



**Recent Advances in Materials and Modern Manufacturing**, pp 683–689

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# Knowledge-Based Engineering Approach to Select Standard Parts and Design Automation for Flange Coupling

[Umeshchandra Mane](#), [Raju Bhosle](#) & [Jeet Patil](#)

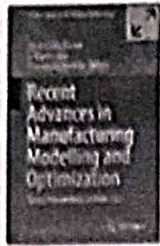
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## Abstract

Computer Aided Design software is widely used in the product development phase. It helps in reducing design time with high level of accuracy. Generally, cost of product development and manufacturing is identified in design phase, so it is important to focus on the design phase to reduce the total cost of the product. Use of standard parts readily available in the market saves manufacturing



**Recent Advances in Manufacturing Modelling and Optimization** pp 439–452

## Design and Analysis of Independent Suspension System of a FSAE Vehicle

Sanjay Lohar, Vaishnavi Patil, Sahil Save & Rakeshkumar Thakur

Conference paper | First Online: 22 April 2022

461 Accesses

Part of the Lecture Notes in Mechanical Engineering book series (LNME)

### Abstract

In Formula Society of Automotive Engineers (FSAE) the design of suspension system is one of the most important area on which performance of vehicle depends. Present study proposes the procedure in designing a double wishbone independent suspension system for FSAE cars. This paper details the procedure utilized for design and analysis of mechanical systems which can be utilized within the FSAE vehicle norms. Suspension geometry is specified on basis of FSAE guidelines, packaging constraints and desired performance parameters. Forces are calculated based on weight of vehicle and weight transfer while riding. Suspension



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# Improved Generalized Regression Neural Network for Target Localization

Satish R. Jondhale<sup>1</sup> · Manoj A. Wakchaure<sup>2</sup> · Balasaheb S. Agarkar<sup>3</sup> · Sagar B. Tambe<sup>4</sup>

Accepted: 7 February 2022

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## Abstract

Knowledge of location is of utmost importance in many indoor Location-Based Services (LBS). Although traditional technique such as trilateration involving the use of received signal strengths (RSS's) is quite popular and simple to use for wireless sensor network (WSN) based target localization, the location estimates obtained using it are not accurate and reliable. The reason behind this is the highly fluctuating nature of RSS's due to dynamic RF environment and non-linear system dynamics. If the dataset is sparse, the concept of centroid is very useful to estimate fairly closer approximation to the underlying relationship in the given dataset. The GRNN architecture is well known for mapping any nonlinear relationship between input and output. To address the problems with the RSS based target localization and tracking (L&T) using WSN for indoor environment, a novel range free Centroid Generalized Regression Neural Network (C-GRNN) algorithm is presented in this paper. The proposed C-GRNN algorithm is formed by combining the advantages of both centroid and GRNN. In order to realize the dynamicity in given RF environment, the variance in the RSSI measurements is varied from 3 to 6 dBm. During simulation experiments, although the variance in the RSSI measurements is doubled, the average RMSE and average localization error are increased by only approximately 28.31%, and 22.28% respectively. This rise in localization errors with the proposed C-GRNN architecture is very less as compared to the trilateration as well as GRNN based technique.

**Keywords** Location-based services (LBS) · Received signal strength (RSS) · Wireless sensor network (WSN) · Trilateration · Centroid · Generalized regression neural network (GRNN) · Localization and tracking (L&T)

## 1 Introduction

Today sensor network is a basic building block in applications involving smart sensing and ubiquitous computing, and has plenty of localization and tracking (L&T) based applications [1–3]. The heavy deployment sensor nodes can scan, sense the useful physical

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# Crop Disease Prediction using Deep Learning

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**Abstract** – Agriculture forms the backbone of the Indian economy. It contributes significantly to our nation's GDP and is a major source of livelihood for rural families. Farmers play a pivotal role in shaping the future of the country. Unfortunately, the agricultural industry has been plagued by several problems due to which farmers in our country daily face a lot of hardships. The two major problems which hinders the economic progress of farmers are as follows: They are not able to detect disease in crops grown at farm This leads to heavy loss due to crop damage. The other obstacle is they are not able to sell their crops at the right price due to middlemen intervention. To solve the above two problems, we propose a solution to create a website where a model built using deep learning (image classification) algorithm helps to predict if the crop is healthy or carrying a particular disease. The website also has a portal where farmers can login and post pictures of crops grown in their farm. Vendors can login and purchase best quality crops from any farmer online from the comfort of their homes. The idea was to create a website which serves as a one stop solution to all agricultural problems.

## I. INTRODUCTION

Farmers are not able to detect disease at an early stage in the crops grown at farm. This leads to heavy loss due to crop damage. This paper proposes a solution to identify disease in crops using deep learning (image classification algorithm). Image classification is a technique that is used to classify or predict the class of a specific object in an image.

Convolutional neural network (CNN) is used for building the model. A Convolutional Neural Network (ConvNet/CNN) is a Deep Learning algorithm which can take in an input image, assign importance (learnable weights and biases) to various aspects/objects in the image and be able to differentiate one from the other. Several data augmentation techniques are used as Data augmentation.

Caching and prefetching, Resizing and rescaling are applied on dataset to improve its performance during training. The main advantage of CNN compared to its predecessors is that it automatically detects the important features without any human supervision. Automatic feature extraction is the main advantage of Convolutional neural network. For example, given many pictures of cats and dogs it learns distinctive features for each class by itself. CNN is also computationally efficient.

## II. LITERATURE REVIEW

Amrita Tulshan and Natasha Raul used KNN classifier to predict 5 different diseases in crops namely Early blight, Mosaic virus, Down Mildew, White Fly, Leaf Miner. [1] This paper aims to predict the emergence of pests and diseases of cotton based on short-term memory network (LSM). First, the problem of the emergence of pests and diseases was classified as a predictor of time series. LSTM was then adopted to resolve the issue. LSTM is a special type of continuous neutral network (RNN), which introduces a gateway approach to prevent a missing or exploding gradient problem. It has been shown to be effective in solving a time series problem and can deal with the long-term problem of dependence, as stated in many books.

Experimental results showed that LSTM performed well in predicting the emergence of pests and diseases in cotton fields, and produced results. The area under the Curve (AUC) is 0.97. The paper also confirmed that climatic factors have a strong influence on the emergence of pests and diseases, and that the LSTM network has great potential in solving the long-term dependence problem. [2]

Umair Ayub and Syed Atif Moqurrab analyzed extensively the data mining dividers in different feature sets to predict the damage done to the grass. The categories we used are: DT, RF, NN, GNB, SVM and KNN. RF and GNB performed better than other binary data separators, and NN and RF performed better than other original data filters. We also designed composite models by combining

# Breast Cancer Classification using Deep learning

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**Abstract** —Breast cancer is one of the most common diseases affecting the lives of many women around the world. Early detection of cancer is very important because when the disease is diagnosed early, the chances of treatment and recovery increase. Unfortunately,

Lack of awareness and resources about breast cancer, as well as other issues of female reproductive health, continue worldwide. Thus, statistics show a dramatic increase in the number of women with breast cancer over the years. Breast cancer is on the rise, both in the country and in India's largest city. The 2018 Breast Cancer Survey report recorded 1,62,468 newly registered cases and 87,090 reported deaths.

Diagnosis becomes more difficult in the advanced stages of your development, and more than half of Indian women experience the side effects of stage 3 and 4 breast impairment. Survival of breast cancer in malnourished women accounted for 60% of Indian women, compared to 80% in the U.S.

## INTRODUCTION

Breast cancer is categorized into two type, namely, Benign and Malignant. Benign tumor is usually harmless, on the other hand a malignant tumor that results in uncontrolled growth of cancerous tissue. Clinical tests, diagnostic tools that include mammography are a variety of techniques used to diagnose breast cancer. Breast cancer is not a disease of the individual but a combination of diseases. Therefore, its acquisition is a challenging task. Usually, women are less likely to recognize the presence of breast cancer or tumor on their own in the early stages, when it can still be cured. Eventually, the tumor grows into a malignant growth, which can exacerbate problems. Women often self-diagnose and find the presence of lumps or masses that suggest cancerous growths. An important reason for the low rate of breast cancer survival in women in the nation stems from their lack of awareness among the population and low levels of initial screening and diagnostic levels. In Histopathology, a biopsy is a diagnostic procedure that can determine if the affected area has cancer or not. Diagnosis by pathologists is usually performed by visual inspection of histopathological images under a microscope known as the gold standard confirmation of the diagnosis. tumors and cancer subtypes. Recently, Convolutional Neural Networks (CNNs) have become the preferred deep learning techniques used for the diagnosis and diagnosis of various diseases using x-ray, CT-scan and histopathological images from those reports. This paper proposes a breast cancer screening solution using an image classification algorithm for deep learning. Convolutional Neural Networks are a class of Deep Neural networks that can detect and distinguish certain features in images and are widely used in visual image analysis. Convolutional Neural Network (ConvNet / CNN) is a deep learning algorithm that can capture the embedded image, provide readable weights and bias in various aspects of the image and is able to distinguish one aspect from another. Images

uploaded to the CNN model are processed in advance using several image processing techniques such as data enhancement, resizing and re-scaling. CNN's biggest advantage compared to its predecessor is that it automatically detects important features without being monitored.

## LITERATURE REVIEW

Sunny, Jean & Rane, Nikita & Canada, Rucha & Devi, Sulochana. in their paper "Breast Cancer Classification and Predictability Using Mechanical Learning" using ML algorithms to differentiate breast cancer tumors. [1] This paper introduces comparisons of six machine learning algorithms (ML): Naive Bayes (NB), Random Forest (RT), Artificial Neural Networks (ANN), Decision Tree (DT), Close Neighbor (KNN) and Support Vector Machine (SVM) in the Wisconsin Diagnostic Breast Cancer (WDBC) database extracted from a digital MRI scan. In order to use these ML algorithms, the database was divided into the training phase and the testing phase. Among these, the algorithm that provides the best results will be used as a backend for the website and the model will then classify cancer as dangerous or dangerous. The study begins by collecting a BCCD database (small blood cell detection database) containing 116 volunteer data with 9 attributes and WBCD database data comprising 699 volunteer data and 11 attributes. It then pre-analyzes the WBCD database data provided and finds information containing 683 volunteers with nine attributes and that is why the index indicates whether the volunteer has a malignant tumor or not. It accurately predicts and diagnoses breast cancer early even if the size of the tumor is small in the insane and painless ways that use data mining algorithms.

[2] Reddy, Anji and Soni, Badal and K., Sudheer in their paper "Breast Cancer Awareness by Improving Machine Learning." introduced a new way to diagnose breast cancer using machine learning techniques. The authors performed an experimental analysis in the database to evaluate the performance. The proposed method has produced more accurate and efficient results compared to the available methods. This paper is a new approach - Deep Neural Network With Support Value (DNNS) was introduced to produce better quality images and streamline other applications. The authors propose a new algorithm and mathematical formulas to evaluate efficiency and effectiveness. The proposed DNNS operating system is divided into three sections. In the pre-processing phase, input cytology images are first processed to remove the noise. This process is completed using an effective filtering method. In the second phase of methodology, entropy, geometric and literary elements are extracted from the analyzed images. Finally, the third stage separates the breast tumor from the extracted images. This was accomplished using an obscure collection based on Histogram based fuzzy clustering.

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# Deep Video Surveillance -Anomaly Event Detection

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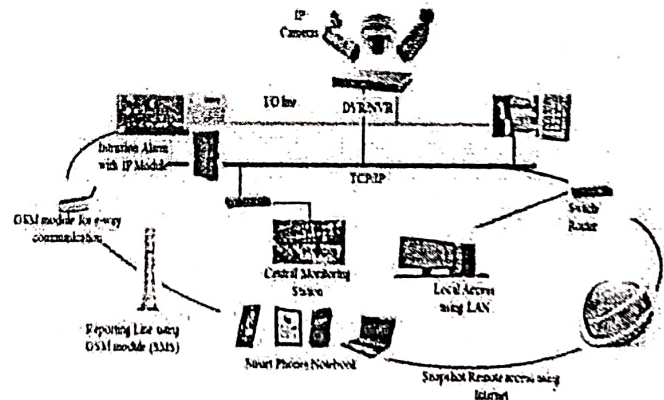
## ABSTRACT

Surveillance videos are capable of capturing many real-life anomalies. In this report, we propose to find out the anomaly by exploiting both normal and anomalous videos. To avoid annotating anomalous segments or clips in the training video, which is very time consuming, we propose to learn anomalies through the deep classification framework of many cases by leveraging the videos for weakly labeled formation, i.e., label the figure (abnormal or normal) at the video level instead of the clip level. In our approach, we consider normal and abnormal videos as pockets and video segments as cases in multi-instance learning (MIL) and automatically learn the predictive deep anomaly ranking model. high anomaly scores for anomalous video segments. Furthermore, we introduce sparsity and time-smoothing constraints in the rank loss function to better locate the anomaly during learning.

## INTRODUCTION

Most of the public places uses CCTV camera, eg. street, intersection, bank, shopping mall, etc. to enhance safety. The supervision capacity of law agents is behind in keeping up. The result is a disproportionation between the usage of cameras and the ratio of cameras to screen. One of the essential tasks of a CCTV camera is to detect unusual events. In general, abnormal events occur infrequently compared with normal activities. Hence,

in order to minimize the extra labor efforts and labor period, the development of algorithms for automatic video anomaly detection is in need.



The aim is to promptly flag deviations from normal patterns and determine how long the anomaly is occurring. Thus, this detection technique can be viewed as raw video comprehension, which filters outliers from normal samples. Algorithms should be developed to detect a specific event that contains anomaly is the step that can be taken for detecting a specific anomaly containing event. It is clear that such solutions cannot be generalized, so they have only very limited practical use.

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## IPL Prediction Using Machine Learning

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**DOI:** 10.17010/ijcs/2022/v7/i3/171267

### Abstract

Cricket is amongst the most popular sports in the world. Indian Premier League, more commonly known as IPL is the biggest domestic cricket league in the world. It generates a lot of revenue along with excitement among fans. Many bookers, bettors, and fans like to predict the outcome of a particular match which changes with every ball. This project studies and compares different Machine Learning techniques that can be applied to predict the outcome of a match. Features like team strength and individual strength of a player are also included along with conventional features like toss, home ground, weather and pitch conditions that are taken into account for predicting the result. Machine Learning algorithms such as Naïve Bayes, Random Forest Classifier, Logistic Regression, XGBoost, AdaBoost, and Decision Tree are selected to determine the predictive model with highest accuracy.

### Keywords

AdaBoost, Decision Tree, Indian Premier League, Machine Learning, Naïve Bayes, Logistic Regression, Random Forest Classifier, XGBoost

### Publishing Chronology















Publishing Chronology : Manuscript Received : May 3, 2022; Revised : May 12, 2022; Accepted : May 15, 2022. Date of Publication: June 5, 2022.

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## EavesDrop

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DOI: 10.17010/ijcs/2022/v7/i3/171268

### Abstract

Interactive Live streaming is the process of transferring real-time data over the internet. The data can be of type audio, video or any common data type. Interactive live streaming is an important feature of applications and platforms in which the actions of the audience affect the content of the communication. Simultaneously, Podcasting is one of the types of contents that people are attracted to. The idea of podcasting includes recording the audio or video file and uploading it to a platform where people can access it. Now, with the thought of mixing these two, the idea of an interactive podcast was born. We analyze that low delay is a restriction for Web Interactive Streaming. Interactive communication over the internet with the restrictions of real-time boundaries requires a framework that will allow the development of the proposed project. Real Time Communication (RTC) has wide-industry uses. RTC is the standard and it also increases the browsing model which allows access to live streaming systems which consist of social media, television, chatting applications, as well as the communication media. Users are allowed to read comments, write comments, record the sessions/audio/video, and edit audio/video which is done within a Cloud Infrastructure which also provides services of quality. The development of the application is the most important part where using different technologies a system can stream audio and video data over the internet, handle a number of users who can make audio rooms to discuss a topic among themselves, where several people can hear them, and they also have a chance to add value to the conversation with their inputs.

### Keywords

Cloud, interactive, live-streaming, podcasting, Real-Time Communication, time-critical.

### Publishing Chronology

Publishing Chronology : Manuscript Received : March 14, 2022; Revised : April 18, 2022; Accepted : April 22, 2022. Date of Publication: June 5, 2022.

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## Language Interpreter and Speaker

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DOI: 10.17010/ijcs/2022/v7/i2/169682

### Abstract

Language Interpreter and Speaker is a device for identifying the language of the written image text and then converting the same text to speech format. This device would surely be useful for blind and visually impaired people. Language identification (LI) is the method in which we identify the natural language of the given content. It is the process of categorizing a document on the basis of its language. In this generation, we are heading towards a phase where computers would be capable of doing all things that humans can do. Recognition of language used is the initial requirement before reading or learning. To start with any of the tasks, humans first try to understand the task and then process the task. Similarly, for language identification, the machine needs to learn the language and once learning is complete, it should be able to recognize the language. The project is divided into three parts. Initially, the handwritten image text would be converted to normal text. In the second part, the language would be identified from the converted text and last, the text would be converted to audio format. This paper discusses the implementation of this idea, gives an approach to problems and challenges that we came across, and some solutions.


### Keywords

AlexNet, CNN (Convolution Neural Network), gTTS (google-text-to-speech), Image Processing

### Publishing Chronology

Publishing Chronology Manuscript Received : February 20, 2022 ; Revised : March 8, 2022 ; Accepted : March 16, 2022. Date of Publication : April 5, 2022.

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# IoT-based Smart Water Musical Fountain

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**Abstract:** Water fountains have been utilized for multifunctional entertainment events such as laser displays. Designing such water fountains is an excellent chance for multidisciplinary learners. The physical construction and control mechanism of a fountain with water-jet dancing effects, as well as lighting, is complex to design. It discusses the use of indoor fountains in educational institutions as well as hospitals to target various types of audience to make them happy and in turn reduce their stress.

Methodologies like IoT and Machine Learning techniques are employed to construct such a smart fountain. The suggested algorithm identifies mood by capturing audience emotions and facial expressions (Fountain Viewer). Based on their emotions, musical instruments along with classical music ragas have been selected from the playlist. For diverse mood-based circumstances, smart fountain is designed in such a manner so that solenoid activity and light systems create distinct water jet dance patterns and light glowing patterns.

Body and mind reaction with music therapy is a new field for the healing process. The challenge involved here is to determine which ragas to listen to and for how much duration. To address the specific raga with notes and swaras, feature extraction techniques from digital signal processing are used. To classify the kind of raga for a specific ailment, machine learning methods are applied. The categorization of ragas is carried out using several classifier methods.

The MHRISCNN Algorithm (Mind Healing Raga Instrument Selection Convolution Neural Network) is presented, which should choose a certain Raga and instrument based on the person's mood at the moment. It has been discovered that those who stay near the fountain, benefit from good music vibrations. This assists in reducing stress, which enhances health.

**Keywords:** IoT, Music Therapy, Machine Learning, MHRISCNN

## 1. INTRODUCTION

Fountains were originally intended to provide water for drinking, bathing, and cleaning purposes to citizens. In the late nineteenth century, the execution of a fountain took a new turn. People began building unique fountains that, when utilized in a certain way, could be used to embellish towns, parks, celebrate persons, ethnic celebrations, and provide entertainment [2].

A novel idea for ethnic beautifying has emerged; a smart music fountain [3] that contributes to the auspiciousness of the event.

Fountains were primarily aesthetic by the 1900s as a result of ubiquitous, accessible indoor plumbing. During this period, gravity was replaced as the primary driver of water straight from the fountain [1] by electric, mechanical water pumps. These were the forerunners of modern fountains, able to recycle water and shoot water high into the air. Fountains may now be seen in parks, squares, private houses, and commercial structures. They have been used for decoration, pleasure, or entertainment [4]. With advancements in technology, fountains today can be synchronized to music and colored lights, and have the spray automatically adjusted remotely with a press of a button.

Music is a part of all living beings and it has a significant impact on their life. Humans listen to music to reduce stress in their day-to-day life. Classical music [12], at its core, provides positive feedback to the body, and as a result, it has been proven that classical music helps relieve stress.

Music therapy for humans [11] is a new phrase that was coined. This also helps to lessen their chronic conditions. Ragas, which are based on timings, are used in classical

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# Modelling of Material Removal Rate in Micro-EDM of Inconel 600 Using Dimensional Analysis



Raju Bhosle, **Umeshchandra Mane**, Jeet Patil, and Balaji Dabade

**Abstract** In the present study, a semi-empirical model is developed for predicting the material removal rate in micro-EDM using dimensional analysis. The model developed is based on thermo-physical properties of Inconel 600 alloy material such as electrical conductivity, thermal conductivity, density, specific heat, and melting point. For this study, four effective parameters namely voltage, capacitance, EDM feed-rate, and pulse on-time are varied and drilled micro holes using tungsten carbide tool electrode. The adequacy of model is verified by finding the mean error, root mean square error and average error. The predictability of the model with experimental results is observed more than 94% using dimensional analysis.

**Keywords** Micro electrical discharge machining · Micro-holes · Inconel 600 alloy · Material removal rate · Dimensional analysis

## 1 Introduction

Micro electrical discharge machining (Micro-EDM) is one of the most recently developed micro-machining technologies and predominantly used to produce miniature components and micro-features. It has many advantages like negligible contact forces, minimal mechanical stresses, chatter, and vibrations, which is due to no direct

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I. A. Palani et al. (eds.), *Recent Advances in Materials and Modern Manufacturing*,

Lecture Notes in Mechanical Engineering,

[https://doi.org/10.1007/978-981-19-0244-4\\_36](https://doi.org/10.1007/978-981-19-0244-4_36)

  
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# Artificial Intelligence for Prediction of Performance and Emission Parameters of CI Engine Using Bio-Fuel

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**Abstract.** The objective of this work is to find the performance and emission parameter of different blends of Karanja biodiesel with diesel and compare these parameters with pure diesel. This study investigates the potential of Karanja oil as a source of biodiesel. The objective of this work is to find the performance and emission parameters of 10 %, 20 %, 30 %, 40 %, and 50 % of blends with biodiesel and compared various parameters with diesel. The results showed that Brake Thermal Efficiency (BTE) decreases with an increase in the percent of biodiesel and Brake Specific Fuel Consumption (BSFC) decreases with an increase in the percent of biodiesel. Hydrocarbon (HC) and carbon monoxide (CO) emission reduces with an increase in blend percent whereas Nitrous oxide (NOx) emission increases with an increase in blend percent. Neural networks obviate the need to use complex mathematically explicit formulas, computer models, and impractical and costly physical models. In this work we use Neurovision software for prediction of performance and emission parameters, separate models were developed for performance parameters as well as emission parameters. To train network, load, blend percentage, calorific value, the viscosity of fuel & air-fuel ratio was used as input value whereas engine performance parameters like brake thermal efficiency, brake specific fuel consumption & exhaust gas temperature were used as output value for performance model and engine exhaust emission such as NOx, CO, and HC values were used as the output parameters for emission model. Artificial Neural Network (ANN) results showed that there is a good correlation between the ANN predicted values and the experimental values for various engine performance and exhaust emission parameters. It is observed that the ANN model can predict the engine BTE, BSFC with a correlation coefficient of about 0.999635668, 0.999616352, and 0.993346689 respectively for performance model and emission model CO, HC and NOx predict with a correlation coefficient of 0.996659659, 0.991243454 & 0.99555593.

## NOMENCLATURE

|      |                                 |       |                                    |       |                              |
|------|---------------------------------|-------|------------------------------------|-------|------------------------------|
| BTE  | Brake Thermal Efficiency        | $C_p$ | Specific heat at constant pressure | HS    | Hybrid System                |
| BSFC | Brake Specific Fuel Consumption | $C_v$ | Specific heat at constant volume   | IP    | Indicated Power, kW          |
| HC   | Hydrocarbon                     | D     | Diameter of cylinder               | $M_f$ | Mass of fuel in the cylinder |
| CO   | Carbon monoxide                 | DI    | Direct Injection                   | MSE   | Mean Square Error            |
| NOx  | Oxides of Nitrogen, ppm         | $C_v$ | Specific heat at constant volume   | N     | Speed (RPM)                  |
| ANN  | Artificial Neural Network       | FL    | Fuzzy Logic                        | PME   | Pongamia Methyl Ester        |
| CI   | Compression-Ignition            | GA    | Genetic Algorithms                 | R     | Coefficient of Correlation   |



## Latent heat storage system by using phase change materials and their application

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### ARTICLE INFO

#### Article history:

Available online 11 October 2021

#### Keywords:

PCM  
Heat transfer fluid  
Thermal energy storage  
Photovoltaic panel  
Engine cooling system

### ABSTRACT

Due to the rapid exploitation of fossil fuels, energy sources are becoming nonrenewable, and there is a need to develop other technologies to provide a clean supply of energy. The heat is stored in the thermal storage unit utilizing phase change materials in one of two ways: sensible heat or latent heat. When the temperature of phase change materials rises, energy stored in the perceptible form in the materials rises as well. While latent heat is stored during phase change of materials during the charging process and retrieved during phase change discharging at a virtually constant temperature during the discharging process. Latent heat has a large capacity to store a large amount of thermal energy per unit space. The use of phase change material (PCM) can be found in a variety of fields, including:

- Improving the efficiency of photovoltaic cell.
- Thermal storage of solar energy.
- Waste heat recovery.
- Engine cooling.
- Building cooling to store energy during peak time and retrieving during requirement.

The main drawback of PCM is its low thermal conductivity, which can be increased by incorporating flux and adding nanoparticles (to enhance heat transfer) in PCM. Our task in this study was to evaluate literature and develop applications for PCM, as well as to reduce PCM charging and discharging by boosting the rate of heat transfer.

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Selection and peer-review under responsibility of the scientific committee of the International Conference on Smart and Sustainable Developments in Materials, Manufacturing and Energy Engineering

### 1. Introduction

The rapid transformation in the global economy has resulted in a daily increase in energy demand. Conventional fuels such as gasoline, diesel, and coal energy, on the other hand, are limited in terms of their use, as well as their impact on the global environment, as they emit hazardous gases and have a direct impact on human existence. By utilizing waste heat energy, solar energy, and other non-conventional energy sources, thermal energy storage has become a significant aspect of reducing the strain on fossil fuels and creating an environmentally friendly atmosphere. The thermal energy unit can be stored in PCM in two ways: latent heat energy storage and sensible heat energy storage. While storing energy in

latent heat requires less space than storing energy in a sensible form, storing energy in sensible form requires more space (Fig. 1). Because phase change materials store more energy in a smaller volume, it is one of the most important advantages of phase change materials to store energy in both sensible and latent heat form. Advanced and novel materials for renewable energy sources are being investigated by researchers. The energy is stored in a proper form so that it can be withdrawn and used to its full potential. It bridged the gap between energy demand and supply and improved the system's performance. Because of the abundant solar energy supply during the day, energy waste during the day must be stored and used as needed, such as at night, to meet the demand. Lin et al. [1] discussed that thermal energy has gotten a lot of attention and has progressed quickly.

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<https://doi.org/10.1016/j.matpr.2021.09.268>

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Selection and peer-review under responsibility of the scientific committee of the International Conference on Smart and Sustainable Developments in Materials, Manufacturing and Energy Engineering




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Original Paper | Published: 03 December 2021

## An Integrative Approach for Analysis of Nonlinear Electrical Circuits Using-Polynomial B-Spline Expansion and B-Spline Krawczyk Operator

D. D. Gawali , A. Zidna & P. S. V. Nataraj

*International Journal of Applied and Computational Mathematics* 8, Article number: 1 (2022)

44 Accesses | 8 Citations | [Metrics](#)

### Abstract

This paper addresses the problem of finding a set of all direct current (DC) operating points of a nonlinear circuit, which is a crucial step in its development and requires the solution of a nonlinear system of polynomial equations. We propose a novel algorithm for finding the set of all solutions of nonlinear electrical circuits, which are modeled as systems of  $n$  polynomial equations contained in an  $n$  dimensional box. The proposed algorithm is based on the following techniques: (i) B-Spline expansion to obtain a polynomial B-Spline form of the original polynomial in power form; (ii) B-Spline Krawczyk contractor for domain pruning. To avoid the repeated evaluation of function value the algorithm suggested uses B-Spline coefficients to find the value of Krawczyk operator and the computation of derivative of polynomial function. We solved three circuit analysis problems using the proposed algorithm and compared the performance of proposed algorithm with INTLAB-based solver and found that the former is more efficient in terms of computation time and number of iterations.

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## CONSTRAINED GLOBAL OPTIMIZATION OF MULTIVARIATE POLYNOMIALS USING POLYNOMIAL B-SPLINE FORM AND B-SPLINE CONSISTENCY PRUNE APPROACH

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AND P. S. V. NATARAJ<sup>4</sup>

**Abstract.** In this paper, we propose basic and improved algorithms based on polynomial B-spline form for constrained global optimization of multivariate polynomial functions. The proposed algorithms are based on a branch-and-bound framework. In improved algorithm we introduce several new ingredients, such as B-spline box consistency and B-spline hull consistency algorithm to prune the search regions and make the search more efficient. The performance of the basic and improved algorithm is tested and compared on set of test problems. The results of the tests show the superiority of the improved algorithm over the basic algorithm in terms of the chosen performance metrics for 7 out-of 11 test problems. We compare optimal value of global minimum obtained using the proposed algorithms with CENSO, GloptiPoly and several state-of-the-art NLP solvers, on set of 11 test problems. The results of the tests show the superiority of the proposed algorithm and CENSO solver (open source solver for global optimization of B-spline constrained problem) in that it always captures the global minimum to the user-specified accuracy.

**Mathematics Subject Classification.** 90-08.

Received June 7, 2021. Accepted November 30, 2021.

### 1. INTRODUCTION

Generally constrained global optimization of nonlinear programming problems (NLP) is the study of how to find the best (optimum) solution to a problem. The constrained global optimization of NLPs is stated as follows.

$$\min_{x \in X} f(x) \quad (1.1)$$

$$\text{s.t. } g_i(x) \leq 0, \quad i = 1, 2, \dots, p, \quad (1.2)$$

$$h_j(x) = 0, \quad j = 1, 2, \dots, q. \quad (1.3)$$

**Keywords.** Polynomial B-spline, global optimization, polynomial optimization, constrained optimization.

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# Prediction of Building Construction Cost Using Variable Selection

Viren B. Chandanshive<sup>1</sup> and A. R. Kambekar<sup>2</sup>

**Abstract :** Estimating construction costs with a greater degree of precision early in the construction process is a critical factor in the construction industry. The aim of this research is to provide a cost estimation model applying Multiple Linear Regression (MLR) analysis to forecast the cost of building construction projects in India. For the development of the regression model, a total of 78 data sets of building construction projects were collected from the Mumbai region, India. The most significant eleven cost variables were applied as independent variables where as construction cost performs the role of the dependent variable. The enter, backward and forward methods were applied to build and develop the MLR models. The results obtained from the Enter method model show a stronger correlation test, with a value of 0.973 for the coefficient of correlation (R). The linear relationship between expected and actual costs was also defined by the coefficient of determination (R<sup>2</sup>), which was 94.6 percent. The Enter method revealed that the prediction is superior to that of the other two methods of regression analysis. With sophisticated statistical techniques, the designed regression model can quickly understand complex and broad data, improving the quality and consistency of decision-making. This study contributes to the Indian construction industry and delivers an effective concept about the project cost prediction modeling which will be helpful to the investors.

**Keywords :** *Building Construction Cost, Multiple Linear Regression (MLR); Estimation; Early-stage; Prediction.*

## INTRODUCTION

Since only a small amount of knowledge about drawings and design is available early in the construction process, construction cost estimation performs an important role in investors' decision-making (Cho, H. G., et al., 2013; Badawy, M.2020; Kim, G. et.al., 2013) The method of providing a construction cost estimate for a project is difficult because it requires a large number of cost factors that must be accurately calculated based on sufficient research, prior experience, and investigation. Due to the paucity of data and information, the prediction of the construction cost with a higher level of precision becomes a very critical job for the quantity surveyor (Al-Zwainy, F. M. S., et al., 2013) The imprecise cost prediction may lead the project's success in to failure (Badawy, M., 2020).

Using multiple linear regression analysis, this research aims to create and utilize a cost estimation model that can estimate the construction cost of residential

building projects at an early stage. Typically, structural elements, brick masonry, finishing works, and other factors have had a greater effect on the construction cost of projects. The construction industry in Mumbai and its surrounding regions in India, provided data for 78 residential building construction projects for this research. The statistical approach and regression analysis have been applied to develop Multiple Linear Regression (MLR) cost prediction models. The proposed MLR model consists of a total of eleven input design parameters, which can be easily identified with the help of architectural drawing and limited design data at the early stage while the construction cost performs the role of output parameter (Arafa, M., and Alqedra, M. (2011).

The subsequent segments present review of the literature, summary of the multiple regression analysis methods, research methodology, development of regression models, and discussion of results. The final segment completes and concludes the study.

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