THE ATHENS INSTITUTE FOR EDUCATION AND RESEARCH

Abstract Book

13th Annual International Conference on Civil Engineering
19-22 June 2023 Athens, Greece

Edited by
Dimitrios Goulias & Olga Gkounta

2023

Abstracts
13th Annual International Conference on Civil Engineering

19-22 June 2023, Athens, Greece

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(In Alphabetical Order by Author's Family Name)

Preface

This book includes the abstracts of all the papers presented at the *13th Annual International Conference on Civil Engineering* (19-22 June 2023), organized by the Athens Institute for Education and Research (ATINER).

A full conference program can be found before the relevant abstracts. In accordance with ATINER's Publication Policy, the papers presented during this conference will be considered for inclusion in one of ATINER's many publications only after a blind peer review process.

The purpose of this abstract book is to provide members of ATINER and other academics around the world with a resource through which they can discover colleagues and additional research relevant to their own work. This purpose is in congruence with the overall mission of the association. ATINER was established in 1995 as an independent academic organization with the mission to become a forum where academics and researchers from all over the world can meet to exchange ideas on their research and consider the future developments of their fields of study.

To facilitate the communication, a new references section includes all the abstract books published as part of this conference (Table 1). I invite the readers to access these abstract books –these are available for free– and compare how the themes of the conference have evolved over the years. According to ATINER's mission, the presenters in these conferences are coming from many different countries, presenting various topics.

Table 1. *Publication of Books of Abtracts of Proceedings, 2011-2023*

Year	Papers	Countries	References
2023	28	19	Goulias and Gkounta (2023)
2022	26	15	Goulias and Gkounta (2022)
2021	12	5	Papanikos (2021)
2020	15	9	Papanikos (2020)
2019	24	15	Papanikos (2019)
2018	34	22	Papanikos (2018)
2017	33	16	Papanikos (2017)
2016	40	17	Papanikos (2016)
2015	33	14	Papanikos (2015)
2014	40	23	Papanikos (2014)
2013	29	18	Papanikos (2013)
2012	20	10	Papanikos (2012)
2011	34	12	Papanikos (2011)

It is our hope that through ATINER's conferences and publications, Athens will become a place where academics and researchers from all over the world can regularly meet to discuss the developments of their disciplines and present their work. Since 1995, ATINER has organized more than 400 international conferences and has published over 200 books. Academically, the institute is organized into 6 divisions and 37 units. Each unit organizes at least one annual conference and undertakes various small and large research projects.

For each of these events, the involvement of multiple parties is crucial. I would like to thank all the participants, the members of the organizing and academic committees, and most importantly the administration staff of ATINER for putting this conference and its subsequent publications together.

Gregory T. Papanikos
President

Editors' Note

These abstracts provide a vital means to the dissemination of scholarly inquiry in the field of Civil Engineering. The breadth and depth of research approaches and topics represented in this book underscores the diversity of the conference.

ATINER's mission is to bring together academics from all corners of the world in order to engage with each other, brainstorm, exchange ideas, be inspired by one another, and once they are back in their institutions and countries to implement what they have acquired. The 13th Annual International Conference on Civil Engineering accomplished this goal by bringing together academics and scholars from 19 different countries (Brazil, Canada, Colombia, Croatia, Germany, India, Italy, Japan, Jordan, Lebanon, Mexico, Nicaragua, Poland, Portugal, Saudi Arabia, South Africa, Spain, Türkiye, USA), which brought in the conference the perspectives of many different country approaches and realities in the field.

Publishing this book can help that spirit of engaged scholarship continue into the future. With our joint efforts, the next editions of this conference will be even better. We hope that this abstract book as a whole will be both of interest and of value to the reading audience.

Dimitrios Goulias & Olga Gkounta
Editors

13th Annual International Conference on Civil Engineering, 19-22 June 2023, Athens, Greece

Organizing & Scientific Committee

All ATINER's conferences are organized by the Academic Council. This conference has been organized with the assistance of the following academic members of ATINER, who contributed by reviewing the submitted abstracts and papers.

1. Gregory T. Papanikos, President, ATINER & Honorary Professor, University of Stirling, U.K.
2. Dimitrios Goulias, Head, Civil Engineering Unit, ATINER and Associate Professor, Civil & Environmental Engineering Department, University of Maryland, USA.

FINAL CONFERENCE PROGRAM

13th Annual International Conference on Civil Engineering, 19-22 June 2023, Athens, Greece

PROGRAM

Monday 19 June 2023

08.30-09.15
Registration

09:15-10:00
Opening and Welcoming Remarks:

- **Gregory T. Papanikos**, President, ATINER.

10:00-11:00 Session 1	
Session 1a **Moderator: Ivanka Netinger Grubesa**, Full Professor, University North, Croatia.	**Session 1b** **Moderator: Timothy M. Young**, Emeritus Professor, The University of Tennessee, USA & CEO and President, T.M. Young Institute, LLC, USA.
1. **Dimitrios Goulias**, Associate Professor & Director of Undergraduate Studies Civil & Environmental Engineering Department, University of Maryland, USA. ***Title:*** *Non Destructive Testing in Concrete Maturity Modelling and Master Curve Development.* 2. **Panagiotis Anastasopoulos**, Associate Professor, University at Buffalo, USA. ***Title****: Using the Transportation Research Informatics Platform to Improve Road-Network Safety with Low-Cost Mitigation Strategies.*	1. **Glen Bright**, Professor, University of KwaZulu-Natal, South Africa. **Christian Basson**, Lecturer, University of KwaZulu-Natal, South Africa. ***Title****: Optimization of Conformity for a Biological Inspired Gripper Utilizing Adaptive Control.* 2. **Karen Roberts-Licklider,** PhD Student, University of Oklahoma, USA. **Theodore Trafalis**, Head, Industrial Engineering Unit, ATINER, Professor of Industrial & Systems Engineering and Director, Optimization & Intelligent Systems Laboratory, The University of Oklahoma, USA. ***Title****: Optimizing Treatment Facility Locations in Oklahoma Using Haversine Distance Optimization.*
Discussion	**Discussion**

11:00-12:00 Session 2	
Session 2a **Moderator: Dimitrios Goulias**, Associate Professor & Director of Undergraduate Studies Civil & Environmental Engineering Department, University of Maryland, USA.	**Session 2b** **Moderator: Glen Bright**, Professor, University of KwaZulu-Natal, South Africa.
1. **Ivanka Netinger Grubesa**, Full Professor, University North, Croatia> **Anita Gojević**, Project Assistant, Josip Juraj Strossmayer University of Osijek, Croatia. **Sandra Juradin**, Full Professor, University of Split, Croatia. **Aleksej Aniskin**, Assistant Professor,	1. **Reinhard Schmidt**, Professor, University of Applied Sciences, Germany. ***Title****: Bamboo as a Lightweight Material in Mobile Applications Using the Example of a City Bike.* 2. **Kiyoshi Nagata**, Professor, Daito

University North, Croatia. ***Title**: The Effect of Hydrophilic Crystalline Admixture on the Durability of Concrete.* 2. **Xavier Hurtado**, Assistant Professor, Natural Science Museum La Salle University, Colombia. **Maritzabel Molina**, Associate Professor, National University of Colombia, Colombia. ***Title**: Experimental Analysis of CSC-Type Shear Connectors Capacity under Direct Shear: Pry-Out Test.* **Discussion**	Bunka University, Japan. ***Title**: Automatic Generating System of Information Security Policy.* **Discussion**

12:00-13:30 Session 3	
Session 3a **Moderator: Dimitrios Goulias**, Associate Professor & Director of Undergraduate Studies Civil & Environmental Engineering Department, University of Maryland, USA.	**Session 3b** **Moderator: Theodore Trafalis**, Professor, The University of Oklahoma, USA.
1. **Khairedin Abdalla**, Professor, Jordan University of Science and Technology, Jordan. ***Title**: Impact of Axial and Cyclic Lateral Loads on the Behavior of CFRP-Confined Circular CFT Steel Columns with Different Concrete Strengths.* 2. **Rajai Al-Rousan,** Professor, Jordan University of Science and Technology, Jordan. ***Title**: Impact of GFRP Reinforcement Ratios on the Behavior Full-Scale Concrete Bridge Deck Slabs.* 3. **Helena Barros**, Professor, University of Coimbra, Portugal. **Carla Ferreira**, Professor, University of Coimbra, Portugal. ***Title**: Using Design Abacus in the Learning of Reinforced Concrete Structures.* **Discussion**	1. **Hugo Gabele**, Professor, Institute for Sustainable Energy Technology and Mobility, Esslingen University, Germany. ***Title**: Helmar – LiMo 2040 – Sustainable Urban Living and Mobility Concept.* 2. **Tyrone Bright**, Lecturer, Durban University of Technology, South Africa. **Sarp Adali**, Professor, University of KwaZulu-Natal, South Africa. **Glen Bright**, Dean of Engineering, University of KwaZulu-Natal, South Africa. ***Title**: Low-cost Sensory Glove in an Advanced Manufacturing System for a Human-Robot Collaboration.* 3. **Leo Siegle**, PhD Student, University of Applied Sciences Jena, Germany. **Sabrina Herbst**, Subject Group Leader, University of Applied Sciences Jena, Germany. **Frank Engelmann**, Professor, University of Applied Sciences Jena, Germany. ***Title**: Design of Rolling Bearings for Use in Potentially Hazardous Areas – A Systematic Review.* **Discussion**

13:30-15:00 Session 4 – A Round-Table Discussion on The Future of Sciences and Engineering Education
Moderator: Gregory T. Papanikos, President, ATINER

1. **Theodore Trafalis**, Professor, The University of Oklahoma, USA.
***Title**: The Future of Sciences, Engineering and Technology: Implications for Engineering Education.*

2. **Mounir Mabsout**, Professor and Chair, Department of Civil and Environmental Engineering, American University of Beirut, Lebanon.
   ***Title**: Higher Learning and the Community: Be Engaged, Stay Relevant.*
3. **Reinhard Schmidt**, Professor, University of Applied Sciences, Germany.
   ***Title:** Making the Mechanical Engineering Studies more Attractive by Integrating the Topics of digitalization and Sustainability into the Curriculum.*
4. **Adel Zeglam**, Professor, University of Tripoli, Libya.
   ***Title**: Challenges Facing Education in Libya: Is There a Way Forward?*
5. **Kiyoshi Nagata**, Professor, Daito Bunka University, Japan.
   ***Title**: The Current State and Issues of Data Science Education in Japan.*
6. **Dimitris Goulias**, Associate Professor, University of Maryland, USA.
   ***Title**: Integrating Multidisciplinary and Global Issues in Engineering Education: Sustainability and Resilience.*

Discussion

15:00-16:00 Discussion + Lunch

20:30-22:30
Athenian Early Evening Symposium (includes in order of appearance: continuous academic discussions, dinner, wine/water, music and dance)

Tuesday 20 June 2023

Session 5

09:30-11:30 Session 5a
Moderator: Mr Kostas Spyropoulos (ATINER Administrator).

1. **Gulcin Dinc Yalcin**, Assistant Professor, Eskisehir Technical University, Turkiye.
   ***Title**: A New Multi-Objective Mathematical Model for the Location of Charging Station for Electric Buses: A Case Study in Tu ̈rkiye.*
2. **Paweł Pienczuk**, Graduate Student, Warsaw University of Technology, Poland.
   Jakub Wierciak, Adjunct Professor, Warsaw University of Technology, Poland.
   ***Title**: Transformation of the Acoustic Amplifier into a Modular Structure.*
3. **Christoph Schattschneider**, PhD Student, Technical University of Applied Sciences Wildau, Germany.
   Sina Piontek, Student, Berliner Hochschule für Technik, Berlin, Germany.
   Hannes Jacobs, Scientific Assistant, Technical University of Applied Sciences Wildau, Germany.
   Andrea Böhme, Scientific Assistant, Technical University of Applied Sciences Wildau, Germany.
   Andreas Foitzik, Professor, Technical University of Applied Sciences Wildau, Germany.
   Concetta Sirena, Scientific Assistant, University of Rome "Tor Vergata", Italy.
   ***Title**: Proof of Principle of Wastewater Treatment Using Plasma Discharge to Reduce the Amount of Methylparaben.*
4. **Juan A. Mateu-Sanchez**, PhD Student, Technical University

08:00-10:30 Session 5b
Old and New-An Educational Urban Walk

The urban walk ticket is not included as part of your registration fee. It includes transportation costs and the cost to enter the Parthenon and the other monuments on the Acropolis Hill. The urban walk tour includes the broader area of Athens. Among other sites, it includes: Zappion, Syntagma Square, Temple of Olympian Zeus, Ancient Roman Agora and on Acropolis Hill: the Propylaea, the Temple of Athena Nike, the Erechtheion, and the Parthenon. The program of the tour may be adjusted, if there is a need beyond our control. This is a private event organized by ATINER

of Valencia, Spain. **Ester Giménez-Carbo**, Associate Professor, Technical University of Valencia, Spain. **Pedro Serna-Ros**, Professor, Technical University of Valencia, Spain. **Carmen Castro-Bugallo**, Associate Professor, Technical University of Valencia, Spain. **Juan Navarro-Gregori**, Associate Professor, Technical University of Valencia, Spain. **José R. Marti-Vargas**, Professor, Technical University of Valencia, Spain. ***Title**: Study on the Stresses Released in a Notched, Postensioned Concrete Beam.*	exclusively for the conference participants.
Discussion	

11:30-13:00 Session 6

Session 6a **Moderator: Mr Konstantinos Manolidis** (ATINER Administrator).	**Session 6b** **Moderator: Reinhard Schmidt**, Professor, University of Applied Sciences, Germany.
1. **Roberto Pinto**, Professor, Federal University of Santa Catarina, Brazil. ***Title**: Ultrasound Applications in the Safety Assessment of Concrete Structures.* 2. **Mounir Mabsout**, Professor, American University of Beirut, Lebanon. ***Title**: Influence of Railing Stiffness on Single-Span Three-Lane and Four-Lane Steel Girder Bridges.* 3. **Roberto Gomez**, Associate Professor, National Autonomous University of Mexico/Institute of Engineering, Mexico. **Raul Sanchez**, PhD Student, National Autonomous University of Mexico/Institute of Engineering, Mexico. ***Title**: Aeroelastic Model Testing of a Railway Bridge.*	1. **Rainald Kasprik**, Professor, Heilbronn University of Applied Sciences, Germany. ***Title**: Realistic Project Budgets through Reverse Determination of Risk Costs.* 2. **Hassan Hijry**, Assistant Professor, University of Tabuk, Saudi Arabia. ***Title**: Multi-Objective Optimization Approach for Healthcare System Design Configuration.* 3. **Victor Tirado**, Full Time Teacher, American University, Nicaragua. ***Title**: Filter Efficiency with Red Rock as Post-Treatment of Stabilization Pond Effluent, Prototype Case Study San Marcos, Carazo, from April to September 2019.*
Discussion	**Discussion**

13:00-15:00 Session 7
Moderator: Rainald Kasprik, Professor, Heilbronn University of Applied Sciences, Germany.

1. **Timothy M. Young**, Director, Center for Data Science (CDS), Emeritus Professor, The University of Tennessee, USA & CEO and President, T.M. Young Institute, LLC, USA.
   ***Title**: Data – The New 'Soil' for Humans and Machine Learning in the Digital Era.*
2. **Ling Guan**, Professor, Ryerson University, Canada.
   ***Title**: Inherently Interpretable Machine Learning.*
3. **Debdatta Saha**, Assistant Professor, South Asian University, India .
   Timothy M. Young, Director, Center for Data Science (CDS), Emeritus Professor, The University of Tennessee, USA & CEO and President, T.M. Young Institute, LLC, USA.
   ***Title**: Predicting Firm Performance and Size Using Machine Learning with a Bayesian Perspective.*
4. **Thomas Wiese**, Professor, SUNY Empire State University, USA.

***Title**: Predicting Operating Train Delays into New York City Using Random Forest Regression and XGBoost Regression Models.*

Discussion

15:00-16:00 Discussion + Lunch

19:00-20:30
Dinner

Wednesday 21 June 2023
An Educational Visit to Selected Islands
or
Mycenae Visit

Thursday 22 June 2023
Visiting the Oracle of Delphi

Friday 23 June 2023
Visiting the Ancient Corinth and Cape Sounio

Khairedin Abdalla
Professor, Jordan University of Science and Technology, Jordan

Impact of Axial and Cyclic Lateral Loads on the Behavior of CFRP-Confined Circular CFT Steel Columns with Different Concrete Strengths

The purpose of the research paper in hand is to investigate of the effect of axially-applied and cyclic lateral loadings on the effectiveness of using carbon fiber-reinforced polymer (CFRP) material in preserving structure's behavior as well as governing the failure's mode of the different-in-strength-of-concrete CFT circular-shaped steel columns. For this purpose, the nonlinear finite element analysis (NLFEA) method has been employed. To begin with, a CFT column model was verified using the findings of previously-published researches; then, the experimental model was extended to include the influence of concrete's strength in the search. Eighteen FEA CFT column samples were prepared and confined – at their ends – with different number of CFRP layers, representing the crucial position (with regard to the capacity of lateral loading) and, also, to prevent the column samples from localized buckling outwardly. Thus, the samples would acquire more strength, greater net drifting, and higher dissipation of energy. The parameters of the experimental research were: i) number of CFRP's layers, and ii) the level of axial load. The aim of the research was to numerically explore, utilizing NLFEA, the influence of the research's parameters on the CFT FEA models' behavior after the samples had been put to adequate calibration and validation as per credible experimental findings. The obtained findings indicated that when the column were strengthened with CFRP, there was an enhancement in the cyclic behavior, represented by: more improved capacity of load, bigger horizontally-oriented displacements, more displacement's ductility, more dissipated energy, and less deterioration in secant stiffness.

Rajai Al-Rousan
Professor, Jordan University of Science and Technology, Jordan

Impact of GFRP Reinforcement Ratios on the Behavior Full-Scale Concrete Bridge Deck Slabs

This research paper aims to evaluate, numerically, the performance of full-scale RC bridge's deck slabs that are strengthened with bars of GFRP (glass fiber-reinforced polymer). The adopted analysis method was to simulate the study model utilizing 3-D NLFEA (non-linear finite element analysis). For an accurate analysis, the simulated bridge's slab model was constructed, adjusted, and put to validation with respect to the findings of previous experimental researches. The experimental procedure consisted of preparing (12) bridge's slab models in order to evaluate the impact of the study's parameters, namely: 1) the transversal reinforcement ratio at the bottom (ρ), and 2) the concrete's strength. To make the process easier, the ratio of the at-the-bottom reinforcement was set at: 0.38, 0.46, and 0.57; while the values of the strength of concrete were set at: 20, 30, 40, and 50 MPa. The findings showed that the majority of the experimented models experienced a punching shear mode of failure, along with a closely identical patterns of cracking. The research found that the at-tension strains were mostly governed by the ratio of the at-bottom transversal reinforcement. Also, it was found that strengthening the slab models with bars of glass-FRP impacted positively the load at-ultimate, elastic stiffness, stiffness after cracking, and energy absorption. Whereas, the reinforcement's stimulus on the at-ultimate deflection was merely noticeable. Further, the research found that the glass-FRP bars became more efficient when the level of the damage-by-heat was raised.

Panagiotis Anastasopoulos
Associate Professor, University at Buffalo, USA

Using the Transportation Research Informatics Platform to Improve Road-Network Safety with Low-Cost Mitigation Strategies

The Transportation Research Informatics Platform (TRIP) is an informatics based system designed to handle massive amounts of transportation data, provide researchers an efficient way to interact with this data, and allow for the straightforward use of analytical tools to assess the data. The platform is capable of supporting a wide range of planning and operations activities, and can combine numerous sources of data, including the Strategic Highway Research Program 2 (SHRP2) Naturalistic Driving Study (NDS) data. Given the immediate need for roadway agencies to improve safety on a budget, this presentation demonstrates the use of TRIP and the SHRP2 NDS data on developing two low-cost safety mitigation strategies. The first project provides new insights into the performance of popular public-private partnership (PPP) contracting approaches by distinguishing differences with respect to the characteristics of crashes that occurred during the contractual period of roadway projects, and by identifying PPP types and contract characteristics that can improve safety. The second project assesses the effect of long term non-invasive pavement deterioration on accident injury-severities, and demonstrates the potential of considering safety as one of the criteria in the pavement management decision making process. Both projects demonstrate the capabilities of TRIP in combining and analyzing extremely diversified data, and providing informative recommendations.

Helena Barros
Professor, University of Coimbra, Portugal
&
Carla Ferreira
Professor, University of Coimbra, Portugal

Using Design Abacus in the Learning of Reinforced Concrete Structures

Engineers performing design of reinforced concrete structures use commonly software that delivers every result needed for the construction of structures. These are very convenient tools but, nevertheless, should be confirmed or tested by other ways. In the initial use of reinforced concrete the engineers had to use table and design abacuses performing with them a design under a more controlled situation that is the more elaborated calculus was performed by different steps that were always controlled. Actually and the calculation methods that include the data, the analysis of the results. Nowadays the evolution of computers permits a very rapid calculus but the results should be confirmed using other reliable tools. The present work aims to present a collection of tables, charts and diagrams that were in previous times used exclusively by engineers. These tables and charts consider the actual recommendations of Eurocode 2. This design is performed in terms of obtaining the longitudinal reinforcement in structures with cross-sections subjected to axial forces and bending moments. These tables and charts deal with the ultimate limit state design and the diagrams are used for evaluation of the stresses in cracked sections for serviceability design considering linear elastic behavior of both steel and concrete. Several examples are presented explaining the correct use of the tables and abacuses.

Acknowledgments

The support of ACIV- Associação para o Desenvolvimento da Engenharia Civil is gratefully acknowledged.

Glen Bright
Professor, University of KwaZulu-Natal, South Africa
&
Christian Basson
Lecturer, University of KwaZulu-Natal, South Africa

Optimization of Conformity for a Biological Inspired Gripper Utilizing Adaptive Control

Grip force control is vital in handling fragile components in manufacturing environments. Grip force control is utilized to regulate the pressure of the grasp. Mechanical self-adapting grippers tend to over-grip, meaning that the fingertips tend to surpass the position of object contact, leading to over-exerting force on the object. It is also essential to consider the distribution of forces on the object to avoid high-point loadings, object compliance is vital for a gripper to conform around an object to improve grasping capabilities. An under-actuated 4-finger gripper based on the Fin-Ray Effect® was developed to utilize active haptic feedback control to self-regulate grip force. Object compliance was improved by designing relief slides to reduce the buckling of the fingertips. Critical buckling force occurred at 0.06 mm of displacement of the pin therefore requiring a relief notch. An anti-slip surface was added to the contact area of the appendages to improve holding capacity. Adding grip tape improved the friction force by a magnitude of 3 thus improving grip performance. The fulcrum design for the under-actuated gripper was intended to optimally increase the envelope area with minimum displacement of the fulcrum pin. The envelope area reached 11,000 mm^2 with 4 mm pin displacement. Geometric improvements were investigated to maximize the conformity performance of the appendage-rib construction. An FEA simulation study was performed to determine the best sensor placement of the fingertip. Active haptic feedback control was investigated to mitigate parasitic conformity due to the Fin-Ray Effect®. The optimal length from the fingertip was found to be 66.3 mm. A dynamic experiment was performed to investigate the parasitic grip force thus requiring an active haptic system to mitigate the parasitic force. A parasitic force of about 70 grams was found across the dynamic motion.

Tyrone Bright
Lecturer, Durban University of Technology, South Africa
Sarp Adali
Professor, University of KwaZulu-Natal, South Africa
&
Glen Bright
Dean of Engineering, University of KwaZulu-Natal, South Africa

Low-cost Sensory Glove in an Advanced Manufacturing System for a Human-Robot Collaboration

Human-Robot Collaboration (HRC) enables humans and robots to co-exist in the same working environment by performing production operations together. In Advanced Manufacturing Systems, it is important to provide a safe environment where humans and robots can interact and work in conjunction with each other. This research explored and developed a device that enabled the creation of a Human-Robot Collaborative environment. The study provided a low-cost sensory glove that was physically attached to the human hands.

The project researched and designed the low-cost sensory glove in the form of both hardware and software. The sensory glove was used to teach the robot by means of physical actions and gestures under safe operating conditions. The sensory glove consisted of IMU sensors to accurately track the user's hand's orientation and speed. An algorithm was developed and designed to compute the data and create a three-dimensional render of the hand as it moved through free space. It produced the image that the robot would recognise when interacting with the worker.

Testing was conducted on the accuracy, repeatability and practicality of the system. The results showed that it was a low-cost innovative way for humans and robots to collaborate. The apparatus provided a safe working environment, whereby humans and robots could perform work operations together. HRC has become a vital technology for industry progress towards the Fourth Industrial Revolution. It focuses on creating flexible manufacturing plants that have high levels of productivity, efficiency, quality and automation while interacting with human workers in the same space.

Gulcin Dinc Yalcin
Assistant Professor, Eskisehir Technical University, Türkiye
Ece Doğan
Eskisehir Technical University, Türkiye
Ahmed Yasin Kaya
Eskisehir Technical University, Türkiye
&
Enes Can Oğus
Eskisehir Technical University, Türkiye

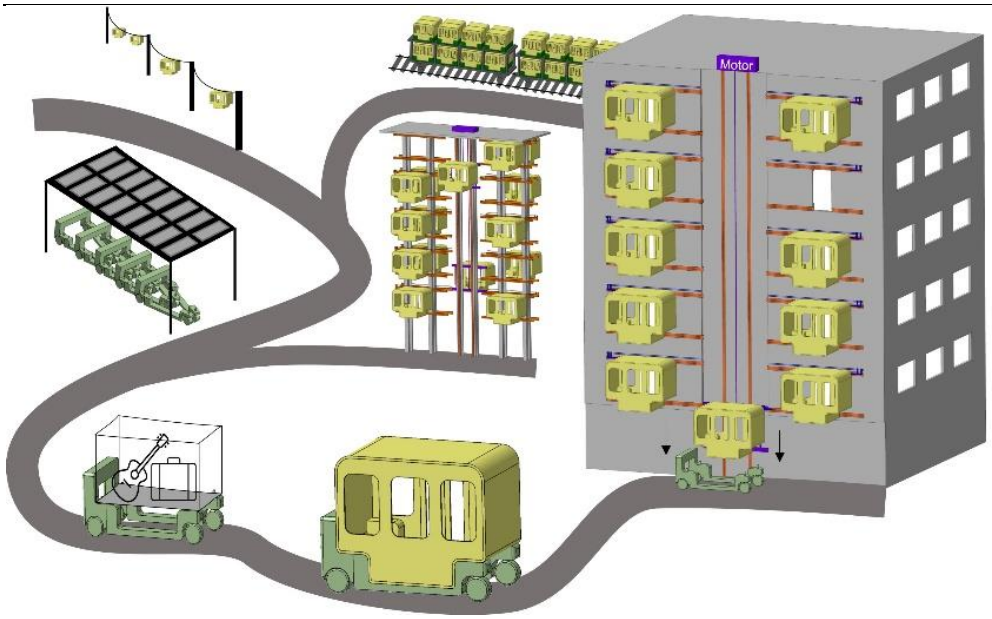
A New Multi-Objective Mathematical Model for the Location of Charging Station for Electric Buses: A Case Study in Türkiye

The usage of electric vehicles instead of traditional vehicles, which is called fossil fuel vehicles, is significant to create sustainable solutions. Determining the locations of the charging stations is essential to increase the number of electric vehicles and especially electric vehicle to be preferred, which are frequently used in the transportation network. Waiting times at the charging stations, having sufficient charge for the next stop, and especially the budget are the basic limitations for the selection of locations of the charging stations. In addition, in this study, the candidate charging stations are determined among the existing bus stops that would prevent extra breaks and thus customer satisfactions would increase. However, due to both driving range and budget constraints, using electric buses on every bus route may not be possible to use. For this purpose, in this paper, we propose a multi-objective mathematical model that both minimizes the number of charging stations and maximizes the number of electric buses and we use the weighted sum method to solve the multi-objective mathematical model using the General Algebraic Modeling System (GAMS) with the data of a bus company in Türkiye.

Hugo Gabele
Professor, Institute for Sustainable Energy Technology and Mobility, Esslingen University, Germany

Helmar - LiMo 2040 - Sustainable Urban Living and Mobility Concept

Modular e-vehicle concepts (consisting of vehicle cabin and chassis) are known (e.g., BMW i3), but have not yet been thought through to their logical conclusion. The LiMo cabin is not only a vehicle cabin, but also a component of a modern high-rise apartment. It therefore requires no parking space and combines urban living and individual mobility sustainably and cost-effectively. If a vehicle is needed, an app can be used to book a chassis that comes along autonomously and waits until the cabin, including its occupants, travels down a sophisticated rail system, docks and autonomously heads for the desired destination.



What is innovative is not so much the individual components, but the multifunctional combination or substitution of systems. The model for the cabin is a small cable car gondola. The chassis comes from the depot of a service provider who takes care of logistics and infrastructure (space-saving parking, battery charging, etc.).

The cabin is owned by the house or apartment owner. It should enable both comfortable living and pleasant driving. Particular challenges here are the connection of the cabin to the house (including

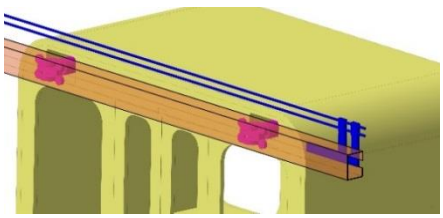
weather protection and insulation) and the vibration-damping connection to the chassis.

The cabin is supported in the rails by 4 roller bearings anchored in the structurally rigid corners of the cabin. Both the two vertical rails (for transport to the desired floor) and the horizontal rails to the opening of the apartment are integrated into the building wall in a space-saving and unobtrusive manner.

The special features can be summarized as follows:

- Comfortable transport of people and goods (especially for people with limited mobility)
- Use sharing principle: for 10 cabins on average only 3 chassis are needed
- Cabin extends and enriches living space (mini conservatory)
- Elevator in the building can be omitted. i.e., more living space per floor.
- Parking at the residence is not necessary
- Parking away from home in innovative and cost-effective parking towers
- Parking space requirement for chassis minimal (pushing one inside the other like shopping carts)
- Chassis can be used multifunctionally, i.e., also for pure goods transport (flatbed body)
- Compact cabin dimensions allow efficient transport by rail.

The self-supporting design is derived from a small cable car gondola with 2 integrated benches. The connection to the chassis is made via 4 quick couplings, which are integrated into the armrests to save space. The cabin shell is made of double-walled recyclable plastic in sandwich construction (heat and sound insulating). Four laterally installed roller bearings are used to hold the cabin in "parking mode" on the building. The roller bearings can be retracted via electrically driven spindles, so they are recessed in "travel mode". For transportation by elevator, they are extended and the rollers are inserted into the rails. In park mode, they are used, among other things, to pull the cabin against the house wall for a firm and tight connection.



Roberto Gomez
Associate Professor, National Autonomous University of Mexico/Institute of Engineering, Mexico
&
Raul Sanchez
PhD Student, National Autonomous University of Mexico/Institute of Engineering, Mexico

Aeroelastic Model Testing of a Railway Bridge

Wind tunnel studies for large span bridges generally comprise section model tests and/or full aeroelastic model testing. The former is usually carried out on a scaled cross section of the bridge and their main objective is to study aspects of instability; usually these tests are performed in a wind environment known as smooth flow. Since only the deck is considered, only lower limits are estimated for the flutter phenomenon, however, turbulent flow tests can also be performed to estimate the response under turbulent knocking and study the sensitivity of any instability of the bridge cross section under turbulent flows. The limitations of section models are that their response does not reproduce the modal shapes of the bridge nor the distribution of energy can be scaled with frequency.

On the other hand, with the tests of complete aeroelastic models, pylons, stays and other components that generate wake turbulence and interference effects (which usually delays the start of instability) are fully simulated. Testing a complete aeroelastic model in a turbulent environment also serves to investigate the sensitivity of any instability identified with section models; in addition, they are used to examine whether turbulence and/or non-uniform mean velocity along the span, due to the effects of topography, could help to stabilize aerodynamically the bridge. With the testing of complete aeroelastic models, the response of a bridge is completely defined, since the three-dimensionality of the structure and the wind are rationally simulated.

This paper presents the experimental methodology used for the study of the aeroelastic behavior of a new railway cable stayed bridge, which will be located in Mexico City. The results of the analysis are presented in terms of forces, moments and displacements in different sections of the model; low turbulence and turbulent wind flows that reproduce the local conditions at the site were simulated in an atmospheric boundary layer wind tunnel. Construction and service stages of the bridge are considered. Based on the analysis of the results, final comments and recommendations are issued.

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Non Destructive Testing in Concrete Maturity Modelling and Master Curve Development

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Inherently Interpretable Machine Learning

In recent years, machine learning (ML), especially deep neural networks (DNNs), have been intensively studied and applied in many scientific and industrial sectors where intelligent processing is required, leading to superior, sometimes unprecedented performance. Typical examples include audio processing, image classification, computer vision, image retrieval, healthcare, to name a few. Despite the extraordinary success, the interpretability of ML systems, especially the black-box nature of state-of-the-art (SOTA) ML architectures, has posed a big challenge, causing concerns about questionable performances and predictions in real applications. Therefore, we have witnessed drastically rising demand for better understanding and more effectively exploring ML-based knowledge representations. To address this black-box problem, interpretable ML (I-ML) has recently drawn considerable attention and interests in the ML community. While most ML models experience certain level of black-box design, the consensus is that the classical neural network (NN)-based models (e.g., neural network, convolutional neural network (CNN) and DNNs in general) exhibit less interpretable characteristics, thus attracting more attention from both academia and industry, first trying to explain the black-box and, more recently, designing new models that are inherently interpretable.

A plethora of publications on I-ML have been made available to the ML and intelligent processing communities, mostly focusing on using classical NN models, feed forward NN (FFNN)-based or DNN-based, to explain the internal structure of a black- box. While acknowledging progress along this line of research, emphasis of this paper will be given to the class of models which are designed to be inherently interpretable from analytically inspired perspectives, especially those integrating statistical machine learning (SML) principles, coined as Statistics Guided Optimization (SGO), with NN architecture (SGO-NN).

The class of SGO-NN models features three distinct characters: a) *Kolmogorov-Arnold (K-A) theorem as the foundation*: three hidden layers are sufficient for a NN to approximate any nonlinear functions; b) *the incorporation of certain neurobiological facts in architecture design*: the ability to process multiple information streams coherently and simultaneously, e.g., audio-visual processing; c) *powerful optimization methods in the training process*: the parameters of the network are

determined by analytically solving SGO problems in the convolutional layers, making the models mathematically plausible.

Analytically, the recent progress in approximation theory has solidly verified K-A theorem under mild conditions. At the same time, numerous practical SGO-NN models with three or fewer layers have emerged and demonstrated their flexibility, effectiveness, and computational affordability. Amongst this branch of I-ML models, those based on canonical correlation analysis (CCA) stand out, demonstrating tremendous potential to address the interpretability challenge in ML research.

To validate the power of inherently I-ML models, SGO-NN models in particular, practical examples in text-image representation, facial analysis, object recognition, and action analysis and recognition are presented. It is expected that the SGO-NN models and the inherently I-ML models in general would better inspire researchers and practitioners in the pursuit of powerful interpret ML models in their R&D endeavor.

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Multi-Objective Optimization Approach for Healthcare System Design Configuration

Understanding risks that can occur in the Emergency Department (ED) is essential to examine the patient's workflow journey. The ED is viewed as unpredictable; hence, it is deemed a high-risk-inducing environment. ED staff experience a variety of situations during their shifts, ranging from patients having upset stomachs or a common cold that requires simple treatment, to acute trauma involving complex procedures. Therefore, efficiency, speed, and accuracy during a patient assessment, diagnosis, and treatment are significant. For the emergency department processes to be improved, it is essential to consider various goals and variables which exist in an unpredictable and highly dynamic environment. Due to this complexity, the process of decision-making is very challenging.

This study offers a knowledge-based Multi-Objective Optimization approach to assess these complexities. The methodology was successfully applied for system improvement and analysis in a Mecca, Saudi Arabia ED using data collected during the Hajj. Consequently, the decision-makers offered different optimal design rules and solutions, significantly reducing the waiting times and length of stay in the system.

This research expands the previous study, where a Discrete Event Simulation model was applied with the OptQuest Optimizer. However, OptQuest is limited to individually changing each parameter (one objective) and running scenarios to search for optimal solutions. In this work, the Multi-Objective Optimization approach ModeFRONTIER software was utilized. This software aims to support decision-making by providing high-quality and proper optimization tools. The methods were applied as follows: the first step was to learn about the process workflow by gathering data and analyzing it and obtaining knowledge about the ED system behavior. The second step was to apply Multi-Objective Optimization technique to get optimal, or nearly optimal, configurations of the ED system. Third, we exposed the most crucial input variables by evaluating the main effects of factors on responses in the study. Finally, the Pareto optimal solutions were provided to the ED management to choose from, depending on their preferences. This methodology provides decision-makers with optimal design

configuration tools for healthcare systems and elsewhere, such as process automation and design optimization for production workflow.

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Experimental Analysis of CSC-Type Shear Connectors Capacity under Direct Shear: Pry-Out Test

The use of composite sections has demonstrated high efficiency in the performance of structural elements, because the capacity of materials is optimally used. In particular, the implementation of hybrid steel-concrete elements has shown an increase in capacity, weight reduction, and improvement in construction processes. In addition, CFS (Cold Formed Steel) sections enhance the use of lightweight flooring systems in small and medium buildings, reducing construction costs, allowing these sections to be considered as an alternative of sustainability in construction.

The CFS-concrete composite sections have been studied by several authors, mainly in the USA, Malaysia, Singapore, and Australia, such as Hanaor (2000), Fontana & Bartschi (2002), Queiroz (2010), Lakkavalli (2006). In their research, different types of shear connectors have been proposed, as well as different fastening systems alternative to welding, because high temperatures may affect the thin steel plates. Despite all the research developed, in the design codes there is no, at least, formal proposal for the implementation of alternative shear connectors, and its implementation in formal construction to guarantee safe use

The authors of this research proposed the CSC-type shear connectors, as result of a process of geometric and mechanical optimization to link both materials. An alternative fastening system was also proposed. The characterization of the structural behavior was initially carried out by numerical simulations, using the finite element method FEM. Subsequently, the results were compared with experimental results obtained throughout Pry-Out test.

The design formulation of CSC-type shear connectors is proposed from the statistical analysis of a set of experimental data and the comparison with analytical results obtained from the numerical simulation. In addition, the system capacities estimated are compared with the response given by the design formulation issued by Oguejiofor and Hosain for perfobond rib connectors.

The proposed formulation allows having a safe and technical response, aimed to become a design condition for the structural design of CFS-concrete composite sections.

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Realistic Project Budgets through Reverse Determination of Risk Costs

The determination of risk costs is helpful for decision makers when comparing the benefits of an investment with the costs. Especially in the early stages of a project, when applying for a permit, it is explicitly allowed or even required (e.g., in the U.S., the U.K., or Austria) to evaluate and consider such possible cost overruns in the decision phase that have a low probability of 20% or less (the Value at Risk 80 or higher).

The main drawback of traditional risk cost assessment methods is the presence of unconscious routines in decision-making: optimism bias. This is considered to be the main factor behind the overrun of planned costs in more than 80% of large military projects in the U.S. or in 20 to 40% of transportation infrastructure projects in the UK.

Therefore, the authors propose a reverse determination of risk costs. The project team is asked to develop cost scenarios based on the degree of uncertainty (e.g., the complexity of the project, the technological novelty of the solution, or the estimability of external circumstances). The cost scenarios should describe a situation in which there is a cost overrun by a certain growth factor, depending on the targeted confidence level. By forcing the project team to consider worse developments of the cost drivers, it is possible for a decision maker to question the planned - and estimated as moat likely - costs, and it enables the project team to react quickly to counteract unfavorable developments, since the relevant cost drivers have been examined and thus weak signals become interpretable.

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Influence of Railing Stiffness on Single-Span Three-Lane and Four-Lane Steel Girder Bridges

The presence of railings or parapets acting integrally with the concrete deck placed on steel girders has the effect of stiffening and therefore altering the lateral wheel load distribution on highway bridges. The American Association of State Highway and Transportation Officials (AASHTO) Standard Specifications for Highway Bridges and AASHTO LRFD Bridge Design Specifications procedures do not account for the presence of railings when evaluating the load-carrying capacity of highway bridges. This paper presents a parametric study using 3D finite element analysis to investigate the influence of railing stiffness on one-span, multi-lane steel girder bridges, namely three lanes and four lanes, following on previous work that was limited to two lanes. Railings of different sizes were placed on one or both sides of the bridge deck, in combination with various span lengths and girders spacing. AASHTO HS20 design trucks were placed longitudinally and transversally in order to produce maximum longitudinal bending moments in the steel girders. The wheel load distribution obtained from finite element analysis at the critical section of each bridge were compared with the AASHTO procedures and with reference cases for bridges without railing. This study confirmed that the presence of concrete railings modeled and built integrally with the deck tends to stiffen the bridge superstructure. Further, the study quantified the effect of railing in increasing the load-carrying capacity of steel bridges. The results of this research will therefore assist structural engineers in better designing new steel girder bridges and/or evaluating more precisely the load-carrying capacity of existing bridges with railings of different sizes. Bridge engineers can consider adding or stiffening railings/parapets as a practical method for strengthening existing steel girder bridges.

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Study on the Stresses Released in a Notched, Postensioned Concrete Beam

For the case of structural prestressed concrete elements (SPCE), and regardeless the prestressing technique used (post- or pre-tensioning), there are several uncertainties when it comes to assessing the actual prestressing force condition. Based on codes, the initial design and subsequent casting of a SPCE are carried out by setting a prestressing force to be introduced. Afterwards, the initial prestressing force decreases through time due to several sources: instantaneous prestress losses due to friction, elastic shortening of concrete and seating loss at anchorage, and time-dependent prestress losses due to concrete creep and shrinkage and reinforcement relaxation. Accordingly, overestimating prestress losses can lead to excessive camber and inefficient designs, while underestimating prestress losses can result in excessive deflection and unexpected cracks. As a result, the accurate determination of the effective prestressing force at any time is essential in the assessment of existing SPCE.

With the aim of monitoring the prestressing force, a new SPCE can be instrumented during casting by placing internal devices embedded into the concrete (e.g., vibrating wire strain gauges), devices at the anchorage head (e.g., electromagnetic sensors) and/or devices into the reinforcement (e.g., fiber optic sensors). However, existing SPCE were commonly cast without any kind of instrumentation devices, and consequently the effective prestressing force and its variations can only be determined on the basis of indirect procedures such as: (a) loading to obtain the available compressive stress in the bottom flange of a member by determining the structural response associated to crack initiation and/or crack re-opening phenomena; (2) cutting a portion

length of the prestressing reinforcement, which is instrumented (e.g. using strain gauges on its surface); (3) analyzing the response of an exposed length of the prestressing reinforcement in terms of deformability when subjected to an external force; (4) releasing stresses through a cylindrical hole drilled in the concrete; and (5) performing notches by saw-cutting the bottom flange of a SPCE and measuring the released strains/stresses.

Since there are only pioneer applications of the last testing procedure with unmonitored prestressing force, further experimental studies are needed to explore consistencies under monitored prestressing force in laboratory conditions. Therefore, this contribution focuses on the study of the stresses released in a notched, postensioned concrete beam by saw-cutting, which seems suitable to be a promising non-destructive testing technique. The rationale of the test is based on the local decompression of concrete by introducing pairs of surface notches. The resulting strain measurements obtained by extensometry in the isolated concrete block are analyzed and accounted for using backward calculations together with consideration of possible uncertainties associated to the initial prestress, the materials properties and their evolution with time. The acquired knowledge will serve for a better understanding of the saw-cutting technique and to facilitate future in-situ applications to determine the effective prestressing force in the case of unmonitored SPCE.

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Automatic Generating System of Information Security Policy

Information security indispensable in any organization should properly guaranteed not only confidentiality but also integrity and availability, then keep them in balance. Establishing an information security policy is effective as a means for that purpose. But it is still a high hurdle for some types of organizations especially for SMEs without neither personnel nor financial leeway. Thus, we thought that a system to help generating information security policies was required, and we have proposed a framework of it and tried to implement it in application programs. At present, the creation process of the basic policy by presenting the template and the creation of the organizational profile are implemented. In this research, we propose a method to reflect the characteristics obtained from the organization profile not only to the basic policy but also to the following countermeasure standards. We also implement it in the application program; then several simulations are performed to verify its effectiveness.

Paper will be organized as follows. After describing the general definition of information security policy and fact-finding survey on it, review and investigate items of organization profile whether they are suitable for information security issues. The main part is the proposing method for effective embedding the organizational characteristics to the policy document. Since a natural language processing program is needed for the implementation of this kind of works, we will refer to some of them. Last part just before the conclusion, we will show some results obtained from simulations with several types of organization.

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The Effect of Hydrophilic Crystalline Admixture on the Durability of Concrete

One of the causes of the deterioration of concrete buildings are the freezing and thawing cycles to which they are exposed. Namely, the water present in concrete turns into ice when freezing which is of a larger volume than the water from which it was formed and therefore creates pressure on the pore walls. As a result of repeated cycles of freezing and thawing, concrete damage occurs in the form of surface scaling or in the form of internal cracking. Crystalline hydrophilic admixtures are powder components added to the concrete mix to reduce the waterproofing of the concrete. The hypothesis of this paper is that crystalline hydrophilic admixtures as substances that reduce the penetration of water into concrete could improve the durability of concrete. Three concrete mixes were prepared; reference mix, mix with air entraining agent (additive commonly used to improve concrete's resistance to freezing and thawing cycles), and mix with crystalline hydrophilic admixture. The compressive strength and waterproofing of the hardened concrete samples were tested before and after exposure to freezing and thawing cycles in the chamber. The resistance of concrete to freezing and thawing cycles was expressed through the ratios of these properties after and before the freezing and thawing cycles. The results confirm the possibility of using a crystalline hydrophilic admixture for the purpose of improving the durability of concrete.

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Transformation of the Acoustic Amplifier into a Modular Structure

The modular concept of device construction is most often based on the results of economic analyses. It allows lowering both manufacturing and design costs. It also improves their operating characteristics, in particular their repairability. It also happens that the modular structure of a consumer product is used to strengthen its market position. The authors of the article faced such a situation. The management of a company producing audiophile equipment decided to offer its potential customers an acoustic amplifier in which the user would be able to replace the preamplifiers himself, depending on the requirements related to the input signal. This type of modularity is known as "component swapping." Before commencing the development of the structure, detailed analyses of the benefits and potential risks related to the individual stages of the product's life cycle were carried out: design, production and operation. On this basis, the "Divaldi" company, the manufacturer of the equipment, developed assumptions regarding the designed amplifier. In particular, it was considered that the modular system would be built by modifying the existing, successful design of the INT-02 amplifier. The modification will enable easy replacement of the two preamplifier sections. Users will have a choice of classic preamplifiers: line and phono, as well as modules integrated with an analogue-to-digital converter and a module with a Bluetooth receiver. A low-volume production was assumed from previously manufactured and stored components: the base and typical preamplifier sections. As for the exploitation stage, the possibility of self-replacement of modules by the user has been adopted. Based on these assumptions, the concept of an amplifier with two identical pockets was proposed, enabling the simultaneous installation and use of two preamplifier sections. Detailed requirements for interfaces between the modules and the base unit were formulated: mechanical and electrical. A review of the available types of signal connectors led to the selection of the PCIe connector as the one that best meets the technical and economic criteria. From the mechanical side, it was proposed to use sliding guides, guaranteeing proper positioning of the modules in the pockets of the base. After

selecting and approving the solutions, constructions of the mechanical components of the system were developed, creating a new standard: frame, module pockets and preamplifier module. The successful implementation of the amplifier's modularity became the basis for formulating proposals for further modifications of the design to meet the growing requirements of users who expect more and more possibilities to adapt the structure and interfaces of devices to their own needs.

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Ultrasound Applications in the Safety Assessment of Concrete Structures

Quality control, structural evaluation, maintenance and increasing service life have become important issues in the construction industry in recent years. The safety assessment of concrete infrastructure systems has become the subject of worldwide study over the last few decades, since many of these structures have already reached or are close to reaching their service life.

The use of stress wave propagation methods such as ultrasound is one of the NDT methods used in the inspection of concrete structures. Ultrasound allows to indirectly estimate concrete mechanical parameters as well as to indicate the presence of internal flaws. Usually, the ultrasonic pulse velocity (UPV) is the wave parameter applied in the inspection of concrete structures, used in the visualization of non-uniformities within the concrete member through ultrasonic tomography, in the estimation of the depth of surface opening cracks, as well as in other applications. However, there are other lesser used wave parameters that may be more sensitive to the presence of non-homogeneities in a concrete member. Energy-based parameters and other waveform parameters have been also used to assess concrete integrity.

Lately, the application of the diffuse ultrasound method has been attracting a lot of attention, especially for its ability to quantitatively assess small-scale damage in the concrete microstructure that is not amenable to identification through common UPV. Concrete is a heterogeneous material, in which aggregates, voids and internal microcracks act as scatterers for the propagated ultrasonic waves. These mechanical waves suffer repeated reflections, intensified according to the relative size of the wavelength to the scatterers. As a consequence, multiple scattering occurs, with energy being translated to a later random arrival of waveforms (called coda waves), which are more sensitive to small changes. As a result, the displacement field of an elastic wave is no longer coherent with its original phase, due to the loss of its temporal and spatial correlation in relation to the incident wave. This displacement field can then be described by the diffusion equation yielding the diffuse ultrasound parameters of diffusivity, dissipation and arrival time of the maximum energy (ATME). These not so used ultrasonic parameters have shown great potential in

assessing concrete integrity conditions. While the ultrasonic diffusivity is related to the microstructure, describing how quickly the ultrasonic intensity is transferred in the material, the dissipation parameter is related to linear energy loss mechanisms, characterizing the viscoelastic properties of the material.

This paper presents the results of an ongoing investigation into the application of energy-based parameters as well as diffuse ultrasound parameters to assess the integrity of concrete. Different stress wave parameters were used in ultrasonic tomography in order to locate the internal damage in concrete structures. Also, changes in the diffuse ultrasound parameters (diffusivity, dissipation and ATME) were related to the extent of cracking in RC elements. The effect of microstructural development over time on the diffuse parameters was also assessed. The results indicated the ultrasonic parameters investigated were able to assess concrete integrity.

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Optimizing Treatment Facility Locations in Oklahoma using Haversine Distance Optimization

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Predicting Firm Performance and Size Using Machine Learning with a Bayesian Perspective

This paper investigates the issue of predicting the financial performance of firms in registered manufacturing in developing countries using machine learning methods along with economic theory to explain the findings. While literature suggests that predictability of top line measures related to sales is lower compared to bottom line measures such as net profits for small informal establishments in developing countries, we find the opposite holds true for firms in registered manufacturing in the food processing industry in India based on the results from machine learning techniques of Bayesian additive regression trees (BART), boosted trees, bootstrap forests, and regression tree algorithms. BART models in validation outperformed the other algorithms in predictability of the dependent variables. Across ten validation studies, BART had an average R^2 ranging from 0.922 to 0.934 and boosted tree models had an average R^2 ranging from 0.873 to 0.905 for predicting sales. A key significant independent variable for predicting sales across all categories and algorithms was real raw material expenses explaining approximately 83% to 88% of the total sums of squares in all validations. This is in line with the realities of the food processing industry, which is intensive in its raw material usage. The dependent variable 'profits' (as measured by real profits before depreciation, interest, taxes and amortization, 'real_pbdita') was more difficult to predict relative to sales. BART models again outperformed the other algorithms in validation with an average R^2 ranging from 0.745 to 0.818. Key significant variables in the models were more diverse where raw material expenses, compensation to employees, and net- or total-fixed assets explained the largest proportions of the total sums of squares. The results from a machine learning approach with a Bayesian perspective can enhance the understanding of the mechanisms that translate sales into profits for registered manufacturing, thereby aiding policy-making for small businesses in the formal sector in developing countries.

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Proof of Principle of Wastewater Treatment Using Plasma Discharge to Reduce the Amount of Methylparaben

Synthetic substances like many pharmaceuticals, preservatives or other chemical compounds are actually very difficult to handle in sewage treatment. These compounds are very stable in aqueous solution and their degradation reactions are insufficient. Therefore, to eliminate these substances from wastewater additional afford is necessary. Extreme conditions like pH value, redox potential, chemical or physical energy need to be present. With our study we try to show that the use of plasma discharge could be a solution to this problem.

Using the example of methylparaben, a preservative, we could show that the physical energy of plasma discharge is able to initialize the degradation reaction in aqueous environment. The concentration was reduced by up to 70 percent in our setting depending on the treatment duration.

Overall, the system showed potential to optimize wastewater treatment. Further examinations are necessary for example regarding undesirable by-products.

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Bamboo as a Lightweight Material in Mobile Applications Using the Example of a City Bike

Bamboo is an environmentally friendly alternative to conventional materials in mechanical engineering such as steel or aluminium. Bamboo is the fastest growing plant in the world. Instead of releasing CO_2 during the manufacturing process, bamboo absorbs CO_2 as it grows.

In addition to the sustainability aspect, bamboo tubes also offer excellent properties as a lightweight construction material, which have been optimised through evolution. Bamboo tubes have high strength and stiffness at low weight when used as tension-compression bars or bending beams. Bamboo has strong, high-density fibres at the boundary area, where bending stresses are greatest. Towards the inside, where the stresses are lower, the bamboo becomes porous to optimise weight. This, together with knots arranged in regular intervals, counteracts buckling.

In mobile applications such as cars and bicycles, lightweight construction is sought for energy efficiency reasons. Because of its excellent lightweight properties, the project investigated whether bamboo could be used in mobile, automotive or agricultural engineering. For example, a bamboo bicycle frame has been developed with the aim to be as light as possible. There are bamboo bicycles on the market, but they can only be made one at a time by hand. The bamboo tubes are joined together and functional elements such as the bottom bracket and headset are integrated by wrapping them in resin-impregnated natural or carbon fibres. This makes the joints very heavy. A different approach is taken here: the bamboo tubes are drilled out slightly to achieve a defined internal diameter, and then short aluminium tubes are glued into the bamboo canes from the inside. To prevent the cane from breaking in the circumferential direction, i.e. perpendicular to the fibre direction, the bamboo tubes are wrapped in a thin layer of natural or carbon fibre impregnated with synthetic resin. The aluminium tubes and functional elements are welded or soldered together beforehand.

The design of the bicycle frame, i.e., the dimensioning of the bamboo tubes and joints, was based on extensive bending and tensile tests to determine the strength properties of the natural material bamboo. The bonding between the bamboo cane and the aluminium

tube was also investigated experimentally. Finally, several prototype bicycle frames were made and tested for durability according to DIN-EN-14764. The frames passed the tests.

The result is a bamboo bicycle that is manufactured with standardised connectors and joints. The assembly concept developed allows both fully automated and semi-automated series production of bamboo bicycles.

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Design of Rolling Bearings for Use in Potentially Hazardous Areas - A Systematic Review

About 30 percent of in-plant explosions and deflagrations are caused by mechanical components. While these usually remain without serious consequences, in a few cases serious explosions occur with property damage or, in the worst case, personal injury. Non-electrical explosion protection attempts to prevent these.

Particularly in the non-electrical explosion range, there is still a great need for research. This is where this work should start and investigate the thermal behavior of various deep groove ball bearings. A common source of ignition in rolling bearings is a hot surface resulting from the inadmissible heating of parts in relative motion.

The current modified service life calculation of rolling bearings takes into account the potential lubricant contamination, but not the lubricant shortage. Errors in production or assembly, as well as unexpected fault conditions during operation, can lead to an insufficient lubricant supply in the rolling bearing. The result is often unexpected heating of the rolling bearing.

The focus of the study is the analysis of current bearing designs and the performance of several test series to determine the thermal behavior of low-lubricant and lubricant-free deep groove ball bearings. The data collected will be used to gain insights into how rolling bearings can be designed safely for explosion-protected areas.

The heating of the rolling bearing is exponential to the reduction of the lubricant. To validate the hypothesis, several test series are carried out on a specially manufactured rolling bearing test rig. The test rig allows parallel testing of four identical deep groove ball bearings. Detected measured variables are:

Rolling bearing heating is measured at four points of the bearing.
Bearing power loss, as the sum of all bearings.
Vibration behavior of the rolling bearings.

During the test series, the amount of lubricant should vary between 0 and 100 percent. Further factors are the amount of the axial and radial rolling bearing load, the speed as well as the number of rolling bearing revolutions (service life). The preparation and modification of deep groove ball bearings are carried out according to the scheme of test preparation of DIN 51819-2.

In addition to the hypotheses considered, other factors are not taken into account in the present investigation. Only deep groove ball bearings of type 6004 are investigated in the tests. It must be shown in further investigations that the results can be transferred to other deep groove ball bearings and other rolling bearing types.

Overall, the research project represents a first step towards the safe operation and design of rolling bearings in potentially explosive atmospheres.

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Filter Efficiency with Red Rock as Post-Treatment of Stabilization Pond Effluent, Prototype Case Study San Marcos, Carazo, from April to September 2019

An experimental unit was built which was located in the vicinity of the domestic wastewater treatment plant of the Municipality of San Marcos in the Department of Carazo. Said unit consisted of two welded metal barrels with a total height of 1.8 m and a diameter of 0.90 m, likewise, this unit comprised three functional zones; the first or input area composed of a collection unit, a driving unit, a flow control unit, and two distribution units; the second or packed zone, which is the axis of the system because it is there where bacterial growth takes place and where the removal of organic matter takes place; and an outlet composed of PVC pipe. The main objective of this work was to determine how efficient a rocky filter turns out to be, using stabilization pond effluent as a post-treatment unit using red concrete as a filter medium. The study consisted in carrying out laboratory tests on water samples taken from the influent and effluent of a filter made up of red rock, as a filter medium, in order to determine the percentage of organic matter removal efficiency that it has used a hydraulic retention time of 19 hours, 15 hours, and 12 hours. Among the aspects to be considered in the experimental study was the characterization of the effluent from the treatment system of San Marco, Carazo, to determine the quality of water that will be of interest to the study. In this stage, four composite samplings were carried out, two of 12 hours and two of 24 hours, in which physical, chemical, and microbiological parameters were analyzed. Likewise, to determine the efficiency of the filter, the same parameters considered in the characterization of the lagoon effluent were analyzed, obtaining removal efficiencies of up to 55.53% in organic matter, and 64.60% in suspended solids for a hydraulic retention time of 19 hours; In the same way, the efficiency of the filter was carried out for retention times of 15 hours and 12 hours, in which organic matter removals of 67.84% and 56.59% and 82.77% and 77.51% in total suspended solids were found, respectively.

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Predicting Operating Train Delays into New York City Using Random Forest Regression and XGBoost Regression Models

The Long Island Railroad operates one of the largest commuter rail networks in the U.S. This study uses data which includes the location and arrival time of trains based on onboard GPS position and other internal sources. This paper analyzes the GPS position of the train to gain insight into potential gaps in on time performance and train operations. This was done by developing a Random Forest Regression model and an XGBoost regression model. Both models prove to be useful to make such predictions and should be used to help railroads to prepare and adjust their operations.

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