Data Structures and Algorithm, CSO-441
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Full Marks 100.

Evaluation Criteria:

Continuous Assessment: 15 (*Its really continuous*: Class interaction, involvement in class, Q&A etc.)

Mid Term Exam: 25. (Based on Exam)

End Sem Exam: 60. (Based on Exam)

Books:

Data Structures & Algorithms in Python by Michael T Goodrich, Roberto Tamassia, Michael H. Goldwasser

Data Structures and Algorithms using Python by Rance D. Necaise

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COMPUTER-AIDED CIVIL AND INFRASTRUCTURE ENGINEERING

Machine Learning Techniques for Civil Engineering Problems

Yoram Reich

First published: 17 December 2002 | https://doi.org/10.1111/0885-9507.00065 | Citations: 41

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Abstract

The growing volume of information databases presents opportunities for advanced data analysis techniques from machine learning (ML) research. Practical applications of ML are very different from theoretical or empirical studies, involving organizational and human aspects and various other constraints. Despite the importance of applied ML, little has been discussed in the general ML literature on this topic. In order to remedy this situation, I studied practical applications of ML and developed a proposal for a seven–step process that can guide practical applications of ML in engineering. The process is illustrated by relevant applications of ML in civil engineering. This illustration shows that the potential of ML has only begun to be explored but also cautions that in order to be successful, the application process must carefully address the issues related to the seven–step process.

Springer Link

Construction Management | Published: 21 August 2015

An analogy between various machine-learning techniques for detecting construction materials in digital images

Abbas Rashidi ✉, Mohamad Hoseyn Sigari, Marcel Maghiar & David Citrin

KSCE Journal of Civil Engineering **20**, 1178–1188(2016) | Cite this article

536 Accesses | **39** Citations | Metrics

Abstract

Digital images and video clips collected at construction jobsites are commonly used for extracting useful information. Exploring new applications for image processing techniques within the area of construction engineering and management is a steady growing field of research. One of the initial steps for various image processing applications is automatically detecting various types of construction materials on construction images. In this paper, the authors conducted a comparison study to evaluate the performance of different machine learning techniques for detection of three common categorists of building materials: Concrete, red brick, and OSB boards. The employed classifiers in this research are: Multilayer Perceptron (MLP), Radial Basis Function (RBF), and Support Vector Machine (SVM). To achieve this goal, the feature vectors extracted from image blocks are classified to perform a comparison between the efficiency of these methods for building material detection. The results indicate that for all three types of materials, SVM outperformed the other two

A BIM-based Decision Support System Framework for Predictive Maintenance Management of Building Facilities

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Abstract:

Facility management (FM) involves multidisciplinary efforts and requires the coordination of different people, properties and processes. Therefore, extensive information of multiple dimensions needs to be stored and managed for FM. Currently, some buildings and facilities are managed manually, while some use databases and automated devices like sensors to capture and manage FM records. However, the current approaches do not fully utilize the collected FM records and provide a user-friendly interface for facilitating the operation and maintenance (O&M) of building facilities. Several academic and commercial efforts attempted to leverage building information modeling (BIM) technology to link and visualize FM records, but these efforts are still weak in proactively predicting asset failure, suggesting maintenance schedules and allocating budget for FM.

This paper presents a decision support system framework based on BIM for O&M of buildings. The framework consists of three modules: Condition Assessment Module, Failure Prediction Module, and Maintenance Planning and Budget Allocation Module. The Condition Assessment Module manages the facility condition data that are automatically captured by sensor devices as well as collected via inspection and condition survey. Incorporated with failure records and lifetime estimation models, the Failure Prediction Module integrates with the Condition Assessment Module and forecasts component failures. The results provide a basis for predictive maintenance of building facilities. BIM is also leveraged to manage and visualize not only the FM data but also the predictive maintenance results. Since each O&M action has its cost implications, the Maintenance Planning and Budget

Tunnelling and Underground Space Technology
Volume 38, September 2013, Pages 69-86

Predictive maintenance of shield tunnels

Yong Yuan ✉, Xiaomo Jiang ✉, Xian Liu ✉

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Highlights

- A comprehensive methodology for predictive maintenance of shield tunnel.
- FMEA approach to prioritize possible defects and facilitate the decision making.
- System-level lifing analysis for proactive maintenance of a tunnel system.
- Both risk prediction and damage accumulation models for system lifing analysis.
- Demonstrate with data for six failure modes collected from real-world tunnels.

Original Article | Published: 31 October 2020

Explainable AI Framework for Imaging-Based Predictive Maintenance for Automotive Applications and Beyond

Vikram Krishnamurthy ✉, Kusha Nezafati, Erik Stayton & Vikrant Singh

Data-Enabled Discovery and Applications **4**, Article number: 7 (2020) | Cite this article

52 Accesses | Metrics

Abstract

Predictive maintenance applications for a wide variety of industrial and commercial components are increasingly utilizing imaging-based sensors along with AI (artificial intelligence)/ML (machine learning) based analytics to determine wear of components. Credibility of the analytics, especially for component health, is strongly dependent on explainability. We initially introduce an explainable framework involving a novel light transmission image processing–based methodology utilizing statistical distance metrics (e.g., Wasserstein distance (WD), Kolmogorov-Smirnov statistic) for discriminative classification of unstructured images combined with Bayesian inference/regression to estimate wear level for an air filter application. Subsequently, we incorporate neural network–based models into this framework to develop an AI framework retaining a high level of explainability. The explainable elements of this novel AI model include generation of a statistical distance pseudometric with a feedforward neural network as a discriminative classifier, a spatial block bootstrapping approach to generate synthetic training data, and the use of this discriminant classifier as a

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Civil Engineering Journal

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Predictive Modeling for Developing Maintenance Management in Construction Projects

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Received 05 January 2019; Accepted 03 April 2019

Abstract

Maintenance is one of the most important global issue and it taking an increasing recognition in numerous study field. Meanwhile, in Iraq with the absence of an efficient building maintenance management and a lack of appropriate predictive maintenance tool of the current buildings can have a significant negative impact on future building development. Currently, there is a paradigm shift in management of building maintenance from corrective to preventive and predictive approaches that is attainable through creating of an evaluative model to evaluate a variety of alternative decisions. This paper aimed at developing mathematical models for the buildings maintenance. This was achieved through the division of building according to the methods of division based on a number of global maintenance manuals and previous studies. Consequently, based on literature review and interviews with experts on building maintenance, questionnaire was designed that included most of the maintenance items of building. Then, the results of the questionnaire were processed using the Statistical Package for Social Sciences (SPSS), to determine the most important maintenance items, the Weighted Sum Model (WSM) technique was used. Finally, this research recommended adoption the model for quick evaluation and appropriately monitoring of buildings. It will also help architects and engineers to make predictions throughout scientific methods instead dependence on personal decisions.

Keywords: Maintenance; Maintenance Management; Construction Projects; Mathematical Model.

1. Introduction

Buildings maintenance is a process that takes a great interest all over the worlds. The managing maintenance properly helps maintain capital and ensure health and safety in the use of the building [1].

An integration of GIS and remote sensing in groundwater investigations: A case study in Burdur, Turkey

Erhan Sener · Aysen Davraz · Mehmet Ozcelik

Abstract The importance of groundwater is growing based on an increasing need and decreasing spring discharges in the Burdur area. Remote Sensing and the Geographic Information System (GIS) have been used for investigation of springs, which are an important groundwater source. The chemical composition of groundwater is not of drinking water quality in Burdur city and water in the Burdur residential area is being obtained from the Cine plain.

The purpose of this study was to investigate new water sources by using remote sensing and GIS methods. Geology, lineament and land use maps of the research area were prepared using the Landsat TM satellite image composed of different analyses on the TM 7–4-1 band. In addition, contours, creeks, roads and springs were digitized using a topographic map of 1/100,000 scale to produce a drainage density map. A groundwater potential map was produced which integrated thematic maps, such as annual rainfall, geology, lineament density, land use, topography, slope and drainage density. According to this investigation, the surrounding villages of Askeriye, Bugduz, Gelincik, Taskapı and Kayaaltı were determined to be important from the point of view of groundwater potential in the research area.

Keywords Burdur · Geographical Information System · Groundwater Exploration · Remote Sensing

Introduction

Remote Sensing and the Geographical Information System (GIS) with their advantages of spatial, spectral and temporal availability and manipulation of data covering large and inaccessible areas within a short time have become very handy tools in accessing, monitoring and conserving groundwater resources. It also has been found that remote sensing, besides helping in targeting potential zones for groundwater exploration, provides input towards estimation of the total groundwater resources in an area.

It was the purpose of this investigation to discover new water resources in Burdur, located in the southwest of Turkey, using remote sensing and geographical information system (GIS) methods (Fig. 1). The research was done in an area of approximately 437 km^2. Drinking water in Burdur has been obtained from wells and springs about 10 km south of Burdur in the Cine plain . Due to the over development of wells in the Cine plain a decrease of groundwater levels has been observed. Separately, local management plan the needs for water supply to settlements on the Cine plain. Therefore, it is necessary to find new water sources for Burdur.

Methodology

This research was accomplished by using the Erdas Image 8.4 process software, Arc GIS 8.2 and Arc View 3.2 (3D analyst and spatial analyst extensions) and SPSS 11 statistical programs at the Suleyman Demirel University Remote Sensing Centre in Turkey. In this study, Landsat ETM+ (178–34 scenes) from the year 2000 images and a 1/100,000 scaled topographical map of Isparta- M24 have been used. In addition, annual rainfall data for the surrounding area was used for the annual rainfall map. The topographical map was digitized using the Arc Info 7.2.1 version software program. Topological changes and coordinate transform were corrected and the data converted to Arc View software program with the 3.2 version. In this study, four stages were applied: collection, satellite image processing, digitizing—building a database and spatial analyses (Fig. 2).

Satellite Data Analysis

Satellite data provides quick and useful baseline information on the parameters controlling the occurrence and

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E. Sener · A. Davraz (✉) · M. Ozcelik
Department of Geological Engineering,

Open Access Article

Spatiotemporal Analysis of Urban Growth Using GIS and Remote Sensing: A Case Study of the Colombo Metropolitan Area, Sri Lanka

by Shyamantha Subasinghe * , Ronald C. Estoque and Yuji Murayama

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(This article belongs to the Special Issue Advances and Innovations in Land Use/Cover Mapping)

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Abstract

Understanding urban growth spatiotemporally is important for landscape and urban development planning. In this study, we examined the spatiotemporal pattern of urban growth of the Colombo Metropolitan Area (CMA)—Sri Lanka's only metropolitan area—from 1992 to 2014 using remote sensing data and GIS techniques. First, we classified three land-use/cover maps of the CMA (i.e., for 1992, 2001, and 2014) using Landsat data. Second, we examined the temporal pattern of urban land changes (ULCs; i.e., land changes from non-built-up to built-up) across two time intervals (1992–2001 and 2001–2014). Third, we examined the spatial pattern of ULCs along the gradients of various driver variables (e.g., distance to roads) and by using spatial metrics. Finally, we predicted the future urban growth of the CMA (2014–2050). Our results revealed that the CMA's built-up land has increased by 24,711 ha (221%) over the past 22 years (11,165 ha in 1992 to 35,876 ha in 2014), at a rate of 1123 ha per year. The analysis revealed that ULC was more intense or faster during the 2000s (1268 ha per year) than in the 1990s (914 ha per year), coinciding with the trends of population and economic growth. The results also revealed that most of the ULCs in both time

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Data Science and Intelligent Applications pp 267–282 | Cite as

Artificial Intelligence: Prospect in Mechanical Engineering Field—A Review

Amit R. Patel, Kashyap K. Ramaiya, Chandrakant V. Bhatia, Hetalkumar N. Shah & Sanket N. Bhavsar

Conference paper | First Online: 18 June 2020

1805 Accesses | **10** Citations

Part of the Lecture Notes on Data Engineering and Communications Technologies book series (LNDECT,volume 52)

Abstract

With the continuous progress of science and technology, the mechanical field is also constantly upgrading from traditional mechanical engineering to the mechatronics engineering and artificial intelligence (AI) is one of them. AI deals with a computer program that possesses own decision-making capability to solve a problem of interest with imitates the intelligent behavior of expertise which finally turns into higher productivity with better quality output. From the inception, various developments have been done on AI system which nowadays widely implemented in the mechanical and/or manufacturing industries with broaden area of application such as pattern recognition, automation, computer vision, virtual

Resources, Conservation and Recycling
Volume 149, October 2019, Pages 352-362

A data driven technique applying GIS, and remote sensing to rank locations for waste disposal site expansion

Amy Richter, Kelvin Tsun Wai Ng, Nima Karimi

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https://doi.org/10.1016/j.resconrec.2019.06.013

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Highlights

- A novel approach to rank suitability of landfills for expansion is proposed.
- Remote sensing and vector data are statistically analyzed based on Thiessen Polygons.
- The best ranked area was mainly agriculture and pasture land with few other features.
- The most poorly ranked area was more urbanized and had more protected features.
- A data driven tool is developed, which does not rely on expert opinion.

The Promise of Artificial Intelligence in Chemical Engineering: Is It Here, Finally?

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DOI 10.1002/aic.16489
Published online December 19, 2018 in Wiley Online Library (wileyonlinelibrary.com)

Keywords: AI, machine learning, data science, predictive analytics, materials science, design, control, optimization, diagnosis, safety

Artificial Intelligence in Chemical Engineering: Background

The current excitement about artificial intelligence (AI), particularly machine learning (ML), is palpable and contagious. The expectation that AI is poised to "revolutionize," perhaps even take over, humanity has elicited prophetic visions and concerns from some luminaries.[1-4] There is also a great deal of interest in the commercial potential of AI, which is attracting significant sums of venture capital and state-sponsored investment globally, particularly in China.[5] McKinsey, for instance, predicts the potential commercial impact of AI in several domains, envisioning markets worth trillions of dollars.[6] All this is driven by the sudden, explosive, and surprising advances AI has made in the last 10 years or so. AlphaGo, autonomous cars, Alexa, Watson, and other such systems, in game playing, robotics, computer vision, speech recognition, and natural language processing are indeed stunning advances. But, as with earlier AI breakthroughs, such as expert systems in the 1980s and neural networks in the 1990s, there is also considerable hype and a tendency to overestimate the promise of these advances, as market research firm Gartner and others have noted about emerging technology.[7]

It is quite understandable that many chemical engineers are excited about the potential applications of AI, and ML in particular,[8] for use in such applications as catalyst design.[9-11] It might seem that this prospect offers a novel approach to challenging, long-standing problems in chemical engineering using AI. However, the use of AI in chemical engineering is not new—it is, in fact, a 35-year-old ongoing program with some remarkable successes along the way.

researchers new to this area. The objectives of this article are threefold. First, to review the progress we have made so far, highlighting past efforts that contain valuable lessons for the future. Second, drawing on these lessons, to identify promising current and future opportunities for AI in chemical engineering. To avoid getting caught up in the current excitement and to assess the prospects more carefully, it is important to take such a longer and broader view, as a "reality check." Third, since AI is going to play an increasingly dominant role in chemical engineering research and education, it is important to recount and record, however incomplete, certain early milestones for historical purposes.

It is apparent that chemical engineering is at an important crossroads. Our discipline is undergoing an unprecedented transition—one that presents significant challenges and opportunities in modeling and automated decision-making. This has been driven by the convergence of cheap and powerful computing and communications platforms, tremendous progress in molecular engineering, the ever-increasing automation of globally integrated operations, tightening environmental constraints, and business demands for speedier delivery of goods and services to market. One important outcome from this convergence is the generation, use, and management of massive amounts of diverse data, information, and knowledge, and this is where AI, particularly ML, would play an important role.

So, what is AI? The term was coined in 1956 at a math conference at Dartmouth College. Over the years, there have been many definitions of AI, but I have always found the following to be simple, visionary, and useful[12]: "Artificial Intelligence is the study of how to make computers do things at which, at the moment, people are better." Note that this definition does not say which "things." The implication is that

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Editorial | Published: 09 November 2021

Role of artificial intelligence in smart grids

Ahmet Onen

Electrical Engineering **104**, 231 (2022) | Cite this article

898 Accesses | **2** Citations | Metrics

This special issue of Electrical Engineering—Archiv fur Elektrotechnik is oriented on the emerging trends of electrical engineering with particular reference to Artificial Intelligence (AI) and trends applied in power systems.

The papers are contributing to challenges and opportunities from increasing penetration of renewables, digitalization, hybrid operation of AC and DC grids, and aging infrastructure as providing AI is one of the great solutions of these. The papers collected in this special issue show that current trends are defined by the rise of studies in the field of artificial intelligent application on power system. In particular, AI architecture and trends are used in power systems, machine learning algorithms in smart grids, blockchain integrated AI-based solutions in electrical power system applications, batteries-based solution with AI, artificial intelligence applied to power system optimization, optimized management in microgrids and energy hubs, AI-driven solutions for the next generation of the smart-grid, decentralization and digitalization in smart grids, data analytics for electrical energy systems.

Machine Learning Approaches to Predict the Hardness of Cast Iron.

- **Source:** Tribology in Industry . 2020, Vol. 42 Issue 1, p1-9. 9p.

- **Author(s):** Fragassa, C.; Babic, M.; dos Santos, E. Domingues

- **Abstract:** The accurate prediction of the mechanical properties of foundry alloys is a rather complex task given the substantial variability of metallurgical conditions that can be created during casting even in the presence of minimal variations in the constituents and in the process parameters. In this study an application of different intelligent methods of classification, based on the machine learning, to the estimation of the hardness of a traditional spheroidal cast iron and of a less common compact graphite cast iron is proposed. Microstructures are used as inputs to train the neural networks, while hardness is obtained as outputs. As general result, it is possible to admit that 'light' open source self-learning algorithms, combined with databases consisting of about 20-30 measures are already able to predict hardness properties with errors below 15 %.

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Journal of Materials Science & Technology
Volume 125, 20 October 2022, Pages 252-264

Review Article

Biomedical applications of the powder-based 3D printed titanium alloys: A review

Amy X.Y. Guo, Liangjie Cheng, Shuai Zhan, Shouyang Zhang, Wei Xiong, Zihan Wang ✉, Gang Wang ✉, Shan Cecilia Cao ✉

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https://doi.org/10.1016/j.jmst.2021.11.084 Get rights and content

Abstract

3D printing technology is a new type of precision forming technology and the core technology of the third industrial revolution. The powder-based 3D printing technology of titanium and its alloys have received great attention in biomedical applications since its advantages of custom manufacturing, cost-saving, time-saving, and resource-saving potential. In particular, the personalized customization of 3D printing can meet specific needs and achieve precise control of micro-organization and structural design. The purpose of this review is to present the most