



## Abstract

Vertical cooperative advertising is an advertising coordination scheme utilized by the manufacturers in order to affect the retailers' behavior. In a cooperative advertising program, the manufacturer incurs a part of retailers' local advertising costs in order to motivate the retailers to invest more on local advertising. On the other hand, the budgeting among different media alternatives is becoming an increasingly difficult marketing task. Each alternative, such as TV, radio, billboard, etc., has different effects on market demand and market share. To the best of our knowledge, all the previous studies on cooperative advertising problem have considered only one advertising option that may lead to sub-optimal solutions.

In this paper, we study cooperative advertising problem with multiple local advertising options in a supply chain comprised of a single manufacturer and two retailers. The manufacturer advertises to strengthen the image of his brand. However, retailers' advertisement intends to acquire short-term sales. Each retailer can choose one of the local advertising options, which directly affect its market share. Moreover, the market demand is assumed to be affected by the manufacturer's advertising cost and retailers' advertising options and advertising costs. Therefore, determining the best advertising options and investments are of great importance.

The aim of the problem is to determine the retailers' equilibrium option, each firm's advertising investment, and the manufacturer's participation rates on retailers' local advertising investment. The problem formulated as a three-stage game theoretic model. The retailers make their decisions simultaneously and a Stackelberg game is played between two echelons with the manufacturer being the leader. We provide an illustrative example as well as sensitivity analysis in order to investigate the Subgame Perfect Equilibrium (SPE) and coalitional strategies. A remarkable result is that the manufacturer's profit as well as the retailers' profit improve in coalitional strategies compared to the equilibrium strategy.

**Key Words:** Cooperative advertising; game theory; multiple local advertising options; retailers' competition.

## THE PRODUCTION, REMANUFACTURE AND WASTE DISPOSAL MODEL WHERE RECOVERED ITEMS ARE NOT

## AS-GOOD-AS NEW WITH THE CONSIDERATION OF IMPERFECT QUALITY PRODUCTION AND REWORK PROCESSES

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## Abstract

Inventory management of produced, remanufactured /repaired and returned items has been receiving increasing attention in recent years. In works in the literature researchers assumed that produced and recovered (repaired or remanufactured) items have the same quality. However, some studies considered a more realistic situation where produced and remanufactured items are incompatible; these studies like other studies assumed that manufacturing and remanufacturing process are imperfect. In the real-life production systems, the generation of nonconforming items is inevitable owing to process deterioration or other uncontrollable factors. These defective products can sometimes undergo rework, so that the overall production costs can be reduced. This paper extends the model of a production, remanufacturing and waste disposal system with defective items and rework process. The manufacturing and remanufacturing process are assumed to be imperfect as it can produce some defectives which are reworked in the same cycle itself. Also we assume that demand for manufactured items is different from that for remanufactured (repaired) ones. This assumption results in lost sales situations where there are stock-out periods for manufactured and remanufactured items. Our model considers a production environment that consists of two markets. The first market is for remanufacturing returned items and manufacturing new items while the second market is for collecting returned items to be remanufactured in the first market. Deterministic mathematical model is presented for multiple remanufacturing and production cycles. A solution procedure was introduced then two numerical examples are provided to perform a sensitivity analysis. Finally, conclusion and future researches are presented.

**Key Words:** Production, remanufacturing, closed-loop supply chain, lost sales, defective items, rework process.

ters and distribution vehicles to get to suppliers and shelters.

To demonstrate the efficiency and applicability of the proposed model, we provide a solution to the model by exact method and perform sensitivity analysis on the main parameters. Results show that the proposed model can be used to decide on simultaneous routing, scheduling, and allocating for relief operations in response phase of disaster.

**Key Words:** Evacuation, allocation, routing and scheduling.

### THREE EVOLUTIONARY MULTI-OBJECTIVE ALGORITHMS FOR DOOR ASSIGNING AND SEQUENCING OF INBOUND AND OUTBOUND TRUCKS IN CROSS-DOCKING TERMINALS

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#### Abstract

Cross docking is a warehouse management concept in which items delivered to a warehouse by inbound trucks are immediately sorted out and reorganized based on customer demands and are routed and loaded into outbound trucks for delivery to customers without being held in inventory in the warehouse. If any item is to be held in storage, it is only for a brief period of time that is typically less than 24 hours. Based on this concept, inventory management cost, turn-around times for customer orders, and warehouse space requirements are reduced. In another definition, a cross dock is a consolidation point in a distribution network, where multiple smaller shipments can be merged with full truck loads to decrease the transportation costs. In cross-docking systems, the truck scheduling problem, which decides

on the succession of inbound and outbound truck processing at the dock doors, is significantly important to guarantee a rapid turnover and on-time deliveries. The cost reduction of the cross-docking systems is proved by the successful implementation of several industries: the retail chain (Wal-Mart), the mailing companies (UPS), the automobile manufacturers (Toyota), and less-than-truckload providers. Cross-docking systems can be distinguished based on when the customer is assigned to the individual products. In pre-distribution cross-docking (Pre-C), the customer is assigned before the shipment leaves the supplier who takes care of preparation and sorting. On the other hand, in post-distribution cross-docking (Post-C), the allocation of goods to customers is done at the cross-dock. In this paper, the truck scheduling problem in pre-distribution cross-docking systems is studied and a multi-objective model based on Mixed Integer Programming is proposed. For solving the proposed model, three multi-objective genetic-based algorithms are developed: Non Dominated Sorting Genetic Algorithm-II (NSGA-II), Pareto Envelope based Selection Algorithm-II (PESA-II), and Strength Pareto Evolutionary Algorithm (SPEA-II). In order to evaluate the performance of the meta-heuristics, several numerical examples are randomly generated along with those presented in the literature. At last, the Pareto fronts of three algorithms are compared by three evaluation metrics which contain: Mean Ideal Distance (MID), Spacing Metric (SM), and Quality Metric (QM). The results show that among these developed algorithms, the SPEA-II obtains the best performance based on all evaluation metrics.

**Key Words:** Cross docking, truck scheduling, door assignment, multi-objective optimization, NSGA-II, SPEA-II, PESA-I.

### COOPERATIVE ADVERTISING WITH MULTIPLE LOCAL ADVERTISING OPTIONS AND COMPETING RETAILERS

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#### Abstract

This paper provides an optimization model for second-handed products from customers and providers' point of views using game theory. Nowadays, customers with low financial ability usually tend to buy second-handed products. This provides the opportunity for dealers of second-handed products to make profit from selling such products. Since the customer is unaware of the product's performance, the dealer offers warranty or upgrades the product. This, in turn, may increase the price of the product and make the customer reject the offer to buy the product. When the dealer determines the warranty coverage and upgrade level regardless of the customer's expected cost, customer may decide not to buy the product. Therefore, the dealer should consider the cost of the customer in addition to his profit. In an actual environment of buying second-handed products, it can be expected that the customer determines the upgrade level and the length of his warranty period so as to minimize his cost during the product's useful life. Upon this decision of the customer, the provider of the second-handed product determines his margin of profit so as to maximize his expected profit considering demand for the second-handed product. In the present study, we consider the conflict between the customer's expected cost and the provider's expected profit for the second-handed products. The customer decides based on cost-benefit balance and the dealer decides based on maximizing his expected profit. Therefore, Stackelberg decision model for modeling this problem is used. In this model, customer is the leader, and dealer is the follower. We assume that warranty coverage and upgrade level are customer's decision variables to be determined so that the customer's expected cost is minimized; warranty, upgrade, post-warranty profit margins are dealer's decision variables to be determined so that the dealer's expected profit is maximized. In this model, the demand for the second-handed product depends on the expected sale price and the expected post warranty price. To solve this problem, the game model is used by the Karush-Kahn-Tucker conditions. Finally, a numerical example and the sensitivity analysis are discussed.

**Key Words:** Warranty, second-handed products, upgrade, game theory, non homogenous poisson process.

## AN INTEGRATED MODEL OF SIMULTANEOUS ROUTING, SCHEDULING, AND ALLOCATING FOR RELIEF OPERATIONS IN RESPONSE PHASE OF DISASTER

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#### Abstract

Every year, man-made accidents or natural disasters, such as earthquakes, tsunamis, hurricanes, etc., make thousands of people homeless and cause considerable damages, and even death of many people. Planning for basic actions can reduce these damages.

One of the most vital actions of disaster response phase is to evacuate healthy people from disaster-stricken areas to shelters and provide basic needs for them. By choosing efficient routes and relief operations at the right time, loss of life and financial damage are diminished.

In this study, an integrated network of routing, scheduling, and allocating at the same time is modeled for evacuating healthy people to shelters and providing relief items for them. In the evacuation operations, the possibility of servicing to healthy people in each disaster by several vehicles, existence of multiple depots of heterogeneous vehicles, and time window constraints for vehicles to get to disaster areas and shelters are considered. In the distribution process of relief items, the possibility of getting service from each supplier by several vehicles, existence of multiple depots of heterogeneous vehicles, and time-window constraints for vehicles to get to suppliers and shelters are introduced. To get closer to the real world, evacuation vehicles for people and item distribution vehicles are considered differently, shelters' capacity constraint and vehicles' number and capacity constraint are introduced to perform a better planning for response phase of disaster.

A mixed integer linear mathematical programming model is presented to minimize the total time required for evacuation vehicles to get to disaster-stricken areas and shel-

of parameters named as advertising effectiveness of each member on rival member's sale response functions, on optimal decision variable paths of each chain member, is examined in three scenarios. In the first scenario, the effect of Manufacturer's advertising on retailer's strategies was performed. In the second scenario, the effect of retailer's advertising on the manufacturer's strategies was evaluated. Finally, in the third scenario, simultaneous change in Manufacturer and retailer's effect on competitor's profit functions was investigated. In all scenarios, it is observed that these parameters have a decreasing effect on all channel member's optimal decision variable paths.

**Key Words:** Differential games, dual channel supply chain, dynamic pricing and advertising, feedback nash equilibrium, stackelberg equilibrium.

## LOCATING REMANUFACTURING AND WAREHOUSE CENTERS IN THE INTEGRATED FORWARD AND REVERSE LOGISTIC CONSIDERING STOCHASTIC DEMANDS AND LIMITED CAPACITIES

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### Abstract

One of the most important issues of location is locating the facilities in two types of problem: facility location problems with limited capacity and non-limited capacity. The objective of these problems is to find the best and most suitable location for facilities. In this paper, with studying various models for locating with in forward and reverse logistics systems and also reviewing recent papers in this area, we proposed an integrated model in facility location in which "forward" and "reverse" networks are considered simultaneously. In this

model, we consider producers, intermediate centers, and remanufacturing centers, and warehouse centers simultaneously which are to be located in an integrated logistics system with limited capacities. To model this problem in this study, we propose a 0-1 mixed integer programming model in which forward and reverse flows and their mutual interactions are considered simultaneously. In this problem, customer demands are considered as stochastic, and demands for this model contain new products and returned products. To examine the efficiency, the mixed 0-1 and integer programming models, various test problems, and numerical calculations are solved by GAMS 24.1.2 optimization software. To show the effectiveness of this model, we have considered the test problem extended to Bostel and Lu study in 2007 in which forward and reverse networks are considered simultaneously with respect to the remanufacturing centers. By comparing the numerical results obtained from the model, it was shown that the proposed model provides a more optimal solution. To satisfy customer demands regarding returned products, we focused on the remanufacturing centers. In the study, we also showed that considering the facilities simultaneously would directly affect reverse logistics network structure. Also, the cost of production and remanufacturing centers affect the total cost of logistic network, such that by increasing the percentage of remanufacturing due to lower production costs, the total cost of network is reduced. So, with appropriate decision making and correct information about choosing the recovery facility (remanufacturing centers), returned products can be as many as possible to remanufacture and repair the damage, and thus avoid extra production costs.

**Key Words:** Facility location; logistics network; forward and reverse logistics; 0—1 mixed integer programming; stochastic demands.

## DETERMINING THE OPTIMAL UPGRADE LEVEL, WARRANTY DURATION AND PROFIT MARGINS FOR SECOND-HANDED PRODUCTS FROM THE VIEWPOINTS OF CUSTOMER AND PROVIDERS USING GAME THEORY

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#### Abstract

The necessity for integration and coordination of various components in a Supply Chain Management has been recognized as an important factor for most companies to remain competitive. Most of the activities in the supply chain management are inter-related and changes in one part of the supply chain management are likely to affect the performance of other processes. Production, inventory management, and transportation are three of the key logistical drivers of the supply chain management. Other components include, location, marketing, and purchasing. Production inventory routing problem combines two classic well-known problems, namely inventory routing problem and lot-sizing problem. The problem is solved in an attempt to jointly optimize Production, inventory, and routing decisions, and is thus a generalization of the inventory routing problem. The implementation of production inventory routing problem is critical, especially in a Vendor Managed Inventory (VMI) replenishment system, where the supplier or manufacturer observes and controls the inventory levels of its customers or retailers. One of the most important benefits of VMI is that it permits a more uniform utilization of transportation resources. This leads to a higher level of efficiency and a much lower distribution cost that often constitutes the largest part of the overall cost. Customers benefit from higher service levels and greater product availability due to the fact that vendors can use the existing inventory data at their customer sites to more accurately predict future demand. Although the Production inventory routing problem has a complicated structure, a growing interest in this problem in recent decade has drawn attentions theoretically to the problem. This article provides a comprehensive review of the existing literature and the associated classifications. The article also presents one of the models of the problem. The proposed model consists of a two-surface supply chain which has a production site and multiple customers with finite demand. The problem is presented in multiple products and inventory shortages are not permitted. Finally, we point out interesting research directions for further developments in production inventory routing problem.

**Key Words:** Supply chain, production inventory routing, exact algorithms, heuristics, multi products.

## FEEDBACK NASH EQUILIBRIUM FOR DYNAMIC ADVERTISING AND PRICING IN DUAL CHANNEL SUPPLY CHAIN

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#### Abstract

This paper considers the problem of optimal advertising and pricing paths of a dual-channel supply chain members through differential games approach. Considered Supply Chain consists of a manufacturer and a retailer. The manufacturer indirectly trades with the final consumer in retail or traditional channel and directly trades with the final consumer in online channel. Retailer trades with the final consumer just in traditional channel. Manufacturer affects on chain members' profits with identifying control variables as online price, global advertising effort, and online advertising effort. The global advertising effort of the manufacturer has indirect and long-term effects on sale functions of both members. On the other hand, local advertising efforts of both firms in retail and online channel have direct and short-time effects on sales functions. Retailer's control variables are retail price and local advertising effort. The state variable of the dynamic system is the goodwill of the manufacturer which means that the accumulated reputation of the manufacturer is increased by the national advertising effort of manufacturer. In this article, competition between chain members are modeled by evaluating Feedback Nash equilibrium. Also, the model is validated by results of the Stackelberg game model with manufacturer leadership consideration. The comparison between the two models showed that, chain profit in Stackelberg model is higher than chain profit in Nash model. At last, with a numerical example, impact

the effect of personality type on the knowledge acquisition (KA) techniques.

This paper examines KA techniques through an empirical study involving 82 participants who were assessed by six KA techniques in this context.

Each technique was implemented by experts in the field of Power Industry; they evaluated the techniques using a questionnaire. Also, Myers-Briggs questionnaire was used to assess personality types consisting of dimensions, such as extroversion- Introversion, Intuition-Sensing, Feeling- Thinking, perceiving- judging.

The results confirmed some relations between the type of personality and KA techniques. As seen, extraversion was positively correlated with interview, card sorting, and twenty- question techniques.

Introversion was positively correlated with laddering techniques, diagram-based and repertory grid technique. Intuition was positively correlated with card sorting, repertory grid, twenty questions; sensing was positively correlated with laddering techniques, diagram-based, and interview.

Thinking was positively correlated with laddering techniques, diagram-based, twenty questions and card sorting; feeling was positively correlated with interview and card sorting.

Perceiving was positively correlated with interview, and judging was positively correlated with laddering techniques, diagram-based, twenty questions, card sorting and repertory grid technique.

**Key Words:** Knowledge acquisition techniques, personality type, knowledge acquisition.

## PRESENTING A FUZZY MULTI-OBJECTIVE MODEL IN SUPPLIER SELECTION FOR MINIMIZING EFFECTS OF GASSES OF VEHICLES TRANSPORTATION

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## Abstract

Supplier selection is one of the most important activities of purchasing departments. This importance increase even more by new strategies in a supply chain. Supplier selection is a multi-criteria decision making (MCDM) problem in which criteria have different relative importance. Due to the key role of supplier's performance on cost, quality, delivery, and service in achieving the objectives of a supply chain. Supplier selection is a multiple-criteria decision-making problem affected by several conflicting factors. In practice, for supplier selection problems, many input pieces of information are not known precisely. The fuzzy set theories can be employed due to the presence of vagueness and imprecision of information.

The essence of evaluation process and supplier selection is a complex multipurpose decision making problem issue that is affected by several factors. In fact, the evaluation process and supplier selection are based on a series of criteria that must be considered in this process. In this research, a multi-objective model in supplier selection issue is presented for one product. The total cost in suggested model consists of supplier costs and purchaser's costs and also environmental polluters caused by vehicles transportation have been spotted as an affective factor on evaluation process and total provider's selection. The considered criteria in the suggested model are comprised comprehensive total cost of providers (total costs of ordering and shortage) and minimizing rate of the rejected and uncorrected goods that is also correctable and incorrigible. In fact, minimization of providers lack of quality goods leads to minimizing receiving rate of delayed goods (reducing lead time) and reducing environment polluters caused by transportation vehicles such as (aerial, marine, earthy, railway). We used two methods, such as Zimmermann Fuzzy and Werner "fuzzyand" approaches, to solve the suggested model. These methods are analyzed by different dimensions on experimental produced issues, and finally, three methods are compared on produced issues.

**Key Words:** Supplier selection, multi-objective optimization, environmental pollutants, vehicles transportation, fuzzy approach.

## A REVIEW OF THE STUDIES OF PRODUCTION INVENTORY ROUTING PROBLEM CONSIDERING MODELING AND SOLUTION TECHNIQUES

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PSO-Greedy algorithms. Based on computational analysis, it can be observed that the PSO-A\* algorithm is more efficient compared to the PSO algorithm in which its lower level sub problems are solved through an exact solver; it is also more effective compared to the PSO-Greedy algorithm.

**Key Words:** Two-Echelon supply chain, procurement problem, stackelberg game, hybrid algorithm.

## CAPACITY ALLOCATION PROBLEM IN A MULTI-PERIOD OF SUPPLY CHAIN MODEL IN LIGHT OF GAME THEORY APPROACH

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### Abstract

Capacity allocation plays an important role in supply chain management. In this study, a multi-period scenario is considered for a distribution system with one supplier and two retailers. The supplier may have infinite or finite capacity and allocates one product to the retailers at the beginning of a selling season. The retailers have a general cost structure and make ordering decisions to maximize their own profits. The order strategy of one retailer affects the order strategies of all other retailers, which results in a strategic interaction among the decision making of all retailers. The quantity requested by a retailer is called an order, or a claim. When the total quantity of orders from retailers exceeds the supplier's capacity, some rules are followed to allocate the capacity to the two retailers. The quantity of product that a retailer actually receives is called an allocation. In general a retailer's allocation is different from its order. The customer demand at each retailer is random in every period of time, and when a demand cannot be met by one retailer due to a stockout, the customers may go to the other retailer. This phenomenon is often referred

to as market search. Since the two retailers compete for both supply and demand, the ordering decision at one retailer affects the demand of the competing retailer, thereby creating a strategic interaction among the retailers' inventory decisions. We analyze the inventory control decisions for the retailers using a game theoretical approach. In this paper game theory is used to study this problem. We are able to derive some necessary and sufficient conditions for the existence of a unique Nash equilibrium. It is shown that if the supplier's capacity is unlimited, there will always be a unique equilibrium; if capacity is limited, there is an equilibrium only under certain conditions.

**Key Words:** Multi-Period of supply chain management, capacity allocation problem, game theory, market search.

## EXPLORING OF THE EFFECT OF PERSONALITY TYPE ON KNOWLEDGE ACQUISITION PROCESS OF EXPERTS

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### Abstract

Experts in organizations are the most valuable resources and assets. If experts leave the organization, their experience and knowledge of the organization are lost, and cost of regaining the lost experience and knowledge would be considerable. Therefore, over the past recent years, interest in knowledge acquisition (KA) has increased radically, because about 90% knowledge is tacit and embedded within employees' minds. We face different types of experts and many different types of knowledge they provide for the organizations.

The literature emphasizes the role of personality characteristics in the process of KA. Benbasat and Dhaliwal (1990) believed that one of the important specifications of experts that affect KA process is personality characteristics. The main objective of this paper is to explore



## MIN-MAX GOAL PROGRAMMING APPROACH

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### Abstract

This paper proposes a new model based on a Min-Max goal programming approach and using robust optimization model for the multi-objective portfolio selection problem. In Min-Max goal programming, decision-makers can achieve more than one objective function. Some uncertain coefficients exist in both single and multi-objective models of the portfolio selection problem, which affect the feasibility and optimality of solutions. Robust optimization is an approach that deals with the uncertainty parameters in mathematical models and guarantees the feasibility of the solutions. This paper tries to address the uncertainty parameters with the robust optimization approach. This paper presents a Min-Max goal programming for the portfolio selection problem and addresses the uncertainty of the parameters by the use of robust optimization approach. For this purpose Markowitz Mean Variance model with two objectives, expected return and expected risk, has been transformed into a four-objective model under uncertainty by adding two new objectives, divided annual profit and stock price in the last day of exchange. Using this model, we may consider decision-makers' opinions and uncertainty together. At first, a min-max goal programming model is presented, and then to add uncertainty, the model is extended to a multi-objective robust model in which uncertainty exists in both expected return and expected risk parameters. Bertsimas and Sim approach (2004) is utilized for robustness of our model. This robust model is linear and applied to optimize a sample of 20 stocks from Tehran Stock Exchange in a period of April 2013 to April 2014 under conditions of uncertainty. The results of the study show that the conservatism of the solution increases when the price of robustness increases. So, the proposed model can efficiently confront uncertainty in multi-objective portfolio selection problem, and this model is more practical in the real world than others.

**Key Words:** Portfolio selection, min-max goal programming, multi-objective robust optimization, bertsimas and sim approach.

## DEVELOPING A BI-LEVEL PROGRAMMING MODEL FOR PROCUREMENT MANAGEMENT AND A HYBRID ALGORITHM FOR ITS SOLUTION

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### Abstract

In this paper, we deal with a procurement problem in a decentralized two-echelon supply chain, in which a buyer (manufacturer) aims to procure a bundle of needed items from a number of suppliers. The problem is modeled via a bi-level programming model, in which the buyer acts as a leader and the suppliers separately act as followers on lower level. To solve this bi-level mathematical model, a hybrid algorithm based on particle swarm optimization (PSO-A\*) is proposed. The proposed mechanism, by satisfying the partners' constraints, is able to reach a near-optimal solution which persuades the partners to contract. In this paper, a comprehensive pattern is proposed for embedding the negotiation process in mathematical models and their solution procedure. This study aims at developing a bi-level programming to deal with a negotiation-based procurement problem, according to the realistic assumptions, in which the buyer is considered as a leader and makes optimal decisions according to suppliers' proposals in lower level as followers. Such a mechanism provides an alignment among suppliers' production planning and order allocation to avoid instantaneous orders, inability of suppliers to supply orders, and impose high inventory cost. In addition, it supports the partnership with valued suppliers through suitable order allocation by taking suppliers' capacities into consideration. This research has been done based on the assumptions derived from the interviews with the experts in supplying automotive parts company called SAPCO and a number of its partners. To evaluate the performance of the proposed algorithm, the results of the PSO-A\* algorithm are compared with those of PSO-Exact and

# Abstracts of Papers in English

## DYNAMIC OPTIMIZING OF PARAMETERS IN HARMONY SEARCH ALGORITHM FOR RELIABILITY-REDUNDANCY ALLOCATION WITH ADDITIONAL COMPONENTS PROBLEM

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### Abstract

Nowadays, metaheuristic algorithms play a significant role in solving optimization problems. These algorithms have primary parameters that optimized tuning of them

play an effective role in the quality of obtained solution. Many of the current methods have considered the tuning parameters as constant in all ongoing stages while it is appropriate for the tuning parameters to undergo necessary changes during the phases under various circumstances. In this paper, we propose a method based on taguchi-based experimental design method to tune the harmony search metaheuristic algorithm. With the aid of this method which is capable of great performance in many metaheuristic algorithms, we hope to tune the primary parameters dynamically. Having examined the performance of dynamic taguchi parameter setting method on the four problem of optimizing additional components assignment, the results confirm the superior stability and reliability of this method in comparison to the classic taguchi method.

**Key Words:** Metaheuristic algorithms, experimental design, reliability-redundancy allocation, optimization.

## ROBUST OPTIMIZATION FOR MULTI-OBJECTIVE PORTFOLIO SELECTION PROBLEM WITH