCTURE OF PIPELINE SYSTEMS WHILE DESIGNING AND RECONSTRUCTING

The optimal selection of the structure of pump station aggregates in the process of design and reconstruction is considered. The task is formulated and the method of solution is presented. The minimum amount of capital and operating costs at the pump station during the entire project period is used as an optimization criterion. The talk of optimal selection of the structure of pump station aggregates is one of the most important tasks in optimal design of piping systems. To ensure the design values of operating parameters at the output of each projected pump station it is necessary to choose the structure of pump aggregates so that to reach the minimum amount of capital and operation costs during the entire project period. After solving the task the resulting recommendations on the pumping equipment structure of the designed pumping station should not only ensure the controllability of the pipeline network flux-distribution but also deliver the minimum amount of capital and energy costs. The method of simulation was used to solve this task. The procedure of the automated selection of pumping station equipment based on the generation of different structures engaging regulated and non-regulated pumps was developed and as a result of data processing

of the ranges of different types of pumps it allows selecting the most cost-efficient pump station structure to ensure specified design values of daily schedule changes of feeding and pressure at the output. The method of branches and boundaries was used as the optimization method. A great number of received results of modeling existing pump stations of water supply and calculation of their optimal regimes has shown that to ensure a smooth feed control of pumping station in the whole range of its consumption it is enough, as a rule, to equip with a variable speed drive only one the most powerful pump unit.

Keywords: design, reconstruction, criterion, pipeline systems, pumping station, method, optimal selection.

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EVALUATION AND FORECASTING OF QUALITY OF PRODUCTS ON THE BASIS OF INFORMATION MINING TECHNIQUES

Structural formalization of the process of evaluation and forecasting of quality in terms of the basic methods of quality control, prediction and quality control theory is done. The advantages of Data Mining methods for decision making in the management of product quality are proved. The requirements for mining techniques to improve the efficiency of data processing for solving hard-formalized problems of quality control in modern production are formulated. Intellectualization of modern methods of assessment and forecasting of quality will allow resolving the contradiction between the uncertainty of a priori information about the multi-dimensional properties of industrial production and the increasing demands on the reliability and efficiency of multi-criteria assessment of its quality in decision-making at various control levels.

Keywords: assessment and forecasting, product quality control, mining techniques.

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RECYCLING OF AIRCRAFT COMPONENTS: ANALYSIS OF NORMATIVE AND TECHNICAL DOCUMENTATION OF QUALITY ENSURE

The article is devoted to describing and analyzing the existing normative and technical documentation for recycling of aircraft and quality ensure of this process. The problems of directly normative and technical documentation of recycling processes and normative and technical documentation for recyclable materials are considered, as well as analyzed the scope of requirements for the quality of products obtained from recycling.

As a result, it is concluded that currently recycling of aircraft elements is seen as an integral part of recycling is practically not separated; normative and technical documentation largely determined for recycling of metallic compounds, and often impose a requirement for quality of recyclable products, and not to the quality of products obtained from recycling and almost no normative and technical documentation for evaluating the quality of products obtained from recycling of aircraft elements.

Keywords: recycling, standards, composite material, titanium alloys, aluminum alloys, quality, normative and technical documentation, aerospace engineering.

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INFORMATION TECHNOLOGIES

METHODS AND ALGORITHMS FOR COMPACT REPRESENTATION OF GRAPHIC INFORMATION IN COMPUTER SYSTEMS

page 32–36

Considering that a large amount of information, that transmitted in digital communication systems, accounts for graphic information, the development and improvement of methods and algorithms for compact representation of image data are very topical task.

This paper shows the results of the study process of compact presentation of graphic information in computer systems, namely:

— the basic methods of compact presentation of graphic information are considered. There are Gray reflex codes, progressive image compression, intuitive methods, JPEG, JPEG-LS, wavelet techniques, a mathematical transformation of the image;

— the main indicators of algorithms for compact presentation of graphic information are considered. There are RLE, LZW, Huffman algorithm, JBIG, JPEG, Lossless JPEG, fractal algorithm, recursive algorithm, JPEG 2000;

— advantages and disadvantages of methods and algorithms are revealed;

— system analysis of opportunities for basic methods and algorithms for compression of graphical information is given.

Investigated in the article impact of using combinations of methods of compact presentation of graphic information in computer systems at the results of the major compression algorithms will identify further ways to improve the degree of compression of graphic information.

Keywords: lossy compression, lossless compression, graphics, compression-decompression method, algorithm.

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DEVELOPMENT OF SYNTHESIS METHOD OF PREDICTIVE SCHEMES BASED ON BASIC PREDICTIVE MODELS

page 36–41

The task of modeling and prediction of processes of various natures is important. Known models and prediction techniques based on the use of integrated information on prehistory of predictive processes. Among the tasks of prediction an important place takes time series prediction. There are many different methods for the prediction of technical, economic processes. In this paper, the method of synthesis of predictive schemes based on key predictive models, which is based on determining the weighting coefficients of the models included in the resulting model. The best step is determined by the background conditions minimizing functional standard deviation at optimum parameters of autoregression models. In the synthesis of predictive schemes for each base model is determined the weighting with which it includes in the final predictive scheme.

Comparison of the results of predictive schemes with the results of basic techniques: autoregressive method, the method of least squares with weights, Brown's linear model, Brown's quadratic model, Winters method. It is used mean square error and average relative error of prediction of the various steps to assess the quality of the predictive models. Predictive scheme mainly improved the results of basic models for the studied time series, while scheme results coincided with the results of Winters model at some steps of prediction.

An important feature of predictive scheme is that it allows adding new time series prediction models, removing it from the models or groups of models, that is, the scheme is flexible to use.

Keywords: trend, prediction model, time series, functional, prediction step, autoregression, training.

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BINARY-REAL CODING OF SOLUTIONS IN GENETIC ALGORITHMS

The problem of solutions coding in genetic algorithms was reviewed in this paper. The main classes of solutions coding are presented. Advantages and disadvantages of binary coding and real coding in genetic algorithms have been analyzed.

The main purpose of the research is to develop a new way of coding solutions in genetic algorithms. The method developed consists of two stages. Binary coding with the partition of solutions area into small intervals is applied during the first stage. Real coding is used at the second stage. This approach allows one to take advantages of both binary and real coding.

Comparative analysis of the efficiency of the new coding method in genetic algorithms for optimization of complex functions is carried out. Efficiency analysis has shown that the use of binary-real coding in genetic algorithms can solve the optimization problem with a quite high degree of accuracy at medium computational overhead.

Practical recommendations for using binary-real coding in various cases are presented.

Keywords: genetic algorithm, binary coding, real coding, optimization.

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CALCULATION OF PROFITABILITY AND RISK OF A PROJECT PORTFOLIO BASED ON THE SHARPE MODEL

Successful realization of projects has become an especially difficult and complex challenge because of the hard economic and political situation in the country. Hence methods of assessing risk and profitability of both an individual project and the whole portfolio on the basis of the market index analysis have become a priority. The Sharpe model has not been used in the portfolio formation practice before. The application of this model will allow optimizing the calculation of the risk and profitability of a project portfolio. The development of methods and models of forming the investment projects portfolio and of planning its realization with the capabilities of the enterprise and the impact of various risks taken into account has become a topical scientific and practical challenge. By means of the risk management processes project managers increase the likelihood of the occurrence risk events and their impact on the project and decrease the likelihood of the occurrence and impact of unfavorable risk events that can have a negative effect on the profitably of the project. Assessment of the current state of the enterprise is a crucial stage in determining the portfolio, because it is necessary to assess resource and technological capabilities of the enterprise to perform project work.

Diversification significantly reduces the risk. The assessment of the current state of the enterprise is carried out by means of the available methods of technological, resource, and managerial analysis. To simplify the analysis and facilitate the calculation, the model of assessing profitability and a project portfolio risk is considered on the basis of the Sharpe model. If the market is stable and predictable, the application of this model allows assessing the risk and profitability of an individual project or the whole project portfolio on the basis of the market index analysis.

Keywords: Sharpe model, risk, project and portfolio risks, risk-free securities, profitability.

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USE OF DISCRETE MODEL OF THE STATES FOR DETERMINATION OF WORKLOAD OF THE HEAD OF THE PROJECT PORTFOLIO

page 51–57

From the effective work of the portfolio manager in organizations depends on the strategic goals of the organization. On the basis of the standard of portfolio management of USA Project Management Institute it is studied the processes of portfolio management using Markov chains for discrete states of the system. Processes in which the portfolio manager is busy most of the time are identified using the model of states, and on the example of supply and demand management of portfolio resources shows that if automate the process of appointment/release of the resources in projects of the organization, it gives free time for manager of the portfolio, and he will be able to pay more time to other processes of project portfolio management. This, in turn, will increase the likelihood of successfully achieving the strategic goals of the company through the timely implementation of the projects portfolio. The model of discrete states helps enterprises to solve management issues of optimum workload of the portfolio manager by involving the experts for help in specific subject areas and/or automation of certain processes.

Keywords: project management, project portfolio, project management office, Markov chains.

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MODELLING MANAGEMENT PROCESSES UNDER NATURAL EMERGENCY CONDITIONS ON HIGHWAYS

page 57–60

Modelling the management of liquidation of natural emergency situations on highways as a complex semistructured technical system with the use of IDEF0 notation has been made. The application of BPwin allows using well-proven IDEF0 methodology for the synthesis of the functional model of natural emergency liquidation management on highways, and then passing to the system formal model with the application of automatic tools.

The developed functional models of managing liquidation of natural emergency on highways allowed describing the modelled system from a number of viewpoints without considering their time characteristics.

The functional model of managing liquidation of natural emergency on highways gives the possibility of effective formalization of properties and characteristics of the subject under research in the part of its semistructured elements and subsystems, providing completeness of description, which is necessary for the analysis and synthesis of the management system.

Keywords: methodology, modelling, decomposition, processes, management, objects, communications, operations, highway.

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MATHEMATICAL MODELING

SOLVING OF SPATIAL PROBLEM OF NON-STATIONARY HEAT CONDUCTION BASED ON SEMI-ANALYTICAL FINITE ELEMENT METHOD

Based on the semi-analytical finite element method it is developed solution for solving of spatial problem of non-stationary heat conduction for prismatic bodies of complex shape cross-section. The basis of the initial equation is correlations of spatial unsteady heat conduction problem in curvilinear coordinates in differential and variational formulations. The formula for determining the matrix elements of thermal conductivity and heat capacity based on semi-analytical finite element method are obtained based on the presentation of temperature distribution along the coordinate by x^3 Mikhlin polynomials allowing to use effective algorithm of the iterations block of upper relaxation systems for linear algebraic equations and implement efficient algorithm solution for solution system of differential equations in time. The value of semi-analytical finite element method and algorithms implemented in the form of problem-oriented subsystems for computer modeling of unsteady thermal processes are obtained. The reliability of results is substantiated by the interpretation of test cases with analytical and numerical results.

Keywords: semi-analytical finite element method, non-stationary heat conductivity, curved coordinate system.

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CONTROL OF FORM FOR NURBS-CURVE BY CHANGING THE WEIGHTS OF NODAL POINTS

The author offers a way to control the form of NURBS-curve, changing scales of control points. It is proposed to build additional graphics of influence of each control point from which to draw conclusions about weight changes of each control point to achieve the desired shape. Each graph shows the change in shape of the curve in the case of weight change per unit, as well as the overall shape is formed as the sum of these graphs, the designer easily determines how much weight must change each checkpoint to reach such shape that has been identified as desirable. The proposed method makes it possible easily change the shape of the curve, which tracts need to increase or decrease the bulge that change the overall shape of projected curve. Results

of research provide a new effective method of designing complex curved forms of machines and units working in a moving media.

Keywords: NURBS-curve, fixed point, weight of nodal point, complementary diagram of charts.

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COMPUTATIONAL EXPERIMENTS FOR INVESTIGATION OF THE «TEMPLATE» — «ARTIFICIAL RECEPTORS» FORMATION KINETICS

page 70–73

In this paper, the commonly used scheme of ligand receptor interaction was adapted for the first time to modeling of the kinetics «template» — «MIP-receptor» kinetic. The mathematical model that describes the binding process for a monovalent receptor and ligand was created taking into account the conservation of mass criterion and initial ligand receptor interaction scheme. The numerical solution of mentioned mathematical model was carried out using of Runge-Kutta method.

That was given an opportunity to investigate the kinetics of noncooperative binding of ligand (template) with MIP-receptor through the carry out of the computational experiment (in Mat-Lab environment).

As a result «template» — «MIP-receptor» concentration profiles were obtained for different concentrations of template. It was shown that achieving a balance and, consequently, the formation of complex «template» — «MIP-receptor» is largely depend on the concentration of the template. The most accurate simulation of real experimental conditions in the computational experiment was provided considering dissociation constants that

was derived from our previous affinity research of «MIP-receptor» — «template» during surface plasmon resonance experiment with utilizing «Biacore 3000» instrument.

This approach significantly increases the probability of the kinetics modeling and makes it possible to optimize the initial experimental conditions (concentration of the ligand and/or receptor) to reduce the time to reach equilibrium. This model can be used to study the kinetics of interaction MIPs that has homogeneous binding sites. These include MIP-nanoparticles synthesized by the method of solid phase synthesis.

Keywords: molecularly imprinted polymers, ligand-receptor interaction, kinetic, Newton-Raphson method.

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THE INTERACTIONS OF THE MICROCOOLERS WITH THE MOLTEN METAL FOR THE VOLUMETRIC CRYSTALLIZATION

page 74–78

An investigation of inoculator's interaction with the liquid metal for the organization of bulk crystallization shows how to change the law of distribution of the particles introduced into the melt, and which law they will go into a zone of bulk crystallization. Knowing these laws, you can calculate the length of the zones in the crystallizer: overheating release zone, isothermal zones and bulk crystallization zone.

A method of calculating speed and distance traveled length by microcoolers to bulk crystallization zone under the influence of an inhomogeneous magnetic field, which makes it possible to calculate the speed of pulling of continuously cast ingot and use it for continuous hot rolling.

This investigation indicates that continuous casting can be combined with a continuous rolling. These increase the quality of the metal, increase the rate of crystallization and to reduce

energy costs because is not necessary to heat the metal for hot-rolling (it goes the right temperature throughout the slice).

Keywords: microcoolers, inoculator, bulk crystallization, continuously cast ingot, crystallizer, magnetic field gradient.

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INFORMATION AND CONTROL SYSTEMS

RADIOELECTONIC APPARATUS PARAMETRICAL RELIABILITY PREDICTING WITH DETERMINISTIC PARAMETER DRIFT BILATERAL LIMITATION

Based on the mathematical tools of theory of runs of random processes it is developed the forecasting method of parametric reliability of electronic equipment (EE), which allows to predict the refusals with reasonable accuracy at stationary and quasi-stationary and quasi-determined processes of drift of deterministic parameters for bilateral restrictions. Parametric reliability characterizes the capacity of device to serve specifications and compliance with defined probabilistic parameters defining parameters of given value. Drifts of deterministic parameters are random processes that are different. In the case of quasi-stationary processes the EE reliability can be predicted using the method of quantile zones. Known methods for forecasting stationary or quasi-stationary processes to date are available. The obtaining method allows to predict parameters of runs of random drift process, namely their number, total duration and average duration of run. Simulations showed ability to predict emission parameters for different characters of drift random processes in the case of bilateral constraints.

Keywords: parametric reliability, reliability analysis, shimmer failure, runs, drift of deterministic parameter.

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PRINCIPLES OF THE OPERATION AND FEATURES OF THE USE OF LITHIUM POLYMER BATTERIES

In this article were discussed different types of batteries based on lithium, described and illustrated the constructions of the most popular types of such batteries, namely, lithium-ion and lithium-polymer batteries. Selection of lithium as a promising basis for a new generation of batteries was not accidental — the metal is chemically very active. However, the reactivity has a downside — the batteries based on lithium are potentially explosive, especially in case of violation of operating conditions.

Modern lithium-based batteries have two main types — Lithium-Ion (Li-Ion) and Lithium Polymer (Li-Pol). The lithium-ion battery cathode consists of carbon anode — of lithium cobalt dioxide, and is used as an electrolyte salt solution containing lithium ions. Typical nominal output voltage of a single cell lithium-ion battery is 3,6 V.

The article found that the most promising for the further development of technologies are lithium polymer batteries. Using the solid polymer electrolyte gives lithium-polymer battery one big plus — they can have any shape, with no need for hard shell (the «Bank»), as in lithium-ion.

The obtained data will be used for the future development of monitoring energy and control the battery level, which use by various technical devices.

Keywords: chemical power sources, lithium polymer battery, memory effect, balancing system.

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FORMULATION OF MULTI-CRITERIA OPTIMIZATION PROBLEM FOR PROCESS A SET OF SIGNALS OF STRAIN GAUGE SYSTEMS

The study defines a set of linguistic variables allowing carrying out a classification of fuzzy signals. Using fuzzy classification signals it is constructed approximating relation that connected the maximum value of a signal received from one source to different systems of primary processing. The proposed algorithm allows narrowing down the set of solutions of formulated multi-criteria optimization problem, the use of which solves the problem of removing anomalies in the current set of signals.

We solve the practical problem of building information model estimating the mass of an object with a limited time of weighing, when the objects are moving at high speed. In practical observations it is revealed that in some cases, high-frequency stochastic noise formed dynamic phenomena occurring in the process of weighing, can strongly reject the measured time series of the real signal. It is the cause of abnormal situations occurring in the measurement of strain signals.

The developed algorithm allows handling certain abnormal situations arising in the measurement of strain gauge signal. This, in turn, improves the accuracy of estimating the mass of the object with a limited weighing time when objects moving with high speed processing.

Keywords: linguistic variable, fuzzy time series, multi-criteria optimization problem.

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DEVELOPMENT OF WIRELESS SENSOR NETWORK ROUTING MODEL TAKING INTO ACCOUNT CORRECTION OF ENERGYCONSUMPTION IMBALANCE

Designing of a wireless sensor network with autonomous nodes arises the question how to provide the maximum duration of its life. For this purpose the paper proposes to use multipath routing mode supporting energy balancing of network nodes. The results of studies show that if the role of nodes is dynamically changed and the topology of the network is dynamically rebuilt, it is possible to bring the lifetime of the network to the terminal device lifetime. This increase of the lifetime is possible due to the fact that each of the nodes most of the time will be in the role of the terminal device. At the same time sets of concurrent routers rotate each other. Decisions on how to rebuild the topology of the network are accepted by the coordinator. The problem of multipath routing in view of redressing the imbalance of power consumption is solved. To achieve maximizing network lifetime it is necessary to find the maximum number of independent sets of routers. In solving the optimization problem of quadratic programming a uniform load between the transit nodes is obtained and hence their energy consumption will be equal.

Keywords: wireless sensor network, multi-path routing, energy consumption.

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