

The results of simulated tests indicate that the proposed model reduces the misclassification error of cyclic and systematic patterns and decreases the estimation error average of their corresponding parameters, in compari-

son with developer models of periodic patterns, for the various emergences states.

**Key Words:** Process control charts, significant patterns, cyclic pattern, systematic pattern.

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### Abstract

The main purpose of this paper is to propose an integrated model by using the existing important factors influencing customer satisfaction and customer loyalty. Its foremost theory contribution is using the most cited related literature and verifying the model in the automobile industry in Iran. In theory testing, for the model in a specific case study, by using an explanatory approach, experts' focus group prioritized the factors. After considering all existing factors in the relevant literature, results showed 9 factors to be included in the integrated model. "Brand Equity", "Product Quality", "Service Quality", "Service Recovery", "Perceived Value"; "Employee Satisfaction", "Effective Customer Relations", "Physical Environment", and "Distribution Channels" are among the most used factors in customer satisfaction literature. For each factor, relevant literature was reviewed to develop an operational definition. The relevant factors with case conditions were selected and tested for the initial assessment of the validity and reliability of the integrated model. Test results showed that the proposed model may have an appropriate level of validity and reliability in this particular case study. Overall, the selected factors can predict more than 74% of customer satisfaction and more than 87% of customer loyalty changes.

**Key Words:** Customer relationship management, customer satisfaction, macro-model.

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### Abstract

The process control charts are most important tool of statistical process control (SPC) approach. The general control procedures of these charts only monitor charts' samples individually and do not consider the obtained common information from successive samples as probable potential disorders.

The existence of natural variations in the control charts is inevitable, but the appearances of significant patterns in these charts warn the special disturbances in production processes and associate out-of-control situations. The natural variations often divert significant patterns from their expected forms; therefore, increase of qualitative sensitivities level for study of unnatural patterns in the control charts is mandatory.

In recent years, to recognize and analyze non-random patterns in the process control charts, numerous models have been presented. These models usually cannot alarm the occurrences of various formations modes of cyclic and systematic patterns, since the periodic patterns have phase difference in their starting point and most of these researches merely have simulated one simple phase of their formation.

On the other hand, few developer models of periodic patterns generating functions have applied the artificial neural networks as recognition tool. Although the neural networks are capable in patterns learning, however they have difficult architectures, time-consuming algorithms and uncertain reliability when the sensitivities of processes to the appearances of significant patterns are high.

This paper introduces a new model based on fitted cosine curve of samples for more accurate discrimination of the various formations phases of cyclic and systematic patterns and more precise estimation of their corresponding parameters at different levels of sensitivity. Our proposed model compares all periodic alternatives, then selects the best fitted cosine curve of samples, and finally determines situation of process.

## RECOGNITION AND ANALYSIS OF CYCLIC AND SYSTEMATIC PATTERNS IN THE PROCESS CONTROL CHARTS

the products reliability just with using traditional life tests is difficult because it only records the time of failures. Therefore, measuring the degradation process have been proposed as an alternative to failure time data to obtain fast and convenient data in manufacturing industries. Accelerated Degradation Tests (ADTs) are useful tools in evaluating lifetime of high reliability products. Many products degrade due to multiple failure mechanisms. In other words, multiple failure mechanisms (competing risks) compete to put an end to the life of a product. In some applications, the process of degradation measurement destructs physical and chemical characteristics of test units. This kind of accelerated test is called Accelerated Destructive Degradation Test (ADDT). In applying these tests resource and estimation issues should be taken into consideration. Sample size, sequence of destructive measurements, number of measurements in each stress level, and other decision variables are important in effectively designing and implementing an ADDT. Therefore, in this paper, the optimal design of an ADDT in presence of competing risks is studied. In this regard, asymptotic variance of the failure time quantile is minimized. A sensitivity analysis on the results is reported to evaluate the robustness of the results to model parameters.

**Key Words:** Reliability, accelerated destructive degradation tests, competing risk, optimal test plan.

## SUPPLY CHAIN NETWORK REDESIGN TO MAKE A RESILIENT SUPPLY CHAIN BY ESTABLISHING ALLIANCE STRATEGY

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### Abstract

A resilient supply chain network design is a strategic issue in the field of supply chain management. Nonethe-

less, designing resilient supply chain has been considered for designing new supply chains in previous research studies, and making resiliency in an existing supply chain has not been investigated. In the current research, redesigning a supply chain to make a resilient supply chain has been studied with the possibility of opening new facilities and closing and resizing the existing facilities. This supply chain consists of a set of manufacturers, existing and potential distribution centers, and existing and potential retailers and customers. Distribution centers and retailers may be redesigned in this chain. For this problem, a mixed-integer linear programming model has been developed. Two existing and most applied strategies consisting of extra capacity and the emergency stock, along with a new disruption risk mitigation strategy, named establishing alliance strategy, have been investigated in various disruption scenarios. Establishing alliance has been applied in two parts of the supply chain including manufacturers and retailers. Computational experiments were conducted to assess the performance of the resilient model and make a comparison between the disruption risk mitigation strategies. The results revealed that the supply capability of the resilient model was 13% higher than that of the non-resilient one. Furthermore, resilient supply chain enjoys 9% better performance than non-resilient supply chain in terms of profit. In addition, "establishing alliance" strategy has greater impact on the supply capability enhancement compared to "extra capacity" and "emergency stock" strategies. Also, establishing alliance between manufacturers in comparison with alliance between retailers has greater impact on the performance of the supply chain in terms of both supply quantity and profit. Through the formation of an alliance among manufacturers, the supply quantity and profit of the supply chain will increase by 6.7% and 5.5%, respectively, while establishing an alliance in retailers improves supply capability and profit by 3.5% and 1.6%, respectively.

**Key Words:** Supply chain network redesign, disruption, resilience, disruption risk mitigation strategy, establishing alliance strategy.

## AN INTEGRATED MODEL OF EFFECTIVE FACTORS IN CUSTOMER SATISFACTION CASE: IRAN KHODRO GROUP CUSTOMER SERVICE

# A BAT ALGORITHM FOR MULTI-PERIOD MULTI-PRODUCT INVENTORY-ROUTING PROBLEM WITH BACKHAULS AND SPLIT DELIVERY

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## Abstract

Transportation planning and inventory management are among the key problems at the various levels of a supply chain. The integration of transportation and inventory decisions is known as the inventory routing problem (IRP) in the literature. Building upon the reviewed literature, this paper expands an operational combination of the classical routing-inventory problem in the form of a two-level supply chain that includes a multi-period, multi-product inventory-routing coupled with various kinds of fleets with different available capacities called Fleet Size and Mix Vehicle Routing Problem (FS-MVRP). In this model, stock out is not allowed. Additionally, two practical and significant features of routing are taken into consideration including: 1- "backhauls" in which the Distributor (Vendor) is supposed to provide services for two groups of the customers (linehaul and backhaul customers), assuming that each one of the vehicles is first unloaded to satisfy the demands of the linehaul customers, and it is later loaded by collecting the loads from the backhaul customers; 2- "Split delivery" strategy according to which there is a possibility to provide the services to each customer by at least one vehicle. Due to the varying demands of the customers, it is quite possible for the demands of some customers to be more than the available capacity of one vehicle. Particularly, in the case of urban transportation, several vehicle transitions occur at a demand point. Thus, the split services can help minimize the number of the vehicles used, which in turn will increase environmental sustainability. Therefore, first, a new mathematical model, i.e., a mixed-integer programming (MIP) formulation,

is presented for the problem. This problem is a non-deterministic polynomial-time hard (NP-hard). Then, according to the literature on routing-inventory problems, a bat optimization algorithm, whose performance is evaluated by an efficient genetic algorithm, is developed for the first time. At the end, the numerical results obtained by this algorithm are analyzed using the randomized test problems.

**Key Words:** Inventory-routing, backhauls, bat optimization algorithm, split delivery, genetic algorithm, multi-product.

# OPTIMAL DESIGN OF ACCELERATED DESTRUCTIVE DEGRADATION TESTS IN PRESENCE OF COMPETING RISKS

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## Abstract

Accurate prediction and evaluation of products reliability is one of the concerns of the companies for technical and managerial decisions. In this regard, failure data of products are used for reliability estimation. However, for products with high reliability, these data require a very long time and a large number of test units that is usually costly and impossible. Therefore, optimal usage of resources such as test units, time and facilities is necessary. Accelerated reliability tests are usually used for gathering failure data of products. However, for products with high reliability no failure or few failures may happen even by accelerated methods. So, evaluation of

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### Abstract

The growth of Information and Communication Technology (ICT) has significantly increased the number of automated web services. Web services are self-contained, modular and distributed piece of software that can be described, published, located, or invoked over the network to create products, processes, and supply chains based on Service Oriented Architecture (SOA). Usually, web services are different in both functional and non-functional (or quality of service) requirements. While functional requirement states what a typical service performs, non-functional requirement states how a service addresses its task. Besides, cloud computing has provided unprecedented opportunities for hosting, developing, publishing, and applying web services. Hence, we are faced with many unique services provided with similar functionality and different Quality of Service (QoS) parameters. Therefore, an efficient service composition is required while providing necessary QoS and user constraints (known as Service Level Agreement). Most of the studies in the literature address service composition problem using QoS values announced by providers (known as advertised QoS values). However, when the services are physically deployed and invoked by service consumer, the values of QoS parameters may vary largely depending on different factors such as network load, number of applications running in the server, and topology changes in network. To address this limitation, in this paper, we present a novel approach based on user observations. The proposed approach considers users' observation in the composition process to overcome the problem of varying QoS values in users-side. The proposed method is implemented using Floyd algorithm and evaluated using real dataset.

**Key Words:** Web service, web service composition, cloud computing, user observation, E-Commerce.

## A QUANTITATIVE FRAMEWORK FOR SELECTING RISK RESPONSE STRATEGIES IN STARTUPS (CASE STUDY: A NANOTECHNOLOGY)

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### Abstract

The failure probability and establishment risk of startups is high due to the required high technical knowledge and added value, new product developments, lack of financial sources and need for specialists. By the use of risk management approaches, one can systematically evaluate the risks related to the decisions and improve the success probability by studying the corresponding opportunities and treats. In this paper, we consider the development phase of Nanotechnology startups as a project and propose a quantitative framework for analyzing the risk response strategies based on the PMBOK standard and a combination of FMEA, TOPSIS, and optimization model. Using FMEA, we can study the effect of risks and risk responses on the startup goals. TOPSIS helps to analyze the impact of risk responses on all the risk factors. The bi-objective optimization model is formulated subject to the prevailing constraints such as budget, time, production capacity and incompatibility of strategies. The proposed optimization model is for determining the Pareto frontier of risk and profits that as a decision tool may help managers to select the appropriate risk response strategies. The validation and sensitivity of proposed framework is analyzed applying it for a Nanotechnology startup in Yazd science & technology Park. Although the complete enumeration can be used to solve the small and medium instances, we propose the Epsilon constraint method successfully in order to solve the large-sized problems. The validation of framework confirm that it can apply to identify, evaluate and select of optimal risk response strategies. Also, the sensitivity analysis results show that the estimation quality of the model parameters particularly costs has a great impact of the outcomes. Therefore, developing the quantitative methods such artificial neural network to estimate the key parameters such as costs, revenues and risk levels is as a direction for the future study.

**Key Words:** Knowledge-based startup, risk, profits, TOPSIS, optimization, FMEA, risk response strategy.

based on a predetermined plan will lead to considerable loss in production performance of oil wells and, hence, higher costs. However, the stopping production process is one of the requirements in giving some services to oil wells and, thus, this leads to greater oil production than the competitor neighbor countries and increasing opportunity cost for us. Therefore, in these conditions, making a balance between servicing with stopping production process and minimizing stopping production is very important. Firstly, a mixed-integer programming model is proposed for the problem considering new applicable and practical features that have not been introduced before. Secondly, algorithms based on Benders and L-shaped exact methods are developed. Moreover, algorithms based on Lagrangian relaxation heuristic method in seven states are developed. Each state involves eliminating some selective constraints of the proposed mathematical model and adding its objective function to obtain the best constraint selection. In fact, the professed goal is to produce a variety of lower bounds. In order to evaluate the performance of the developed algorithms, various small to large instances are generated and, then, the algorithm is applied to simulated instances. Computational results indicate that algorithms based on L-shaped and Lagrangian relaxation methods produce better lower bounds. Moreover, by strengthening the model, algorithms based on Lagrangian relaxation method are able to produce better lower bounds with respect to the algorithms based on the L-shaped method in a short time period.

**Key Words:** Production wells in shared oil fields, well technical services, mixed-integer programming model, lower bound.

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### Abstract

Due to the necessity of communication between production and marketing functions, joint lot size and pricing decisions play an important role in supply chain planning. Moreover in many real world problems there is a fraction of defective items in a received lot that their quality should be evaluated before storage. In this paper, we focus on the problem of simultaneously determining of optimal lot-sizing, pricing and inspection policy with and without replacement of nonconforming items for an inventory system in which demand is price sensitive. The proposed model is based on a maximization of total profit for buyer. It is assumed that the fraction of nonconforming items in a received lot follows a beta distribution and buyer conducts some kind of inspection policies, that include no inspection, inspection and sampling inspection. In addition, in sampling inspection manufacturer's risk and the buyer's acceptable quality level are considered to obtain a fair sampling plan. We assume two standard demand functions which are linear and exponential function of price. We first study our NLP model mathematically and then we develop an analytical algorithm to solve the problem and obtain the optimal inventory-inspection-marketing policies. Finally numerical examples are presented to conduct a sensitivity analysis for important model parameters and to illustrate important issues about the developed models.

**Key Words:** Lot size, non-linear optimization, pricing, statistical inspection planning, two-stage supply chain.

## A JOINT POLICY FOR PRICING, STATISTICAL INSPECTION AND LOTSIZING PLANNING PROBLEM

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## WEB SERVICE COMPOSITION BASED ON USER OBSERVATION IN CLOUD COMPUTING

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with GAMS and Global Criteria's technique. The paper finally identifies the gaps for future modeling efforts.

**Key Words:** Hierarchical facility location-allocation, queuing theory, bi-objective optimization.

## THREE-PHASE AND BI-OBJECTIVE MODELING OF TRANSPORTATION PLANNING, SELECTION AND TACTICAL CHANGES OF THE VEHICLE BASKET

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### Abstract

In this paper, a multi-phase bi-objective mathematical model is presented for a transportation planning. It is assumed that there is a planning horizon which includes some planning periods. In each phase, its related decisions are made. In the first phase, a transportation planning is done for each planning period considering products inconsistency features and other real conditions. In mentioned model steaming decision is made to solve products inconsistency before transporting the new product and the model considers transportation, steaming and other related costs to define optimal tour plan for each vehicle in each time period. The model is solved for each period separately according to the products demands and supplies in mentioned period. In the second phase, according to the total benefit and cost of each vehicle in each period, an optimal portfolio of vehicles is determined. The proposed model of the second phase considers average and risk of using various vehicles and tries to select proper ones. By the proposed portfolio, the transportation company will face to a strategic number of vehicles plan and according to observed periods may have more profit in the future. In the third phase, a bi-objective model is proposed for tactical decisions of

purchasing or sale of each vehicle considering their age, their potential profits, their maintenance and other costs at the beginning of each time period. The first objective tries to maximize the total benefit of the transportation company while the second one minimizes the deviation of number of vehicles with their target value which was determined in the second phase by the portfolio selection model. By the third model, the transportation company will decide to purchase or sale each vehicle types to be used for the next time period. This decision is made considering the required demands or supplies, different costs and benefits. Finally, a fuzzy goal programming approach is used to solve the bi-objective model. Sensitivity analysis is done to consider models validity. Comparison of the proposed three phased approach with a classic transportation problem for a numerical example confirms efficacy of the proposed approach.

**Key Words:** Transportation planning, period planning, horizon planning, portfolio selection, fuzzy goal programming.

## PERIODIC ROUTING OF WELL TECHNICAL SERVICES GROUPS IN OFFSHORE SHARED OIL FIELDS

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### Abstract

Production wells in offshore shared oil fields require well technical services. These services are done by two types of well technical services groups: wellhead services and wire-line services. Production wells in offshore shared oil fields require well technical services and the lack of services affects production productivity of oil wells. In fact, due to supply limitations, there are fewer well technical service groups compared to the number of oil wells. Failure to service oil wells by well technical service groups

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## Abstract

In this paper, the optimal periodic inspection interval over a finite time horizon for a two-component system with two types of failures is determined. The failure type of the first component is hidden. The hidden failure is not self-announcing, i.e., it does not stop the system from working. Thus, it is detected only by inspection; however, any delay in the detection of hidden failures causes an increment in operating costs. The failure type of the second component is of two stages. In other words, the second component has three possible states: healthy, defective, and failed. The defective state is identified just by inspection; however, the failed state is self-announcing, i.e., it reveals itself by stopping the system from working. Each defect and revealed failure of the second component causes a shock to the first component and increases its failure rate. Both components of the system are periodically inspected simultaneously to identify defects and hidden failures. Whenever the system stops working due to the revealed failures of the second component, the first component is also inspected opportunistically to detect the hidden failures. The first component is either minimally repaired or replaced upon inspection if the hidden failure is detected. The second component is also either minimally repaired or replaced upon inspection if found defective or at revealed failure. The total cost of the system includes the periodic and opportunistic inspection costs, downtime penalty costs due to hidden failures, and the minimal repair and replacement costs due to hidden failures, defects, and revealed failures. The goal is to find the optimal periodic inspection interval minimizing the expected total cost over a finite time horizon. In the introduced approach, the inspection model is first developed mathematically. Then, due to the complexity of numerical computing, a simulation algorithm is designed to estimate the expected total cost of the system. Finally, the suggested approach is explained by a numerical example with sensitivity analysis for an electrical distribution system.

**Key Words:** Two-component system, optimal inspection interval, opportunistic inspection, hidden failures, two-stage revealed failures.

## MODELING A HIERARCHICAL FACILITY LOCATION-ALLOCATION PROBLEM WITH QUEUEING

## APPROACH AND SENSITIVE ANALYSIS

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## Abstract

The primary objective of a typical hierarchical facility location problem is to determine the location of facilities in a multi-level network in a way to serve the customers at the lowest level of hierarchy.

Nowadays, hierarchical facility location models have been widely applied in public facility location problems. In most of such cases, a developed model may need to deal with the relocation of existing facilities along with the construction of new facilities. This further acknowledges the need to focus on solving relocation hierarchical facility location problem using innovative approaches such as dynamic time elements.

A facility is an establishment providing services; its level is defined by the highest level of service it offers. Low level services can be supported by a relatively small population. Also, those facilities can be located relatively densely in space. High level services require a large supporting population; they can only be located sparsely in space. Successive inclusiveness means that facilities of each level offer the services available at all lower levels of facility as well as those that require at least that level of facility.

Although, the systems of facilities usually exist as hierarchical systems, location problems have been mostly studied for single-level systems. Hierarchical systems have to decide about the locations of their interacting facilities within a multiple layer configuration. Systems with a hierarchical structure are common both in public and private sectors. In this paper, we present the hierarchical facility location-allocation with two layers, Because of demand congestion in service networks, an M/M/1/K queuing system is considered. We assume that the capacity of each facility is limited. Furthermore, servers of each level offer a different service and Users can go to the higher level server without a low-level server refers them to it. We formulate the problem as nonlinear integer-programming models and solve model

detail element (which is performed as a high-pass filter). The first method proposed in this paper only applies approximation coefficient for process monitoring. The second and third methods consider the detail coefficient by using hard thresholding and soft thresholding, respectively. These methods use a likelihood ratio-based statistic for process monitoring. Hence, they can show an out-of-control status and estimate the change point that is one of the most important diagnostic information. The performance of these methods is evaluated and compared with respect to the average run length and the difference between real and estimated change-point criteria. Simulation studies are performed by using a textile image. Results showed a suitable degree of accuracy in detecting out of control status and estimating change points.

**Key Words:** Control chart, profile monitoring, wavelet, image processing, phase II, generalized likelihood ratio.

## A GAME THEORETIC APPROACH FOR DETERMINATION OF ADVERTISING LEVEL OF A MAIN PRODUCT AND PRICING OF TWO SUBSTITUTE PRODUCTS WITH SPECIFIED PRICE OF THE MAIN PRODUCT

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### Abstract

Advertising is a form of marketing efforts to promote using a product or service. Researches show that in 2015 an estimate of US\$529.43 billion was spent on advertising in the world. In addition, pricing, as the part of the business's marketing plan, is the process of setting the price at which customers buy products and services. In the pricing, manufacturers consider the price at which it

could acquire the goods, the market place, the manufacturing cost, competition, brand, market condition, and quality of product. Therefore, advertising and pricing are two strategic important decisions for manufacturers. In the current paper, three products including one main product and two substitute products where each substitute product is the complementary product for the main product are considered. In this paper, for the first time, the problem of determining the advertising level of the main product as well as determining the pricing of the two substitute products is addressed. It is assumed that the price of the main product is constant and specified. The solution of the mentioned problem is obtained based on the Stackelberg game in which the manufacturer of the main product is the leader and the two manufacturers of the complementary products are the follower. The equilibrium solutions for the mentioned structure are obtained. Also, some sensitivity analysis of the important parameters is done and presented. The results show that the market base has no effect on the main product advertising effort. Also, the result shows that the self-price has the negative effect on the advertising effort but the cross-price has the positive effect on the advertising effort. In addition to, the results show that the main product price has the positive effect on the advertising effort that means if the main product price increases the equilibrium advertising effort will be increases.

**Key Words:** Advertising, pricing, substitute products, stackelberg equilibrium and game theory.

## OPTIMAL PERIODIC INSPECTION INTERVAL OVER A FINITE TIME HORIZON FOR A TWO-COMPONENT SYSTEM WITH TWO TYPES OF FAILURES

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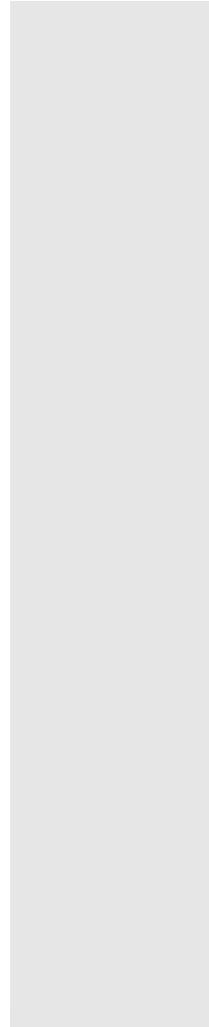
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# Abstracts of Papers in English



## DEVELOPING WAVELET-BASED METHODS FOR MONITORING IMAGES

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### Abstract

Statistical process control plays an impressive role in industries due to the growing complicated products and

processes. This tool helps practitioners prevent the production of defected products and waste of money and time. Due to the importance of processes and inefficiency of methods based on human inspection, the use of image data for statistical process control has gained great attention among researchers in recent years. Image data have been applied by industries for many years for separating defected products and preventing them to get to customers. In recent years, some methods are proposed by researchers in the area of applying statistical features of image data in statistical process control. Image data analysis is decomposed into two categories: spatial domain and frequency domain. The main concentration of previous research studies in the area of process monitoring using image data is in the area of spatial domain analysis. This study has proposed three methods based on one-dimensional wavelet decomposition for monitoring image data with respect to frequency domain features. At each level of decomposition, wavelet transformation decomposes each signal into two elements including an approximation part (which is similar to the main signal and is performed as a low-pass filter) and a