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2019-20



ST. ANNE'S COLLEGE OF ENGINEERING AND TECHNOLOGY

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10	Performance analysis of an M/M/1 queue with N-policy	Dr. A. Azhagappan	S&H (Mathematics)	Applications and Applied Mathematics:	1932-9466	0.766



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	interrupted closedown preventive maintenance balking and feedback			An International Journal		
11	Transient behavior of an M/Ek/1 queue with vacations, balking and control of admission during vacations	Dr. A. Azhagappan	S&H (Mathematics)	International Journal of Mathematics in Operational Research	1757-5869	1.212

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Variant impatient customers in an M/M/1 queue with balking re-service and Bernoulli multiple vacations

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ABSTRACT

The impatient behavior of customers' plays a vital role in the growth of the economy of a country. Customers leaving the queue, before getting served due to impatience, lead to heavy loss in trading centers. So, it is very important to study and analyze the impatient behavior of customers in various queueing models. A mathematical analysis of one such model is presented in this present research work. This paper analyzes the transient behavior of an M/M/1 queue with Bernoulli multiple vacations, balking, re-service and variant impatient customers. As soon as the server becomes free, he resumes Bernoulli multiple vacations. That is, the server commences either multiple vacations or multiple working vacations. During vacations and working vacations, the customers possess balking behavior. During working vacations, as the service speed is low, the customers waiting in the queue become impatient due to the huge waiting time. But, the customer who gets the service in slow service rate does not become impatient. After the completion of service, the customers may demand re-service during the busy periods. The transient system size probabilities, mean and variance are derived. Further, numerical simulations are provided to analyze the influence of various parameters of the system.

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KEYWORDS

The M/M/1 queue; multiple vacations under Bernoulli schedule; variant impatient customers; balking and re-service; transient probabilities

JEL CLASSIFICATION

C44; C49; C61

1. Introduction

During the past few decades, vacation queueing models were developed by many researchers due to their vast applications in a variety of fields such as service systems, computer networks, communication systems, etc. As soon as the system becomes empty, the server may start Bernoulli multiple vacations. That is, he may begin either multiple vacations (MV) or multiple working vacations (MWV).

For the MV periods, the server is unavailable to serve the arrivals (Altman & Yechiali, 2006; Ammar, 2015; Doshi, 1986). For the MWV periods, the server serves the arrivals with a slow service rate (Guha, Goswami, & Banik, 2015; Laxmi & Jyothisna, 2015; Selvaraju & Goswami, 2013; Servi & Finn, 2002; Sudhesh & Azhagappan, 2018; Sudhesh, Azhagappan, & Dharmaraja, 2017; Zhang & Zhou, 2017). During the MV and MWV periods, the arrivals are getting no service and service with a slower rate, respectively. As a result, they may become discouraged and decide not to join (i.e. balk) the queue (Laxmi & Jyothisna, 2015). Meanwhile, after joining the queue, they may also move out from the queue (i.e. renege) before getting served due to the slow service (no service) during MWV (MV) periods (Altman & Yechiali, 2006; Ammar, 2015; Evdokimova, Turck, & Fiems, 2018; Kim & Kim, 2015; Laxmi & Jyothisna, 2015; Selvaraju & Goswami, 2013; Sudhesh & Azhagappan, 2018; Sudhesh et al., 2017; Yu & Liu, 2017). After the completion of service, every unsatisfied customer may demand for another immediate service called re-service (Takacs, 1963).

The *practical application of the proposed model* is given as follows: In *wireless communication systems*, if a signal (customer) is received in the base station (server), one of the channels nearest to the frequency of that signal is getting

connected (service) with that signal. When there is no signal (system empty) waiting for connection, all the channels in the base station either resumes some maintenance works (vacations) like self boost up activities or connecting the signal slowly along with maintenance works (working vacations). During the time of slowly connecting the signals, the signals which are waiting to be connected, maybe lost due to the long waiting time (impatience). During the maintenance activities, the signals may not wait for connection with the channels (balking). When the processing of the signal does not meet the required standard, it would be repeated immediately (re-service).

Doshi (1986) analyzed the situation that the server is unavailable to serve the primary customers whenever he serves the secondary customers (MV). He analyzed this scenario, in detail with various illustrations. The impatient behavior of customers for various queueing models with MV was studied by Altman and Yechiali (2006). They derived the steady state system size distributions, mean number of customers in the system at an arbitrary epoch, proportion of customers being served, etc. Ammar (2015) analyzed the impatience of customers in an M/M/1 queueing model wherein the server is subjected to multiple vacations. He obtained the time-dependent distributions, mean and variance of system size.

The concept of working vacations was introduced by Servi and Finn (2002) in a single server queue in which the server provides service to the arrivals with a slower rate instead of completely stopping the service. The M/M/1 queueing model with working vacations (single and multiple) and a different impatient behavior of customers was analyzed by Selvaraju and Goswami (2013). They derived



Diagnosis of Parkinson's Disease at an Early Stage Using Volume Rendering SPECT Image Slices

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Abstract

The non-degenerative variant called scans without evidence of dopaminergic deficit (SWEDD) is clinically analyzed and wrongly understood as Parkinson's disease (PD) that results ineffective diagnosis of PD in the early stage. The present work is designed to improve the diagnostic accuracy at the early stage of PD from SWEDD and healthy control (HC). The volume rendering image slices are used as a novel method to achieve better diagnostic accuracy. These image slices are chosen from the single-photon emission computed tomography (SPECT) images based on their striatal uptake region, which contributes appreciated information on the shape of the striatum. Features related to surface and the shape of the striatum are calculated from the segmented region of the chosen image slices to illustrate the good amount of variations among early PD, SWEDD, and HC. Among these feature sets, the most optimized feature is selected using genetic algorithm. The performance of the classifiers like linear, radial basis function-support vector machine (RBF-SVM), extreme learning machine (ELM) activation functions, and RBF-ELM are investigated and compared based on the most optimized feature. It is noted that the RBF-ELM offers better performance with an accuracy of 98.23% than the other classifiers. This also proves that the present work is better than the previous studies. Hence, the proposed approach could act as an aid in the detection of early stage of PD.

Keywords Volume rendering image slices · SPECT · SWEDD · Early PD · RBF-ELM · Shape and surface fitting

1 Introduction

Parkinson's disease (PD) is a neurological disorder, which is caused as the dopamine content in the striatum is reduced from the normal amount. This disease is clinically recognized with the observation of the cardinal symptoms like tremor, bradykinesia, rigidity, postural instability, psychiatric, cognitive disturbances, and so on. Such symptoms of PD are full blown, and it has an effective response to the drug levodopa (medication used to treat PD) in the advanced stage. However, the symptoms are unknown and it has an ineffective response to the drug levodopa at an early stage of the disorder, that is, to say in the initial period of 2 years [1, 2]. Hence, a novel and effective methodology is required for diagnosing early PD.

The SPECT image is used to identify the small variations in dopamine content, even in the early stage of the

disease. In SPECT imaging, the radiopharmaceutical drug is injected and gets absorbed by the active dopamine cells in the striatum. The scan machine captures the absorbed drug level. The captured images can be normal (no dopamine deficit) or abnormal based on its uptake pattern [3]. The normal or HC images appear as a symmetric or comma-shaped striatum regions (putamen and caudate) as shown in Fig. 4c; whereas abnormal or PD images appear as an asymmetry or dot-shaped striatum regions as shown in Fig. 4a [4–6]. About 10–15% of subjects diagnosed as PD by the experts have the normal uptake pattern in the scans. These subjects coined as “scans without evidence of dopaminergic deficit” (SWEDD) [7, 8]. SWEDD subjects do not respond to PD medication (levodopa) and the regular follow up of these subjects is unlikely to have PD [9, 10]. This process made itself more accurate and simple only by the SPECT images. Hence, the SPECT images are found to support the clinicians in diagnosing early stage of PD [4, 11]. Unlike the other image called synthetic aperture radar (SAR) [12], magnetic resonance imaging (MRI), and computed tomography (CT), the raw SPECT images are preprocessed by the experts of Parkinson's progression markers initiative (PPMI)

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Investigation characteristics of prosopis juliflora biodiesel blended with diesel fuel in a DI diesel engine

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ABSTRACT

The main aim of the work is to performance and emission of Prosopis Juliflora oil blended with Diesel fuel in a diesel engine. To extract the oil from the Prosopis Juliflora. oil through mechanical extraction. Property studies were made on the oil called PJFO, PJFO50D50 and PJFO40D50DEE10 to property characterise it as fuel for diesel engines. Blending of PJFO (namely PJFO50D50 and PJFO40D50DEE10) was prepared by mixing, respectively, diesel by volume. All the fuels were tested in a single cylinder diesel engine for their performance was compared to diesel fuel. Engine test results showed comparable performance for all PJFO50D50 and PJFO40D50DEE10with diesel fuel. At the full load condition, the power output the brake thermal efficiency was found as 31.43%, respectively, with PJFO40D50DEE10 and whereas it was 29.5% with BD. There is a considerable reduction in Smoke and NO_x emissions with PJFO40D50DEE10 compared to BD at all power outputs.

Abbreviations: PJFO: Prosopis juliflora oil; BP: Brake Power; BTE: Brake Thermal Efficiency; SFC: Specific Fuel Consumption; EGT: Exhaust Gas Temperature; NO_x: Nitrogen oxide; HC: Hydrocarbon; CO: Carbon Mono Oxide

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KEYWORDS

Prosopis Juliflorabio diesel;
smoke; brake thermal
efficiency

1. Introduction

Diesel engines are popular prime movers which are used in industrial, transport and agricultural applications due to their high efficiency and reliability. However, suffer from high smoke and nitric oxide emissions. The increasing in the cost of diesel fuel, reduced availability, more stringent governmental regulations on exhaust emissions and the fast depletion of world-wide petroleum reserves provide a strong encouragement to the search for alternative fuels. The commonly accepted that clean combustion in diesel fuel can be achieved only if engine development with fuel reformulation and the use of alternative fuels are implemented. There are many number of alternative fuels for diesel engines such as vegetable oil esters, tyre Thermal cracking oil, orange oil, kikar seeds oil, coconut shell oil, etc., were introduced from the recent researches. Depletion of diesel derivatives and increase in emission in diesel engine increases the research interest in the area of alternative fuels. Thermal cracking is the thermal degradation of carbonaceous materials at temperatures between 300°C and 700°C in the absence of oxygen. The process is endothermic and requires an external indirect input of energy typically through the walls of the reactor. The heat volatilises and decomposes the organic matter to produce a Thermal cracking gas and liquid and solid char in

relative proportions depending on the process parameters of temperature and pressure. An oxygen-free atmosphere in the paralytic chamber is hard to achieve was reported by Howell heck. Therefore, an oxidation zone may exist. Oxygen bound in the refuse and from the air reacts with solid carbonised fuel, producing carbon monoxide.

2. Products of thermal cracking

2.1. Gas

The gas is primarily of methane, hydrogen, carbon monoxide, water, and more complex of hydrocarbons, each as ethane, propane, oils and tars. The exact components in per cent composition of these gases formed by Thermal cracking of either MSW or any other feed stream cannot accurately be predicted in a real system.

2.2. Liquids

The Thermal cracking oil consists mainly of tar, light oil, and liquor. The tar contains from 17% to 26% olefins, 62% to 80% aromatics, and 4% to 15.5% paraffin's and naphthenes, and the remainder is organic compounds that have been identified as acids, bases, ketones, and aldehydes containing from one to eight

Investigation on utilization of biogas & Prosopis juliflora biodiesel in dual fuel mode in a single cylinder DI diesel Engine

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Abstract

Alternative fuels gained importance due to increasing vehicle population in turn escalation of fuel cost. India being an agricultural based country, bio fuels are the best solution for diesel engine which is also a reason for improving rural economy. In this work, experiments were carried out on a single cylinder DI diesel engine by means of using bio-gas as a primary gas and Prosopis Juliflora biodiesel and diesel oil as secondary fuel in dual fuel operation. The experiments were executed to investigate engine performance i.e. (brake specific fuel consumption, brake thermal efficiency and exhaust gas temperature) and emission parameters together with Carbon Monoxide, Carbon dioxide, Nitrogen Oxide and unburned hydro carbon. For the Dual-fuel system, the consumption device of the engine used to convert into biogas and biodiesel. Biogas was admitted by injection at right duration by means of a gas injector. All the parameters of engine were obtained by gradually changing the loads for diesel and PJFO. However, the BSFC of the engine confirmed lowering slope with increase in engine load for all study conditions. For above 40% of engine load the BSFC values are very closer. The engine emission observation confirmed that the CO₂, CO and NO_x emissions increased with engine load. The NO_x emission of dual fuel mode is superior than that of single fuel mode.

Keywords: Biodiesel; Biogas; Dual fuel; Engine performance; Exhaust emission.

1. Introduction

These days, due to the rapid depletion, ever rising fuel charges, uncertainty in supply and ever increasing demand of petroleum and most importantly stringent emission norms have triggered an extensive research for alternative fuels. Subsequently fuels which can be renewable, smooth burning and can be produced in a decentralized manner are being investigated as alternative fuels. Over few decades, lot of studies has been done on use of alternative fuels in IC engines. Diesel fuel is essentially fed on via the transportation quarter, agriculture & power manufacturing. Performance tests based on the engine overall performance have hooked up the feasibility of the usage of distinct bio-fuels [1]. The biodegradable, non-poisonous and possesses low emission profiles. The term bio-gas is noted opportunity fuel which is produced from biomass. Bio-diesel is a surroundings pleasant alternative liquid fuel for the diesel. Biodiesel is produced by a trans-esterification process of vegetable oils, animal fats and waste oils. Chemically, bio-diesel is known as the mono-alkyl-esters of lengthy-chain-fatty acids derived from renewable liquid fuel. The benefits of biodiesel are that it reduces the formation of sulphur dioxide (SO₂), CO, HC and pm emissions throughout the combustion system due to its low sulphur, low fragrant, and the presence of oxygen-containing compounds [2]. Similarly to this, biodiesel has appropriate ignition potential in engine due to its extraordinarily excessive cetane range as compared to that of traditional diesel fuel [2, 3]. Biogas is produced from anaerobic biodegradation of



Analysis of Batch Arrival Single and Bulk Service Queue with Multiple Vacation Closedown and Repair

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Abstract

In this paper, we analyze batch arrival single and bulk service queueing model with multiple vacation, closedown and repair. The single server provides single service if the queue size is ' $< a$ ' and bulk service if the queue size is ' $\geq a$ '. After completing the service (single or bulk), the server may breakdown with probability ξ and then it will be sent for repair. When the system becomes empty or the server is ready to serve after the repair but no one is waiting, the server resumes closedown and then goes for a multiple vacation of random length. Using supplementary variable technique, the steady-state probability generating function (PGF) of the queue size at an arbitrary time is obtained. The performance measures and cost model are also derived. Numerical illustrations are presented to visualize the effect of system parameters.

Keywords: Batch arrival; Single service; Bulk service; Multiple vacation; Closedown; Repair; Supplementary variable technique

MSC 2010 No.: 60K25, 90B22, 68M20



Transient Behavior of a Single-Server Markovian Queue with Balking and Working Vacation Interruptions

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Abstract

This paper studies the time-dependent analysis of an M/M/1 queueing model with single, multiple working vacation, balking and vacation interruptions. Whenever the system becomes empty, the server commences working vacation. During the working vacation period, if the queue length reaches a positive threshold value ' k ', the working vacation of the server is interrupted and it immediately starts the service in an exhaustive manner. During working vacations, the customers become discouraged due to the slow service and possess balking behavior. The transient system size probabilities of the proposed model are derived explicitly using the method of generating function and continued fraction. The performance indices such as average and variance of system size are also obtained. Further, numerical simulations are presented to analyze the impact of system parameters.

Keywords The M/M/1 queue · Single and multiple working vacation · Balking · Vacation interruption · Continued fractions · Transient probabilities

Mathematics Subject Classification 60K25 · 90B22 · 68M20

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Analysis of state dependent $M^{[X]}/G(a, b)/1$ queue with multiple vacation second optional service and optional re-service

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Abstract: The objective of this paper is to analyse an $M^{[X]}/G(a, b)/1$ queueing model with second optional service, multiple vacation, state dependent arrival and optional re-service. After completing the first essential service, a batch of customers either requests for re-service or leaves the system without re-service. After the completion of first essential service (with or without re-service), the batch of customers either requests for second optional service or leaves the system. At the completion moment of second optional service, the batch of customers either requests for re-service or leaves the system after the second service. Whenever the queue size is less than 'a', the server commences vacation. At the instant of vacation completion, if at least 'a' customers wait for service, the server starts a busy period. Otherwise, the server resumes another vacation. Using supplementary variable technique, the steady-state probability generating function (PGF) of the queue size is obtained.

Keywords: bulk queue; second optional service; multiple vacation; optional re-service; state dependent arrival.

Reference to this paper should be made as follows: Deepa, T. and Azhagappan, A. (xxxx) 'Analysis of state dependent $M^{[X]}/G(a, b)/1$ queue with multiple vacation second optional service and optional re-service', *Int. J. Operational Research*, Vol. x, No. x, pp.xxx-xxx.

Transient solution of an M/M/ ∞ queue with system's additional tasks and impatient customers

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Abstract: This paper studies the impatient behaviour in an infinite server queue with additional tasks assigned to the system. Whenever the system becomes empty, the system as a whole is assigned a secondary task of duration U whose distribution is exponential. Any arrival during the period U becomes impatient due to the unavailability of service facility. Each individual waiting customer activates an independent impatience timer of duration T which is exponentially distributed. When the system comes back after the completion of U , before T expires, the waiting customers are simultaneously taken for service and they leave the system after the completion of service. If T expires before the completion of task U , the customers abandon the system and never to return. The transient system size probabilities of this model are derived explicitly for both single and multiple task cases. The time-dependent mean and variance of system size are also derived. Further, numerical simulations are also presented to analyse the effect of system indices.

Keywords: infinite server queue; single and multiple tasks; impatient customers; transient probabilities.

Reference to this paper should be made as follows: Sudhesh, R. and Azhagappan, A. (2020) 'Transient solution of an M/M/ ∞ queue with system's additional tasks and impatient customers', *Int. J. Mathematics in Operational Research*, Vol. 16, No. 1, pp.82–97.

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Performance Analysis of an $M/M/1$ Queue with N-policy Interrupted Closedown Preventive Maintenance Balking and Feedback

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Abstract

This paper investigates the transient and stationary behavior of a $M/M/1$ queueing model with N-policy, interrupted closedown, balking, feedback and preventive maintenance. The server stays dormant (off state) until N customers accumulate in the queue and then starts an exhaustive service (on state). After the service, each customer may either leave the system or get immediate feedback. When the system becomes empty, the server resumes closedown. If any arrival occurs before the completion of closedown time, the closedown work of the server is interrupted and starts the busy period in an exhaustive manner. If no arrival occurs during the closedown time, the server commences preventive maintenance work. When this period ends, the server moves to the idle state and waits N accumulate for service. When the N^{th} one enters the queue, the server starts the service. The customers may either join the queue or balk when the size of the system is less than N and the server is in off state. The transient and stationary system size probabilities of the proposed model are derived by the method of generating function. Some system performance indices are computed and the numerical simulations are also presented.

Keywords: N-policy queue; Interrupted closedown; Preventive maintenance; Balking; Feedback

MSC 2010 No.: 60K25, 90B22, 68M20

Transient behaviour of an $M/E_k/1$ queue with vacations, balking and control of admission during vacations

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Abstract: This paper studies the transient behaviour of an $M/E_k/1$ queueing model with single and multiple vacations, balking and control of admission during vacations. An arriving customer undergoes k exponential phases of service before leaving the system. Whenever the system becomes empty, the server starts vacation (single or multiple). All the arriving customers are not allowed to join the queue during vacations. That is, they are either permitted to join the queue or rejected. During the vacation period, the permitted arrivals may either join the queue or balk. Using the method of generating function, the transient system size probabilities are derived for the proposed model in terms of generalised modified Bessel function of the second kind. The system performance measures such as average and variance of system size, probability of system empty and server idle are also obtained. Numerical illustrations are presented to analyse the influence of the system parameters.

Keywords: the $M/E_k/1$ queue; single and multiple vacations; balking; admission control; generalised modified Bessel function; time-dependent probabilities.

Reference to this paper should be made as follows: Deepa, T. and Azhagappan, A. (2020) 'Transient behaviour of an $M/E_k/1$ queue with vacations, balking and control of admission during vacations', *Int. J. Mathematics in Operational Research*, Vol. 17, No. 3, pp.371–390.

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