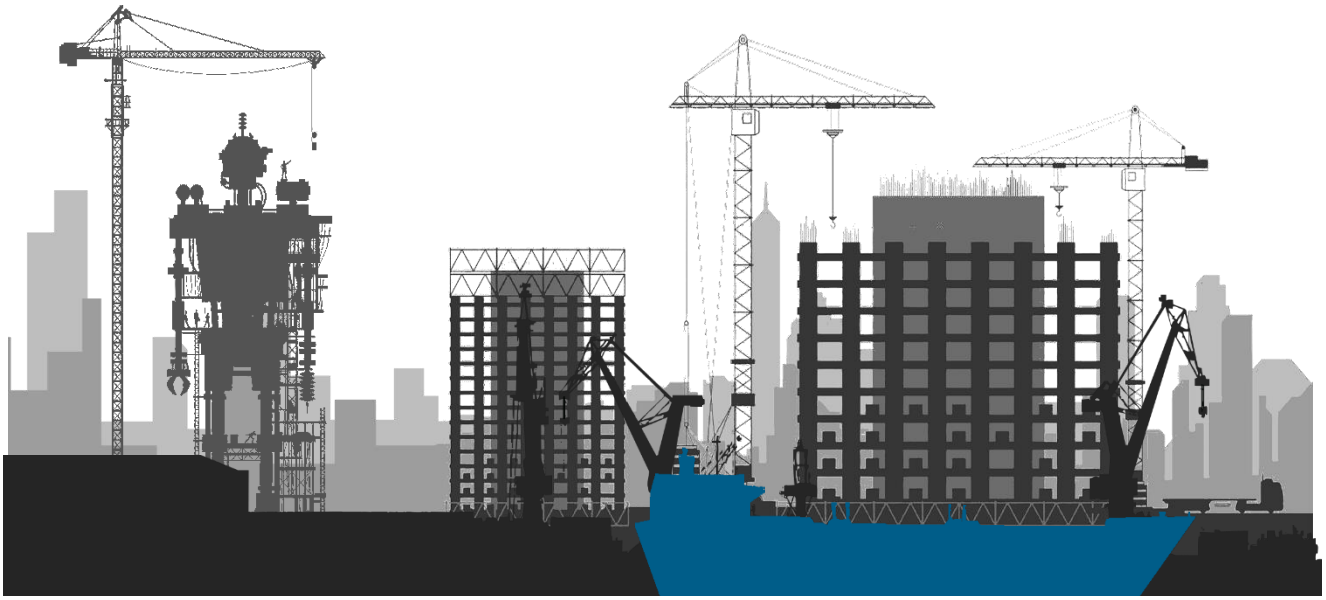
8th Annual PhD Conference on Engineering and Technology

MY FIRST CONFERENCE 2024



MFC 2024

September 19, 2024

Hosted by University of Rijeka,
Faculty of Maritime Studies
Studentska 2, Rijeka, Croatia

Book of Abstracts of the 8th Annual PhD Conference on Engineering and Technology MFC 2024

Publisher

University of Rijeka, Faculty of Maritime Studies, Rijeka, Croatia

Editors

Tomislav Krljan, Marko Strabić, Antonio Blažina, David Brčić

Copy Editing and Proofreading

Jasmina Jelčić Čolakovac

ISBN: 978-953-165-144-8

Published in 2024

My First Conference 2024

Faculty of Maritime Studies, Rijeka, Croatia, 19 September 2024

Organisers

University of Rijeka: Faculty of Maritime Studies, Faculty of Civil Engineering, Faculty of Engineering, Rijeka, Croatia

Scientific Committee

David Brčić, Sanja Dugonjić Jovančević, Domagoj Lanc

Organising Committee

Adrijana Agatić, Dea Aksentijević, Antonio Blažina, Jasmina Jelčić Čolakovac, Davor Jelenović Damjan Jurković, Tomislav Krljan, Dario Ogrizović, Marko Strabić, Davor Šakan, Hana Vukotić, Ivan Sulovsky, Dejan Žagar

Programme Chairs

Marko Strabić, Antonio Blažina

Conference co-chairmen

Adrijana Agatić, David Bačnar, Antonio Blažina, Josip Dujmović, Darko Glujić, Damjan Jurković, Davor Jelenović, Tomislav Krljan, Marko Strabić, Ivan Sulovsky, Hana Vukotić

CONTENT

Interactive workshops:

Statistics

Preface to the 8th edition

My First Conference (MFC) is an annual conference for doctoral and graduate students in engineering and technology studying at the University of Rijeka, and beyond. We welcome all students with ambitions in scientific research to present their activities to colleagues and other students. In addition to giving presentation, one of the conference objectives is making new acquaintances with similar research interests and from a related or the same professional field.

The goals for the conference participants are:

- providing feedback for students' research, both completed and ongoing;
- improvement of presentation skills in English as the event's official language;
- providing the opportunity for interdisciplinary research projects between doctoral students from different institutions, and other forms of networking;
- public presentation of research results as part of the doctoral programme requirements (this presentation may be used for the above stated purpose with the permission/requirement of relevant authority at the institution implementing the doctoral programme).

The MFC is a joint initiative of the Faculty of Engineering, the Faculty of Maritime Studies and the Faculty of Civil Engineering. This year, the conference takes place at the University of Rijeka, Faculty of Maritime Studies. The conference includes 24 presentations, two keynote lectures and two interactive workshops. All abstracts and summaries are included in this publication.

The organisers would like to thank all authors for their contributions and participation in the eighth edition of My First Conference as well as the organizing institutions and the members of the Scientific and Organizing Committee for their contribution to the realization of this year's event.

We are kindly inviting you to the ninth edition of My First Conference in 2025!

MFC 2024 Organisers

KEYNOTE LECTURES

Influence of disturbing factors on the workload of the officer on watch during a collision avoidance simulation

Dejan Žagar
University of Ljubljana, Faculty of Maritime Studies and Transport, Portoroz, Slovenia
E-mail: dejan.zagar@fpp.uni-lj.si

Abstract

Onboard, the Officer on Watch (OOW) is tasked with safely navigating the ship, primarily following maritime Collision Regulations (COLREGs) to avoid collisions. Additional tasks during working hours, unrelated to navigation, increase the user's workload, which is considered challenging. This study aims to assess participants' psychophysiological responses during simulated collision avoidance manoeuvres. The experiment involves experienced captains, marine pilots, and students using a multi-sensor wristband to measure heart rate, electrodermal activity, and blood volume pulse. Results reveal increased workload during challenging manoeuvres, potentially compromising navigation safety. Despite being hindered by simulator constraints and sensor type, the study proposes an original experimental setup utilizing non-invasive biometric sensors.

Enhancing maritime voyage planning with global path planning based on Electronic Navigational Charts

Davor Šakan
University of Rijeka, Faculty of Maritime Studies, Rijeka, Croatia
E-mail: davor.sakan@uniri.hr

Abstract

Maritime voyage planning, traditionally done by navigators on board vessels, consists of numerous elements required to create a safe and efficient vessel route. On the other hand, global path planning developed in fields of graph and control theory, robotics, and automation deals with finding an optimal or near-optimal geometric path in a static environment without kinematic and dynamic constraints. Nonetheless, global path planning can be considered as an element of maritime route planning and broader voyage planning. Creating global path planning solutions requires constructing an environment model, typically discrete and represented by grids, meshes, or polygons on which algorithms like Dijkstra's or A* are commonly utilized. The resulting path is often simplified and smoothed according to the characteristics of the specific vessel or vehicle. Although there are many path-, trajectory-, or motion-planning approaches in the maritime navigation context, elements of traditional, human-centric navigational planning are not commonly considered. Notably, these would include the use of official and standardized electronic navigational charts as a basis for the environment model, constraints and procedures in maritime voyage planning. Therefore, the aim of the presented research was to create a methodology through the combination of these elements. This was conducted using electronic navigational chart objects, ingested in PostgreSQL object-relational database management system with PostGIS spatial extension, which were adapted to resolve issues with chart objects overlapping over different scales. Based on the chart objects, multi-resolution hexagonal grid was created as an environment model with Dijkstra's algorithm employed to determine a global path. Finally, the path was simplified with the Ramer, Douglas and Peucker and Visvalingam and Whatt algorithms and smoothed by B-splines. The path was validated by comparing the actual paths of vessels between the ports of Savannah and Charleston in the USA and in a navigational simulator.

CONTRIBUTING LECTURES

Impact of the cultural factor on the cruise ship's evacuation process in the light of Hofstede's cultural dimensions

Hiliana Vallejo de Brunsko

Maritime -Technical school Dubrovnik, Croatia
E-mail: hiliana.vallejo@student.uniri.hr

Abstract

The ship's evacuation is the most critical safety procedure on board, and the crew is the key to a successful evacuation process. The cruise industry faces challenges in designing evacuation models that comply with international regulations. Additionally, a cruise ship, as a workplace, assembles a multicultural crew that, during an evacuation, responds in accordance with conducive procedures to achieve a common goal. Considering that lack of awareness among the crew leads to a series of mistakes and ship accidents, this research aims to investigate the crew's response and the impact of cultural factors on the ship's evacuation process. Reviewing Hofstede's cultural dimensions, this research aims to determine the favorable attitudes and reactions of each participating seafarer, with the goal of enhancing the effectiveness of the evacuation process. A survey was created with seven questions for each Hofstede's cultural dimension to investigate the crew's reactions during a critical cruise evacuation process. A sentiment analysis was made to understand the participants' positive or negative reactions to the open-ended questions. This study has shown that a crew that possesses a well-defined hierarchical structure, adheres to their respective ranks on board, and recognizes the importance of following procedures is the optimal team for encouraging a successful evacuation process on a cruise ship. Such a crew consists of individuals who consider the ship's safety as a collective and interconnected cooperation process that affects everyone on board. Original values such as caring for others are considered a favorable trait in leaders. A trained and well-prepared crew, education, and investment in the crew's competencies are all important factors influencing ship's safety. The crew should react accordingly, disregarding emotions, but for leaders, a positive attitude is considered appropriate in emergencies, and having a day off for crew members in charge of the ship evacuation process is considered to increase performance on board.

Keywords: multicultural crew, cruise ship's evacuation, Hofstede's cultural dimensions, safety

References

[1] Galea, Edwin R., Markus, Sauter, Deere, Steven J., Filippidis & Lazaros (2015). Investigating the impact of culture on evacuation response behaviour. https://gala.gre.ac.uk/id/eprint/14352/.
[2] Hofstede, G & Hofstede, G. J. (2010). Cultures and Organizations: Software for the Mind.
[3] İnegöl G. M. & Yildirim U. (2022). Conflicts Due to Cultural Differences in Multicultural Ships. https://doi.org/10.1080/18366503.2024.2310188
[4] Noble A., Vangehuchten L. & Van Parys W. (2011). Intercultural competence and effective communication at sea: an invitation to celebrate diversity on board. The International Maritime English Conference. https://www.pfri.uniri.hr/bopri/IMEC_Proceedings/PDF/IMEC23.pdf#page=132.23.
[5] Van der Wal C. N., Formolo D., Mark A. R., Minkov M. & Bosse T. (2017). Simulating Crowd Evacuation with Socio-Cultural, Cognitive, and Emotional Elements. https://link.springer.com/chapter/10.1007/978-3-319-70647-4_11.

The use of the HFACS method in the analysis of maritime accidents

Ivana Ćosić[1,*], Jakša Mišković[2]

[1]*University of Rijeka, Faculty of Maritime Studies*
E-mail: ivana.cosic@student.uniri.hr

[2]*University of Split, Faculty of Maritime Studies*
E-mail: jmiskovi1@pfst.hr

Abstract

Although naval technology and engineering are constantly improving, humans play a central role in maritime transportation and safety. Despite all the technical and technological advances, accidents at sea caused by human factors remain an important issue. When analyzing maritime safety, official accident reports provide valuable information on why and how an accident occurred [1]. The analysis of official investigation reports of merchant vessels of 100 gross tons or more from 2012 to 2024, which are available in the database of the UK Maritime Accident Investigation Branch (MAIB) [2] shows that groundings account for almost 30 % of all accidents at sea. This large proportion underlines the urgency of addressing the human factors that lead to these accidents. Due to the large proportion of the total number of maritime accidents, the influence of human factors and the fact that ship groundings can lead to property loss, loss of life and impact on the environment, the factors leading to this type of accident need to be closely monitored. A systematic analysis of the official reports of the MAIB and the Danish Maritime Accident Investigation Board (DMAIB) for the period from 2012 to 2024 was carried out using the Human Factor Analysis Classification System (HFACS) and its modified version (HFACS-Ground). The aim of the analysis is to identify the most common causal factors in order to make suggestions on how to closely monitor them and implement sufficient measures that could help reduce the number of grounding-related maritime accidents caused by human factors and consequently increase the safety of navigation.

Keywords: HFACS-ground, maritime accidents, human factors, accident analysis

References

[1] Mazaheri, A., Montewka, J., Nisula, J. and Kujala, P. 2015. "Usability of Accident and Incident Reports for Evidence-Based Risk Modeling - A Case Study on Ship Grounding Reports." Safety Science 76 (July): 202–14. https://doi.org/10.1016/j.ssci.2015.02.019.

[2] Marine Accident Investigation Branch official website, Marine Accident Investigation Branch - GOV.UK (www.gov.uk)

* Corresponding/presenting author

The Panama Canal drought crisis and its impact on the tanker market

Dan Martinčević*, Igor Rudan, Davor Šakan

University of Rijeka, Faculty of Maritime Studies, Rijeka, Croatia
E-mail: dan.martincevic@icloud.com, igor.rudan@pfri.uniri.hr, davor.sakan@pfri.uniri.hr

Abstract

The Panama Canal, one of the most crucial and well-known waterways in the world, is facing record-breaking droughts which are directly impacting its operations and transit of vessels through the canal [1]. Panama Canal Authority has imposed draft limitations of the transiting vessels, mostly impacting tankers which pass through the Neopanamax locks [2]. Main disruption causes, which can be attributed to the global warming, are of meteorological origin and include lack of rainfall, El Niño phenomenon [3] and record-breaking temperatures [4]. The tanker market is experiencing the biggest loss since the shipowners have trouble paying skyrocketing auction prices to secure transit slots through the canal from the US west coast to the Mexican Gulf and even consider alternative shipping routes [2,5]. To cope with the challenges, Panama Canal Authority evaluates building more reservoirs or even the cloud-seeding method to increase the rainfall and prevent future droughts [6]. Therefore, the aims of this study include analysis of the causes leading to the ongoing drought crisis, its impact on the U.S tanker market and assessment of applicable drought crisis solutions. The ongoing Panama Canal situation highlights the vulnerability of key infrastructure to climate change as well as the importance of implementing more sustainable water management systems thus ensuring the continuous functioning of one of the world's main shipping waterways. The Panama Canal's uncertain future compels the shipowners to evaluate the goods transport alternatives by bypassing the canal and using the shore pipelines to transport crude oil or alternative waterways which could result in Neopanamax class tankers becoming obsolete.

Keywords: Panama Canal, draft limitations, global warming, tanker, sustainable water treatment

References

[1] Carse, "What Comes after the Conquest of Nature?" Modern American History, vol. 7, no. 1, pp. 136–140, Mar. 2024, doi: 10.1017/mah.2024.9
[2] Riviera News, "Riviera - Opinion - Panama Canal drought: 'large oil tankers will not feature in this trade anymore.'" Accessed: Jun. 30, 2024. [Online]. Available: https://bit.ly/4cHbtNQ
[3] G. Aguilar and L. Naranjo, "The Panama Canal," in El Niño Ready Nations and Disaster Risk Reduction: 19 Countries in Perspective, M. H. Glantz, Ed., Cham: Springer International Publishing, 2022, pp. 347–360. doi: 10.1007/978-3-030-86503-0_19
[4] S. Ruiz and C. Shintani, "Drought, Climate, and the Panama Canal - Woodwell Climate." Accessed: Jun. 30, 2024. [Online]. Available: https://bit.ly/3W1rKaO
[5] D. A. Gantz, "Supply Chain Alternatives for Ocean Shipping if Climate Change-driven Water Shortages Persist at the Panama Canal | Baker Institute." Accessed: Jun. 30, 2024. [Online]. Available: https://bit.ly/45PlUwE
[6] M. Fleury, "Can the Panama Canal save itself?" Mar. 06, 2024. Accessed: Jun. 30, 2024. [Online]. Available: https://www.bbc.com/news/business-6846752

* Corresponding/presenting author

Nature-inspired metaheuristic algorithms for Ship Routing Problem (SRP)

Matej Šuper*, Marko Gulić

University of Rijeka, Faculty of Maritime Studies, Rijeka, Croatia
E-mail: matej.super@uniri.hr, marko.gulic@uniri.hr

Abstract

Passage (or voyage) planning is a crucial process where a navigational officer and the ship's master develop a plan for the vessel's upcoming voyage. The plan consists of four stages [1]: Appraisal, which involves information collection and risk assessment; Planning, which includes drawing the route and developing the plan details; Execution, which entails following the planned voyage; and Monitoring, which involves tracking the ship's progress and updating the plan based on changing variables. Various factors must be analysed for an efficient and safe voyage plan, including arrival time at the next port, fuel consumption for both economic and environmental reasons, meteorological and oceanographic conditions, navigation characteristics of the voyage such as expected marine traffic and characteristics of the waterway, and other safety and security considerations [2]. Given the complexity of these factors, optimizing ship routing becomes a critical component of passage planning. To optimize ship routing, previous research has utilized metaheuristic algorithms, specifically well-known, nature-inspired metaheuristics. However, recent state-of-the-art metaheuristic algorithms inspired by nature have demonstrated superior performance on well-known optimization problems, such as the Travelling Salesman Problem. Consequently, these newer algorithms are expected to enhance the ship routing problem. The aim of this paper is to introduce new nature-inspired metaheuristic algorithms as a solution to the problem and to evaluate and compare their multi-objective optimisation results with the results of other well-known algorithms. The research may also ease the selection process of an appropriate algorithm for the ship routing problem.

Keywords: passage planning, ship routing problem, optimization algorithms, nature-inspired metaheuristics

References

[1] International Maritime Organization, "Guidelines for voyage planning, IMO Resolution A.893(21)." 1999.
[2] W. Zhao, Y. Wang, Z. Zhang, and H. Wang, "Multicriteria ship route planning method based on improved particle swarm optimization–genetic algorithm," J Mar Sci Eng, vol. 9, no. 4, Apr. 2021, doi: 10.3390/jmse9040357.

* Corresponding/presenting author

Failure analysis and a composite patch repair of a ruptured pressure vessel

Benjamin Mihaljec*, Goran Vukelić

University of Rijeka, Faculty of Maritime Studies, Rijeka, Croatia
E-mail: benjamin.mihaljec@uniri.hr, goran.vukelic@pfri.uniri.hr

Abstract

Low maintenance of pressure vessels is one of the causes that leads to the formation of cracks, fractures, and, ultimately, failures. One of the methods for repairing pressure vessel cracks is the application of composite patches [1]. In this paper, experimental failure analysis was performed on a pressure vessel that failed during the hydrostatic test when a through-wall crack occurred on the shell, and test fluid leakage was recorded along with a pressure drop. Non-destructive investigation methods were used to determine possible causes of crack occurrence and vessel rupture. Visual examination revealed the condition of the internal surface of the shell. Ultrasonic testing was used to measure the thickness of the shell [2,3]. According to the obtained results, it was concluded that the lack of drainage caused excessive corrosion at the bottom part of the pressure and, subsequently, cracks that emanated through the walls. A four-layer fiber-glass composite patch was applied over the crack to repair the vessel. Results here show that the square-shaped composite patch was able to withstand hydrostatic test pressure, marking the method as acceptable for repairing failed pressure vessels [1,3].

Keywords: composite patch repair, failure analysis, pressure vessel, fiber-glass patch

References

[1] Alnaser I.A., Alsaadi Y., Keller M.W. (2019). Comparison of the crack-growth rates for full-encirclement and patch composite repairs, Elsevier, https://doi.org/10.1016/j.compstruct.2019.111257
[2] Vukelić G., Vizentin G., Bozić Ž., Rukavina L. (2021). Failure analysis of a ruptured compressor pressure vessel, Elsevier, https://doi.org/10.1016/j.prostr.2021.03.006
[3] Vukelić G., Vizentin G., Bakhtiari R. (2021). Failure analysis of a steel pressure vessel with a composite wrap repair proposal, Elsevier, https://doi.org/10.1016/j.ijpvp.2021.104476

* Corresponding/presenting author

Comprehensive annotation of underwater data for image segmentation

Deni Klen*, Jonatan Lerga

University of Rijeka, Faculty of Engineering, Rijeka, Croatia
E-mail: deni.klen@riteh.uniri.hr, jonatan.lerga@riteh.uniri.hr

Abstract

In the field of marine research, accurate segmentation of underwater images is crucial for various applications such as environmental monitoring, maintenance of underwater infrastructures, and marine biological studies. Researchers have developed various deep learning techniques such as adapting state-of-the-art segmentation architectures to deal with underwater images, extending the success of the Segment Anything Model (SAM) on underwater images [2], and using encoder-decoder architectures like SegNet or others for semantic segmentation of underwater images [1,3, 4]. This paper presents a detailed approach to labelling a diverse underwater image dataset of more than 7,000 harbour images. The dataset contains images of various objects such as algae, cracks, depressions, ropes, tires, rubbish, fish, and sea cucumbers. To improve the effectiveness of image segmentation, we implemented a careful annotation process that categorizes these objects into different classes. We have also defined two special tags for difficult scenarios: 'reflection' and 'above water.' These tags refer to cases where image clarity is affected by light reflections on the water surface and images taken over water respectively. Our annotation process uses a systematic approach to accurately label these different objects providing a robust basis for training segmentation models. By improving the accuracy of object identification and segmentation, our work aims to contribute to developing robust computer vision models in underwater environments. In this paper, we will discuss the composition of the dataset, the annotation process, and the rationale behind the tags chosen. We will also highlight the challenges and solutions we have developed to ensure high-quality annotations. With this research, we hope to pave the way for future advances in underwater image segmentation and enable more effective and accurate analysis of underwater images.

Keywords: annotation, image processing, image annotation, segmentation, detection, underwater image processing

Acknowledgements: This work was fully supported by the EU Horizon 2020 project INNO2MARE ("Strengthening the capacity for excellence of Slovenian and Croatian innovation ecosystems to support the digital and green transitions of maritime regions") under the number 101087348, and University of Rijeka projects uniri-tehnic-18-17, uniri-tehnic-18-15, and uniri-zip-2103-4-22.

References

[1] Guo, Y., Liu, Y., Oerlemans, A., Lao, S., Wu, S., & Lew, M. S. (2016). Deep learning for visual understanding: A review. Neurocomputing, 187, 27-48.
[2] Xu, M., Jianhao, S., Liu, Y (2023). AquaSAM: Underwater Image Foreground Segmentation
[3] Huang, X., Zhang, L., & Li, J. (2021). Underwater Image Segmentation Using Deep Learning: A Review. Remote Sensing, 13(9), 1702.
[4] Smith, J., Johnson, K., & Lee, M. (2022). Underwater Image Segmentation: A Comprehensive Dataset and Annotation Approach. Journal of Marine Science and Engineering, 10(3), 456.

* Corresponding/presenting author

AI-based prediction of trajectories for personal watercrafts

Lucija Žužić*, Franko Hržić, Jonatan Lerga

[1]*University of Rijeka, Faculty of Engineering, Rijeka, Croatia*
E-mail: lucija.zuzic@uniri.hr, franko.hrzic@uniri.hr, jonatan.lerga@uniri.hr

Abstract

In order to minimize accidents in prominent tourist areas caused by unskilled motorboat operators, it is crucial to monitor rental boats and identify instances of irresponsible driving behaviour. Examining the driving patterns and trajectories of motorboat operators is one technique to achieve this. By calculating trajectories and restricting the boat's power using an integrated control system in real time, such mishaps can be avoided. We evaluated and developed algorithms based on deep learning approaches for trajectory prediction by evaluating trajectories derived from a marine watercraft tracking system and collected globally in the following countries: Greece, Croatia, Spain, Portugal, Greece, Canada, and the United States. First, we tested different AI models used in highway traffic [1], machine translation [2], and foundation models for various time-series datasets and tasks [3]. To make the test robust and immediately applicable to the emerging monitoring system, several variables describing trajectories were examined, including heading, longitude, latitude, offset, and speed. Our findings demonstrated that the foundation model strategy produced the best outcomes, thereby extending the application of foundation models to the field of maritime trajectory prediction.

Keywords: personal watercraft, trajectory prediction, artificial intelligence, foundation model

References

[1] Altche, F., de La Fortelle, A., 2017. An LSTM Network for Highway Trajectory Prediction. 2017. IEEE 20th international conference on intelligent transportation systems (ITSC). doi: 10.1109/ITSC.2017.8317913
[2] Hiemsch, P., 2023. Incorporating Attention Mechanisms in RNN-based Encoder-Decoder Models. Lebanese International University. Available online: https://github.com/PatrickSVM/Seq2Seq-with-Attention/blob/main/report/732A81-2023-PRA1-pathi619.pdf, accessed 1 July 2024
[3] Gao, S., Koker, T., Queen, O., Hartvigsen, T., Tsiligkaridis, T., Zitnik, M., 2024. UniTS: Building a Unified Time Series Model. Zitnik Lab, Department of Biomedical Informatics, Harvard University. Available online: https://arxiv.org/html/2403.00131v1, accessed 1 July 2024

* Corresponding/presenting author

Trajectory modelling basis for ships' avoidance of adverse weather

Marijana Balas[1,*], Jasna Prpić-Oršić[1], Marko Valčić [1,2]

[1] *University of Rijeka, Faculty of Engineering, Rijeka, Croatia*
E-mail: marijana.balas@riteh.uniri.hr, jasna.prpic.orsic@riteh.uniri.hr

[2] *University of Zadar, Maritime Department, Zadar, Croatia*
E-mail: mvalcic@unizd.hr

Abstract

In ship weather routing there is a constant need to comply with emerging environmental restrictions in order to meet the transportation requirements of the International Maritime Organization [1]. As a result, different path planning and optimization methods for ship routing have been proposed to account for sustainability and energy efficiency [2, 3, 4]. The aim of this study is to provide a practical route optimization framework by introducing a simplified model for ship route planning. Several ship parameters, including maneuvering characteristics and turning radius, were adopted from a bulk carrier so that the proposed approach corresponds to real-life scenarios. In trajectory modelling, the ship moves at a constant forward speed, while changing its course and angular velocity to avoid obstacles. The development of an optimization problem formulation is discussed by taking into account various aspects such as adverse weather conditions, fuel consumption, and environmental constraints. Considering these elements, an approach to optimal route planning is identified to assess a balance between efficiency, safety, and environmental responsibility.

Keywords: optimization, path planning, ship weather routing, trajectory modelling

Acknowledgements: This work has been fully supported by the Croatian Science Foundation under the project IP-2022-10-2821.

References

[1] Vettor, R.; Guedes Soares, C. (2016). Development of a ship weather routing system. Ocean Engineering, 123, 1-14. https://doi.org/10.1016/j.oceaneng.2016.06.035

[2] Yang, J.; Wu, L.; Zheng, J. (2022). Multi-Objective Weather Routing Algorithm for Ships: The Perspective of Shipping Company's Navigation Strategy. *J. Mar. Sci. Eng*, *10*, 1212. https://doi.org/10.3390/jmse10091212

[3] De Osés, F.X.M.; Ventura Jariod, E.; Belmonte López, R. (2021). A Ship Routing System Applied to the Statistical Analysis of the Western Mediterranean Wave Trends. *J. Mar. Sci. Eng. 9*, 599. https://doi.org/10.3390/jmse9060599

[4] Wang, H.; Mao, W.; Eriksson, L. (2019). A three-dimensional Dijkstra's algorithm for multi-objective ship voyage optimization. Ocean Engineering, 186, 106131. https://doi.org/10.1016/j.oceaneng.2019.106131

* Corresponding/presenting author

Computational ship hydrodynamics in full scale: RANS computations using a Post-Panamax containership data

Ivan Sulovsky*, Jasna Prpić-Oršić

[1]*University of Rijeka, Faculty of Engineering, Rijeka, Croatia*
E-mail: ivan.sulovsky@uniri.hr, jasna.prpic.orsic@uniri.hr

Abstract

Numerical simulations in the context of marine hydrodynamics are steadily shifting towards their application in a full-scale manner. In this work, an entire set of full-scale CFD simulations are covered while using the dataset from a 13,000 TEU containership. OpenFOAM, an open-source toolbox for CFD, is used [1] with an appropriate RANS model. Since the main target of this work is to simulate a realistic navigation case while considering propulsion, first step is to develop a numerical framework for modelling propeller effects within finite volume method. Consequently, an actuator disk-based model (AD) is developed within OpenFOAM to simulate propeller-induced flow. Open water propeller simulations are performed beforehand, since the AD model requires thrust and torque open water curves. Verification of open water simulations are also performed in order to quantify the numerical errors. The proposed AD model is validated with the data from sea trials with an acceptable accuracy. Sulovsky et al [2] gives a solution with a fully discretized propeller for the same ship. Lastly, navigational simulations are performed and compared with onboard measurements [3], which presents a unique use of fully viscous, full-scale CFD application in ship hydrodynamics.

Keywords: ship hydrodynamics, OpenFOAM, CFD, propulsion

Acknowledgments: This work has been fully supported by the Croatian Science Foundation under the project IP-2022-10-2821.

References

[1] Weller, H.G.; Tabor, G.; Jasak, H.; Fureby, C. A tensorial approach to computational continuum mechanics using object-oriented techniques. Comput. Phys. 1998, 12, 620. https://doi.org/10.1063/1.168744.
[2] Sulovsky, I.; Mewes S.; Moctar, O.E; Prpić-Oršić, J.; URANS-based Simulaton of Ship Propulsion in Seaways. October 2023, Conference: 25th Numerical Towing Tank Symposium, Ericeira, Portugal J;
[3] Jabary et.al (2023) Development of machine learning approaches to enhance ship operational performance evaluation based on an integrated data model. ISOPE 2022., Ottawa, Canada

* Corresponding/presenting author

Evaluation of hindcast and reanalysis of sea levels against tide gauge data in Croatia

Marta Marija Bilić[1,*], Nino Krvavica[1], Nevenka Ožanić[1], Christian Ferrarin[2]

[1]*University of Rijeka, Faculty of Civil Engineering, Rijeka, Croatia*
E-mail: marta.marija.bilic@uniri.hr, nino.krvavica@uniri.hr, nozanic@uniri.hr

[2]*Institute of Marine Sciences, National Research Council (ISMAR-CNR), Venice, Italy*
E-mail: christian.ferrarin@cnr.it

Abstract

Flooding in coastal and estuarine areas is usually caused by heavy rainfall, high sea levels and high river discharges. As high sea levels are one of the most common causes of flooding in coastal areas, the measured data are required for the analyses. In Croatia, tide gauge stations with publicly accessible long data sets are relatively scarce. Apart from availability, the problem is to obtain data for the locations without tide gauges. In the absence of measured data, one option is to obtain sea level data from publicly available hindcast or reanalysis models. Hindcast is a methodological approach for simulating and analysing past weather conditions, which primarily serves as a validation tool for predictive models. Reanalysis, on the other hand, combines past short-term weather and climate forecasts with observations through data assimilation to improve the quality and availability of past observational data. The MedSea reanalysis was selected for this study because it provides good results despite its relatively low spatial resolution, especially for the Croatian coast [1]. SHYFEM was chosen as the hindcast because it has better spatial resolution and can capture the Croatian coast more accurately, even though the hindcast results are generally less accurate than those of the reanalysis [2]. The results of the SHYFEM hindcast and the MedSea reanalysis were validated by comparing the simulated and measured data from the tide gauges in Bakar, Zadar, Split and Dubrovnik. The statistical analysis was performed for the extracted daily and monthly maxima series as well as for return sea levels obtained from the extreme value analysis using the peak-over-threshold approach. When comparing the model with the measured data, it was found that all SHYFEM datasets overestimate the measured sea levels, while the MedSea datasets underestimate them. For Bakar, the MedSea data show a better statistical performance for all three observed datasets. However, for Zadar, Split and Dubrovnik, the MedSea data show a better statistical performance for the daily and monthly maxima values, while the SHYFEM data present a better option when comparing the return sea level values.

Keywords: sea levels, hindcast, SHYFEM, reanalysis, MedSea

References

[1] Escudier, Romain, et al. “Mediterranean Sea Physical Reanalysis (CMEMS MED-Currents)”, (Version 1) [Data set], 2020, Copernicus Monitoring Environment Marine Service (CMEMS). doi: 10.25423/CMCC/MEDSEA_MULTIYEAR_PHY_006_004_E3R1

[2] Bajo, Marco, et al. “Modelling the Barotropic Sea Level in the Mediterranean Sea Using Data Assimilation.” Ocean Science, vol. 19, no. 3, May 2023, pp. 559–79., doi: https://doi.org/10.5194/os-19-559-2023

* Corresponding/presenting author

Reconstituted silty sand's relative density determination

Davor Marušić[1,*], Vedran Jagodnik[1,2]

[1] *University of Rijeka, Faculty of Civil Engineering, Rijeka, Croatia*
E-mail: davor.marusic@uniri.hr

[2] *Center for Artificial Intelligence and Cybersecurity, Rijeka, Croatia*
E-mail: vedran.jagodnik@uniri.hr

Abstract

The silty sand specimens for the geotechnical laboratory testing are often prepared artificially, usually by mixing quartz sand and silt or clay [2, 6, 9]. Such an approach attempts to simulate the prototype silty sand behaviour in physical models and can also be reconstituted for various static and dynamic geotechnical laboratory testing procedures. To control the sandy soil's geotechnical characteristics within the proper specimen reconstitution process, a relative density (D_r) parameter is used [1, 3]. Relative density (herein D_r) represents the most common conventional parameter, which indicates the relative position between the maximum and minimum void ratios (e_{max} and e_{min}) of the soil, in other words, the soil's theoretical most loose and dense physical states respectfully. Along with the soil's specific gravity (G_s), both e_{max} and e_{min} can be determined with relatively simple laboratory tests [5, 7]. These parameters are used with the soil's theoretical volumetric relations to determine the soil mass amount needed to achieve the targeted density within a given volume. However, additional research [4, 10, 11] differs from the conventional understanding of the silty sand soils and often indicates the inapplicability of the given methods for the silty sands e_{max} and e_{min} determination. Consequently, the targeted value of D_r parameter determined by conventional methods is also questionable which can cause poor control over reconstituted sample testing. This issue was noticed in the current research, where the reconstituted silty sand specimen at the conventionally determined $D_r = 80\%$ (relatively high for sandy soil density), was apparently loose with numerous visible macro-pores characteristic of loose soils. Several equations were established by previous researchers, that were able to calculate the e_{max} and e_{min} of the silty sand specimens [2, 8]. These equations were used alongside the conventional methods to determine the amount of soil needed to reconstitute the specimens with the targeted $D_r = 80\%$. Static and dynamic triaxial shear tests have been conducted on differently reconstituted soil specimens and more are planned within the ongoing research. The obtained results' correlation is used to evaluate the methods applied and to establish better control of the model samples.

Keywords: relative density, void ratios, silty sand, kaolinite clay

References

[1] Bolton M (1980) A guide to soil mechanics. Wiley, New York
[2] Chang CS, Wang JY, Ge L (2016) Maximum and minimum void ratios for sand-silt mixtures. Engineering Geology 211:7–18. doi: 10.1016/j.enggeo.2016.06.022
[3] Holtz RD, Kovacs WD, Sheahan TC (2011) An introduction to geotechnical engineering, 2nd ed. Pearson, Upper Saddle River, NJ
[4] Lade P, Chaney R, Demars K, Liggio C, Yamamuro J (1998) Effects of Non-Plastic Fines on Minimum and Maximum Void Ratios of Sand. Geotech Test J 21:336. doi: 10.1520/GTJ11373J

* Corresponding/presenting author

[5] Lunne T, Knudsen S, Blaker Ø, Vestgården T, Powell JJM, Wallace CF, Krogh L, Thomsen NV, Yetginer G, Ghanekar RK (2019) Methods used to determine maximum and minimum dry unit weights of sand: Is there a need for a new standard? Can Geotech J 56:536–553. doi: 10.1139/cgj-2017-0738
[6] Marušić D, Jagodnik V (2023) Determination of the Atterberg limits using a fall cone device on low plasticity silty sands. MGPB 38:133–145. doi: 10.17794/rgn.2023.3.11
[7] Mijic Z, Bray JD, Riemer MF, Cubrinovski M, Rees SD (2021) Test method for minimum and maximum densities of small quantities of soil. Soils and Foundations 61:533–540. doi: 10.1016/j.sandf.2020.12.003
[8] Rahman MM, Lo SR, Gnanendran CT (2008) On equivalent granular void ratio and steady state behaviour of loose sand with fines. Can Geotech J 45:1439–1456. doi: 10.1139/T08-064
[9] Tafili M, Knittel L, Gauger V, Wichtmann T, Stutz HH (2023) Experimental study on monotonic to high-cyclic behaviour of sand-silt mixtures. Acta Geotech. doi: 10.1007/s11440-023-02126-6
[10] Thevanayagam S (1998) Effect of Fines and Confining Stress on Undrained Shear Strength of Silty Sands. Journal of Geotechnical and Geoenvironmental Engineering 124:479–491
[11] Thevanayagam S, Shenthan T, Mohan S, Liang J (2002) Undrained Fragility of Clean Sands, Silty Sands, and Sandy Silts. J Geotech Geoenviron Eng 128:849–859. doi: 10.1061/(ASCE)1090-0241(2002)128:10(849)

Traditional materials in the protection and restoration of neglected rural landscapes

Jasna Galfi Stella*, Iva Mrak, Denis Ambruš

[1]*University of Rijeka, Faculty of Civil Engineering*
E-mail: jasna.galfi.stella@uniri.hr, iva.mrak@gradri.uniri.hr; denis.ambrus@gradri.uniri.hr

Abstract

The article focuses on the revaluation, recognition, and preservation of the cultural landscape of the Croatian area in a contemporary context [2]. Analyzing the latest results of examining the possibilities of building with traditional, natural materials [3] opens two seemingly distant topics. The broader, spatial context and the micro-construction context and the building material in the spatial planning aim to be correlated to examine whether their parallel existence potentially results in a cause-and-effect relationship. This feedback loop is analyzed in the context of protecting and restoring the cultural landscape as its unifying element [2]. Furthermore, an analysis is to be conducted to answer the specific question: could the introduction of modern technologies [1] in building with traditional materials [3] initiate an efficient driving force (economic factor), which would, in turn, actualize the topic of evaluating existing protection methods [4,5] and accelerate the need for the restoration of abandoned valuable spatial entities? The work examines the issue on three levels: through a broader spatial context, then the micro-construction technical context, and finally, the economy-driving context [4]. The research method applied is a review of literature related to the latest technological research, and those that address both newer architectural-spatial issues and those identified in the recent past, that are nowadays reaching their prophetic peak.

Keywords: cultural built heritage, building materials, landscape planning, protection and preservation, sustainability, economics of conservation, cultural values, valorization

References

[1] Chipperfield D.,2020. Will technology save us? Domus, magazine. Available online: https://www.domusweb.it/en/speciali/guest-editor/david-chipperfield/2020/10/01/david-chipperfield-will-technology-save-us.html
[2] Dumbović B., Obad Šćitaroci M.,2007. Cultural Landscape in Croatia– Identification and Protection.
[3] Prostor,journal issue:15[2007] 2[34]. Available on: https://hrcak.srce.hr/file/28904
[4] Goodhew S., Carfrae J., Hood-Cree K., Fox M., Boutouil M., Streiff F., 2019. Building with earth: How we are working to revive an ancient, sustainable building technique. CRI journal. CIOB and Taylor&Francis group. Available on: https://doi.org/10.1080/20450249.2019.1700077
[5] Mrak I., 2013. Cultural goods as bearers of cultural and economic values. Vjesn. Državnog Arh. u Rijeci. Available online: https://www.bib.irb.hr:8443/651184
[6] Mrak I.,2014. Evaluation methods in the protection of built heritage. Građevinar, journal. Available online: https://hrcak.srce.hr/file/173018

* Corresponding/presenting author

Historical pavilions in Zagreb

Mina Plančić*, Tamara Zaninović, Sanja Gašparović

University of Zagreb, Faculty of Architecture, Zagreb, Croatia
E-mail: mplancic@arhitekt.hr, tmaric@arhitekt.hr, sgaspar@arhitekt.hr

Abstract

The focus of this research are 7 historical pavilions built in public gardens in Zagreb from the mid-19th to the mid-20th century, explored and presented with the aim of establishing an analytical framework for understanding their urban and architectural characteristics [1,4], as well as their relation to the spatial and functional composition of the associated urban and landscape context. The initial research has identified 41 built historical pavilions so far in Croatia's promenades, public gardens and parks [5], out of which only 25 examples still exist in their original or restored state. The research was carried out through a literature review based on relevant books and papers, plans, and internet databases, together with field research. Most examples of historical pavilions in Croatia are located in Zagreb [5] which allows for comparison and typological identification to be carried out. In Zagreb's public gardens of Maksimir, Zrinjevac, Botanical Garden, and Park Tuškanac, there were 7 historical pavilions built, 6 preserved, and 4 restored over time. For the purpose of the 1891's Jubilee Economic-Forestry Exhibition in Zagreb, 3 pavilions were built, after which they were relocated to Tuškanac, Maksimir, and the Botanical Garden [2]. According to building material used (wooden, brick masonry, or metal), Zagreb examples include wooden pavilions (Paraplui, Birch hut, and Jeka / Echo pavilion in Maksimir, Pavilion in Tuškanac, and one in Botanical Garden), one brick masonry pavilion (Maksimir Belvedere/the Kiosk) and one metal pavilion (Zrinjevac). According to their purpose, they can be characterized as an exhibition pavilion (Botanical Garden), a vista pavilion (Maksimir), a gazebo (Birch hut and Paraplui in Maksimir), a music pavilion/ bandstand (Tuškanac and Zrinjevac), or a sound pavilion (Jeka in Maksimir) [3,6]. The resulting research framework and categorization, developed through the analysis of urban and architectural characteristics of historical pavilions in Zagreb, will be used in future comparative research of historical pavilions in Croatia.

Keywords: landscape architecture, public gardens, historical pavilions, bandstand, belvedere, gazebo

References

[1] Angelova, D., 2012. Contemporary Pavilions as Part of the Common Urban Areas, Conference paper, 10.13140/2.1.2635.7446
[2] Gostl. I., 1996. Najsjajnija zagrebačka predstava, ABC naklada, Zagreb
[3] Perušić, M., 2018. Povijesna arhitektura u Botaničkom vrtu Prirodoslovno-matematičkog fakulteta u Zagrebu, Portal 9/2018, 10.17018/portal.2018.7
[4] Rabbitts, P., 2018. Pavilions for music, entertainment, and leisure, Historic England London
[5] Bojanić Obad Šćitaroci, B., Obad Šćitaroci, M., 2004. Public Parks and Gardens of Croatian Towns in 19th century in European Context / Gradski perivoji Hrvatske u 19. stoljeću, javna perivojna arhitektura hrvatskih gradova u europskom kontekstu, Šćitaroci; Arhitektonski fakultet Sveučilišta u Zagrebu
[6] Galerija nepokretnih kulturnih dobara Grada Zagreba, Gradski zavod za zaštitu spomenika kulture i prirode, available online: http://www1.zagreb.hr/galerijakd.nsf, accessed 19th June 2024.

Multi-modal contrastive learning for medical imaging analysis

Zinaid Kapić*, Ivan Štajduhar, Kristijan Lenac

University of Rijeka – Faculty of Engineering
E-mail: zkapic@student.uniri.hr, ivan.stajduhar@uniri.hr, kristijan.lenac@uniri.hr

Abstract

The major obstacle in developing deep learning models for medical purposes is the scarcity of quality-labeled medical images. Annotating medical image datasets requires domain-specific knowledge and is a time-consuming, legally sensitive, and expensive task. Although medical images are rarely annotated, they often have corresponding textual diagnoses. In this study, we address the issue of insufficient labeled medical data and employ multi-modal contrastive learning to train a CLIP-like model for medical image analysis [1]. By matching image-text pairs in a shared latent space, Contrastive Language-Image Pretraining (CLIP) simultaneously optimizes the vision and text encoder while learning visual representations from textual diagnoses supervision [2]. Using the ResNet50 and DistilBERT encoders on the ROCOv2 dataset, our model shows a 31.51% improvement in classification accuracy compared to the OpenAI CLIP. In addition, our model also displays enhanced precision across all classes in the text-to-image retrieval task. Zero-shot results on COVID-19 dataset classification indicate the transferability of this model to other tasks and datasets. These results highlight the potential of CLIP models in advancing medical applications. Future works will include bigger and more diverse dataset integrations, different text and visual encoders, and an adaptation to textual diagnoses in the Croatian language. Ultimately, the objective of this research is to develop high-quality foundation models for medical applications.

Keywords: medical imaging, multi-modal contrastive learning, CLIP model, classification

References

[1] Zhao, Zihao, et al. "Clip in medical imaging: A comprehensive survey." arXiv preprint arXiv:2312.07353 (2023).
[2] Radford, Alec, Jong Wook Kim, Chris Hallacy, Aditya Ramesh, Gabriel Goh, Sandhini Agarwal, Girish Sastry et al. "Learning transferable visual models from natural language supervision." In International conference on machine learning, pp. 8748-8763. PMLR, 2021.

* Corresponding/presenting author

Processing radiology diagnostic reports using natural language processing

Mária Krajči*, Ivan Štajduhar

University of Rijeka, Faculty of Engineering
E-mail: mkrajci@student.uniri.hr, ivan.stajduhar@riteh.uniri.hr

Abstract

The growing volume of narrative radiology reports requires advanced computational methods for effective diagnostic linkage and classification. In this study, unsupervised learning and natural language processing techniques are used to uncover patterns and keywords in unstructured radiology reports. A transformer model trained with masked language modeling (MLM) [1] was used to generate latent embeddings, which were then reduced in dimensionality using Uniform Manifold Approximation and Projection (UMAP) [2] and clustered using Hierarchical Density-based Spatial Clustering of Applications with Noise (HDBSCAN) [3]. The keywords for each cluster were identified using Term Frequency-Inverse Document Frequency (TF-IDF) [4] and Support Vector Machine (SVM) weights [5], which facilitated the cluster analysis. The results showed several clusters with high SVM classification accuracy and keywords for each cluster. It is expected that future improvements in model evaluation and keyword extraction will increase the precision and reliability of clustering results.

Keywords: machine learning, natural language processing, clustering, keyword analysis, radiology reports

References

[1] Devlin J., Chang M., Lee K., Toutanova K., 2019. BERT: Pre-training of Deep Bidirectional Transformers for Language Understanding, Proceedings of the 2019 Conference of the North American Chapter of the Association for Computational Linguistics: Human Language Technologies, Volume 1 (Long and Short Papers), Association for Computational Linguistics. doi: 10.48550/arXiv.1810.04805
[2] McInnes L., Healy J., Melville J., 2020. UMAP: Uniform Manifold Approximation and Projection for Dimension Reduction, CoRR, doi: 10.48550/arXiv.1802.03426
[3] McInnes L., Healy J., Astels S., 2017. hdbscan: Hierarchical density based clustering, Journal of Open Source Software, doi: 10.21105/joss.00205
[4] Sammut, C., Webb, G.I., 2011. TF–IDF. Encyclopedia of Machine Learning. Springer, Boston, doi: 10.1007/978-0-387-30164-8_832
[5] Cortes C., Vapnik V., 1995. Support-vector networks, Machine Learning, doi: 10.1007/BF00994018

* Corresponding/presenting author

RadiologyNET pretrained models: Enhancing medical image analysis with transfer learning

Mateja Napravnik*, Ivan Štajduhar

University of Rijeka, Faculty of Engineering, Rijeka, Croatia
E-mail: mateja.napravnik@riteh.uniri.hr, ivan.stajduhar@uniri.hr

Abstract

In recent years, there has been a discernible rise in the number of publicly available medical datasets, but the process of obtaining a sufficient amount of labelled medical data remains laborious and costly. To tackle the problem of data scarcity in medical machine learning (ML), common approaches include augmenting the training data, and/or using models previously trained on another (preferably related) problem. In the latter approach, the most common pretrained models are those pretrained on ImageNet [1], a large dataset consisting of natural images. RadiologyNET is a custom medical dataset consisting of 1.9 million of radiology images (acquired through standard clinical practice at the Clinical Hospital Centre Rijeka) which was used to pretrain a comprehensive list of popular ML architectures. These RadiologyNET pretrained models were tested on four publicly available datasets against models trained from scratch, and those pretrained on ImageNet. The chosen challenges included (i) VINDR-SpineXR [2] (binary classification), (ii) Brain Tumor [3] (multiclass classification), (iii) RSNA Paediatric Bone Age Challenge [4] (regression), and (iv) LUng Nodule Analysis Challenge [5] (segmentation). The results indicate that using RadiologyNET pretrained models gives a boost to model performance, which is also present while training on reduced amounts of data.

Keywords: RadiologyNET, transfer learning, medical machine learning

References

[1] Krizhevsky, A., Sutskever, I., Hinton, G.E.: ImageNet classification with deep convolutional neural networks. Communications of the ACM 60(6), 84–90 (May 2017)
[2] Pham, H.H., Nguyen Trung, H., Nguyen, H.Q.: VinDr-SpineXR: A large annotated medical image dataset for spinal lesions detection and classification from radiographs (2021)
[3] Nickparvar, M.: Brain Tumor MRI Dataset (2021) https://doi.org/10.34740/KAGGLE/DSV/2645886
[4] Halabi, S.S., Prevedello, L.M., Kalpathy-Cramer, J., et al.: The RSNA Pediatric Bone Age Machine Learning Challenge. Radiology 290(2), 498–503 (Feb 2019)
[5] Setio, A.A.A., Traverso, A., de Bel, et al.: Validation, comparison, and combination of algorithms for automatic detection of pulmonary nodules in computed tomography images: The LUNA16 challenge. Medical Image Analysis 42, 1–13 (Dec 2017)

* Corresponding/presenting author

How to design the chemical composition of steel to meet required hardenability using artificial neural networks

Neven Tomašić

University of Rijeka, Faculty of Engineering, Rijeka, Croatia
E-mail: neven.tomasic@uniri.hr

Abstract

One of the most important criteria for the selection of steel for machine elements is the required hardenability, which ensures a fixed distribution of properties on the cross-section. The hardenability of steel depends on its chemical composition. Using a representative dataset of hardness values obtained from the Jominy end quench test of the specimen and a chemical analysis of steel, the complex regression model is made using supervised artificial neural networks. This model of designing steel with desired hardenability can be of great benefit in the mechanical engineering and manufacturing industry.

Keywords: hardenability, chemical composition, microstructure, artificial neural network

References

[1] Bhadeshia, H.K.D.H.; 'Neural networks in materials science. ISIJ Int. 1999, 39, 966–979. https://doi.org/10.2355/isijinternational.39.966
[2] Canale, L.C.F.; L. Albano, L. Hardenability of Steel. In Comprehensive Materials Processing; Hashmi, S., Batalha G.F.; Elsevier, 2014, Volume 12, pp. 39-97. doi: https://doi.org/10.1016/B978-0-08-096532-1.01219-X
[3] Sitek, W.; Trzaska, J. Practical Aspects of the Design and Use of the Artificial Neural Networks in Materials Engineering. Metals. 2021, 11, 1832. doi: https://doi.org/10.3390/met11111832
[4] Smoljan, B; Iljkić, D.; Tomašić, N. Mathematical modelling of Hardness of Quenched and Tempered Steel. Archives of Materials Science and Engineering 2015, 74, pp. 85-93 http://www.amse.acmsse.h2.pl/vol74_2/7425.pdf
[5] Gemechu, W.F.; Sitek, W.; Batalha, G.F. Improving Hardenability Modeling: A Bayesian Optimization Approach to Tuning Hyperparameters for Neural Network Regression. Appl. Sci. 2024, 14, 2554. doi: https://doi.org/10.3390/app14062554

Freight delivery model in urban centres

Matej Plenča*, Mladen Jardas, Ana Perić Hadžić

University of Rijeka, Faculty of Maritime Studies, Rijeka, Croatia
E-mail: matej.plenca@uniri.hr, mladen.jardas@uniri.hr, ana.peric@uniri.hr

Abstract

Urban freight logistics presents significant challenges in managing delivery activities within city centres [1,4]. This paper examines current delivery patterns and their impact on traffic congestion, air pollution, and noise levels in urban city centres. Key findings indicate that inadequate organization of delivery activities contributes to these urban issues [2,3]. Moreover, while most transport operators adhere to standard working hours, economic entities, particularly in hospitality, retail, and service sectors, operate beyond typical delivery windows. Addressing these challenges requires optimized delivery strategies, including potential dual consolidation centres and extended delivery hours, supported by improved infrastructure and regulatory frameworks. This research underscores the complexity of urban logistics and advocates for sustainable solutions to enhance urban liveability and economic vitality.

Keywords: urban freight logistics, delivery patterns, traffic congestion, sustainability

References

[1] Foltyński, M. (2014). Electric Fleets in Urban Logistics. *Procedia - Social and Behavioral Sciences*, 151, 48-59. doi: 10.1016/j.sbspro.2014.10.007

[2] Onnela, N. (2015). Determining the Optimal Distribution Center Location. Master's Thesis, Tampere University of Technology

[3] Malindretos, G., Bakogianni, M., & Mavrommati, S. (2018). City Logistics Models in the Framework of Smart Cities: Urban Freight Consolidation. In *Proceedings of the 4th International Conference on Smart Cities and Green ICT Systems* (pp. 65-74)

[4] Triantafyllou, M. K., Cherrett, T. J., & Browne, M. (2014). Urban Freight Consolidation Centers: A Case Study in the UK Retail Sector. *Transportation Research Record*, 2411(1)

* Corresponding/presenting author

Exploring the purpose and evolution of the TAM model

Marko Mikša*, Nenad Sikirica

University of Applied Sciences Hrvatsko Zagorje Krapina, Krapina, Croatia
E-mail: marko.miksa@vhzk.hr, nenad.sikirica@vhzk.hr

Abstract

The Technology Acceptance Model (TAM), introduced by Fred Davis in the 1980s, is an important model used in information systems to predict user acceptance and adoption of new technologies [1]. The model researches and confirms the relation between two factors - perceived usefulness and perceived ease of use [1]. Perceived usefulness supposes that technology will increase the efficiency of technology usage whereas perceived ease of use supposes effortlessness in using technology, where perceived ease of use exerts a causal effect on perceived usefulness [1], [5]. These factors influence an individual's attitude towards technology, affecting their intention and actual use. TAM has been widely validated across various fields, including IT, e-commerce, education, social media marketing, enterprise systems, healthcare, etc. proving its efficiency in explaining technology adoption behaviours [3]. TAM has limitations such as social influence, personal innovativeness and organizational environment, but TAM2, TAM3 and UTAUT models provide solutions for some of these issues. TAM2 includes subjective norms and has been evaluated using longitudinal research designs [3], TAM3 includes computer anxiety, computer playfulness, computer self-efficiency, perception of external control, computer enjoyment and objective usability [2], and UTAUT (Unified Theory of Acceptance and Use of Technology) model includes effort expectancy, performance expectancy, social influence and facilitating conditions, which are related to age, gender, experience and voluntariness of use in influencing the intention to use technology [4].

Keywords: technology acceptance model, UTAUT, perceived usefulness, perceived ease of use

References

[1] Davis, F. D. (1993). User acceptance of information technology: system characteristics, user perceptions and behavioral impacts. International Journal of Man-Machine Studies, 38(3), 475–487. Available online: https://doi.org/10.1006/IMMS.1993.1022, accessed 7 July, 2024

[2] Kronberg, S. 2024. The Effect of Gender on ChatGPT Use: A Technology Acceptance Model 3 (TAM3) study. In Proceedings of Umea's 27th Student Conference in Computing Science USCCS 2024 (p. 57). Available online: https://www.diva-portal.org/smash/get/diva2:1824671/FULLTEXT01.pdf#page=63, accessed 9 July, 2024

[3] Legris, P., Ingham, J., Collerette, P. (2003). Why do people use information technology? A critical review of the technology acceptance model. Information & Management, 40(3), 191–204. Available online: https://doi.org/10.1016/S0378-7206(01)00143-4, accessed 9 July, 2024

[4] McLean, G., Osei-Frimpong, K. (2019). Hey Alexa … examine the variables influencing the use of artificial intelligent in-home voice assistants. Computers in Human Behavior, 99, 28–37. Available online: https://doi.org/10.1016/J.CHB.2019.05.009, accessed 7 July, 2024

[5] Venkatesh, V, Davis F., 2000. A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies. Management Science. 46. Available online: DOI: 186–204. 10.1287/mnsc.46.2.186.11926, accessed 8 July, 2024

* Corresponding/presenting author

Integrated approach to process planning in transport wheel production

Hana Vukotić*, Mladen Perinić, Zoran Jurković

University of Rijeka, Faculty of Engineering, Rijeka, Croatia
E-mail: hana.vukotic@riteh.uniri.hr, mladen.perinic@riteh.uniri.hr, zoran.jurkovic@riteh.uniri.hr

Abstract

Detailed process plan is the key to a successful production of a part. This project aimed to define process plan corroborated with an advanced simulation of the production of the transport wheel, 179 mm in diameter, used as a part of a production line transferring bottled medicine in factories. Emphasis was on in-depth planning of the technological process which enabled transformation of input materials into final parts integrating different scientific disciplines such as mechanical engineering, industrial engineering, material science, computer-aided design (CAD), and computer-aided manufacturing (CAM) to achieve techno-economic efficiency of a process and a high-quality, cost-effective transport wheel [1]. Technological analysis was carried out from a structural and technological perspective to understand and optimize the technological process. The transport wheel was designed with specific dimensions and tolerances that are critical to its performance, which required a detailed analysis of the design and configuration, the allowable deviations in shape and position, and the quality of the machined surfaces. The technological process was carefully structured, including the selection and preparation of jigs, machines, and tools, with focus on their cutting data. A detailed concept of the technological process consisted of numerous operations including sawing, turning, milling, drilling, and threading. The technological process was simulated using Mastercam which enabled visual and technical validation of the operations and ensured accuracy and efficiency. Prepared simulation was used to obtain the NC program for the machines. Total production time of the transport wheel was 80 minutes. The final control of achieved measures of the transport wheel was done using CMM (Coordinate-Measuring Machine) for validation of accuracy. An expense analysis was carried out to assess the cost efficiency of the production and technological process and it included the cost of machinery, workforce, preparation of simulation, material, and final control. The study successfully prepared a process which produced a high-quality, cost-efficient transport wheel and provided valuable insights into optimizing the technological process. The results underline the importance of thorough process planning and the use of advanced simulation tools in modern manufacturing.

Keywords: process planning, technological process, CAM/CAD, mastercam simulation

References

[1] Gačnik, V., Vodenik, F., 1990. Projektiranje tehnološkog procesa. Tehnička knjiga. Zagreb, Croatia.

* Corresponding/presenting author

Comparison of corrosion behaviour between conventional and 3D-printed titanium in phosphate-buffered saline solution

Dario Kvrgić*, Matej Fonović, Sunčana Smokvina Hanza

University of Rijeka, Faculty of Engineering, Rijeka, Croatia
E-mail: dario.kvrgic@riteh.uniri.hr, matej.fonovic@riteh.uniri.hr, suncana.smokvinahanza@riteh.uniri.hr

Abstract

This paper compares the corrosion behaviour of conventional (Grade 5) and 3D-printed Ti-6Al-4V alloys in a phosphate-buffered saline (PBS) solution at 37°C (i.e., in simulated physiological solution in the human body). 3D-printed alloys are increasingly used in medical applications due to their customizability for patient-specific needs. Understanding their corrosion resistance under conditions simulating the human body is crucial. [1] The corrosion properties were analyzed using open-circuit potential (OCP) measurements, linear polarization, and cyclic polarization. OCP provides insights into corrosion resistance stability, while linear polarization determines polarization resistance, essential for assessing long-term durability. Cyclic polarization helps understand corrosion mechanisms and localized corrosion resistance. [1,2] The conventional sample and the 3D-printed sample were embedded in epoxy; the samples were polished to achieve a smooth surface. Tests were conducted in the PBS solution at 37°C to simulate physiological conditions. The samples were imaged before and after potentiostatic methods using an optical microscope. Results showed similar nature of OCP values for both materials, with the 3D-printed alloy having a slightly more positive value. Linear polarization indicated higher corrosion resistance for the 3D-printed alloy. However, potentiostatic measurements revealed a higher corrosion rate for the 3D-printed alloy, at $2*10^{-3}$ mm per year. Despite some positive characteristics, the long-term corrosion resistance of the 3D-printed alloy may be lower than that of the conventional alloy.

Keywords: Ti-6Al-4V alloy, 3D-printed metal, phosphate-buffered solution, corrosion

References

[1] Gudić, S.; Vrsalović, L.; Kvrgić, D.; Nagode, A. Electrochemical Behaviour of Ti and Ti-6Al-4V Alloy in Phosphate Buffered Saline Solution. Materials 2021, 14, 7495. https://doi.org/10.3390/ma14247495

[2] Jaquez-Muñoz, J.; Gaona-Tiburcio, C.; Lira-Martinez, A.; Zambrano-Robledo, P.; Maldonado-Bandala, E.; Samaniego-Gamez, O.; Nieves-Mendoza, D.; Olguin-Coca, J.; Estupiñan-Lopez, F.

* Corresponding/presenting author

Optimizing battery usage in PV-BESS systems

Stella Dumenčić*, Siniša Družeta, Jonatan Lerga, Alfredo Višković, Vladimir Franki, Lado Kranjčević

University of Rijeka, Faculty of Engineering, Rijeka, Croatia
E-mail: stella.dumencic@uniri.hr, sinisa.druzeta@uniri.hr, jonatan.lerga@uniri.hr, alfredo.viskovic@uniri.hr, vladimir.franki@uniri.hr, lado.kranjcevic@uniri.hr

Abstract

Renewable energy sources are not reliable, which is why economically efficient output of the generated electricity is a challenging, constrained optimization problem. To store the electricity produced by solar panels when needed, a battery system (BESS) is typically introduced as an enhancement to a photovoltaic (PV) installation, making it a PV-BESS system. In this way, the electricity can be stored in case of excess production or low selling prices, and then sold later when the demand increases or the prices rise. Optimization algorithms can be used for managing the produced electricity, i.e. determining whether it should be stored or discharged from the battery considering the PV output and selling price. This approach can be used in PV-BESS system planning, as well as in its daily operation as a production management tool. In this research, 15 optimization methods were tested for the task of optimizing the PV-BESS system operation on an hourly basis and for the period of 24 hours using the Indago library [1]. From these 15 methods, five competent optimization methods were chosen for a more detailed analysis. The goal of this investigation was to identify the best method for an optimization strategy of the PV-BESS system management in a realistic system operation scenario.

Keywords: optimization, renewable energy, PV-BESS system

References

[1] Družeta, S., Ivić, S., 2021. Indago – Python Module for Numerical Optimization.

* Corresponding/presenting author

Dynamic response of masonry walls with adhesive foam binder

Ivan Sindičić*, Nina Čeh, Leo Škec

University of Rijeka, Faculty of Civil Engineering, Rijeka, Croatia
E-mail: isindicic@student.uniri.hr, nina.ceh@uniri.hr, leo.skec@uniri.hr

Abstract

In seismically active regions, the resilience of structures against earthquakes is of crucial importance. Despite being a traditional construction method across the world, masonry structures are susceptible to damage even during moderate ground motions due to their relatively massive and rigid load-bearing structure. To improve their seismic response, it is essential to enhance their ductility which can be done by using innovative alternatives to traditional mortar binder, such as adhesives or foams. This work aims to investigate the behaviour of masonry walls with elastic binders in seismic conditions. For this purpose, experimental tests on different wall models are conducted [1,3] and an efficient numerical model is developed based on rigid blocks connected by an elastic interface [2]. By assessing the influence of the ductility of the binder on the dynamic response of masonry structures, this research will contribute to a better understanding and improved design of new masonry structures, with a special emphasis on their safety and resilience in seismically active regions.

Keywords: dynamic analysis, masonry structures, adhesive binder, foam binder, experimental tests, numerical model

References

[1] D. Foti, M. Lerna, and V. Vacca, “Experimental Characterization of Traditional Mortars and Polyurethane Foams in Masonry Wall,” Adv. Mater. Sci. Eng., vol. 2018, 2018, doi: 10.1155/2018/8640351.

[2] M. Gams, P. Triller, and A. Jäger, “In-plane seismic behaviour of urm and confined masonry built from vertically perforated blocks and polyurethane glue,” Structures, vol. 58, p. 105528, Dec. 2023, doi: 10.1016/j.istruc.2023.105528.

[3] M. Lißner, E. Alabort, H. Cui, R. Rito, B. R. K. Blackman, and N. Petrinic, “Experimental characterisation and numerical modelling of the influence of bondline thickness, loading rate, and deformation mode on the response of ductile adhesive interfaces,” J. Mech. Phys. Solids, vol. 130, pp. 349–369, Sep. 2019, doi: 10.1016/j.jmps.2019.06.011.

* Corresponding/presenting author

AlSi7Mg0,3/MWCNT metal nanocomposite development with aim to improve GDC-casted elements with great energy savings

Ivan Pentek[1,2*], Kristina Marković[2], Vedrana Špada[1], Davor Stanić[1]

[1] *Istrian University of Applied Sciences, Pula, Croatia*
E-mail: ipentek@iv.hr, vspada@iv.hr, dstanic@iv.hr

[2] *University of Rijeka, Faculty of Engineering, Rijeka, Croatia*
E-mail: kristina.markovic@riteh.uniri.hr

Abstract

As the automotive industry represents a large consumer of Al alloys globally, it is essential to have minimum losses of the mentioned materials whenever possible, mostly for ecological and economic reasons in accordance with global trends. Further, choosing the proper material for each part type is necessary from the safety and performance point of view. As described in [1], alloy AlSi7Mg0,3, known as a casting alloy often used for GDC or LPDC, is observed in this research. The main goal of the research was to achieve stable and homogeneous AlSi7Mg0,3 matrix nanocomposite, reinforced with Multi-Walled Carbon Nano Tubes (MWCNT), which enables mass parts reduction and consequently mass vehicles reduction as a whole resulting in fuel and CO_2 emission savings. On the other hand, with nanocomposite material having superior mechanical properties in comparison to the base material (AlSi7Mg0,3), a great amount of energy and financial resources could be saved in the production process if there is no need to get the casted elements through the T6 heat treatment (solution annealing and artificial ageing) to satisfy all properties requirements. An industrial experiment of mixing MWCNT in the melted AlSi7Mg0,3 followed by GDC casting process was made with constant monitoring of processing parameters and quality control in the CIMOS d.d. Roč foundry. Špada et al. [2] proved that a significant increase in material properties could be achieved if metal matrix nanocomposite preparation is done properly. Mechanical properties such as tensile strength, hardness and Charpy impact toughness were tested using the universal static testing machine, Vickers hardness testing machine and Charpy pendulum in METRIS Research centre of the Istrian University of Applied Sciences. The obtained results were then compared with reference base material properties. In future work, the microstructure of nanocomposite material will be analysed using an optical and scanning electron microscope (SEM) to determine both, the success of nanocomposite development in terms of nanoparticle reinforcement dispersion and interphase bonding in metal matrix, which is extremely important [3]. Also, the correlation of mechanical properties with MWCNT dispersion and microstructure condition will be analysed.

Keywords: nanocomposite, AlSi7Mg0,3, MWCNT, GDC casting, mechanical properties, microstructure

Acknowledgements: This work has been supported by the CIMOS d.d. (foundry Roč), Istrian University of Applied Sciences (METRIS Research centre) and University of Rijeka under project number uniri-iskusni-tehnic-23-168.

References

[1] Stanić, D. (2012). Influence of the solidification conditions and melt treatment on microstructural and mechanical properties of AlSi9MgMn alloy [Doctoral dissertation, University of Zagreb, Faculty of Metallurgy]

* Corresponding/presenting author

[2] Špada, V., Stanić, D., Brnardić, I. (2019). Investigation of the mechanical properties of AlSi9Cu3(Fe)/MWCNT nanocomposites prepared by HPDC. Materiali in tehnologije/Materials and technology 53 (2019) 4, 601-606. UDK 620.1:67.017:620.3
[3] Špada, V. (2019). Preparation of nanocomposites from carbon nanotubes and Al-alloy by high pressure die casting [Doctoral dissertation, University of Rijeka, Faculty of Engineering]

INTERACTIVE WORKHOPS

Language technologies in written communication

Mirjana Borucinsky, Jana Kegalj

University of Rijeka, Faculty of Maritime Studies, Rijeka, Croatia
E-mail: mirjana.borucinsky@pfri.uniri.hr, jana.kegalj@pfri.uniri.hr

Summary

The workshop is intended for PhD students who are interested in improving their English language skills. The main objective of the workshop is to acquaint students with language technologies (LT) and their application in improving written communication skills, i.e. writing a scientific article and/or a doctoral dissertation.

Discrete-event simulation with virtual reality

Dario Ogrizović

University of Rijeka, Faculty of Maritime Studies, Rijeka, Croatia
E-mail: dario@pfri.uniri.hr

Summary

A discrete-event simulation (DS) is the method of simulating the behaviour and performance of real entities, systems, and processes. This workshop is intended for graduate and PhD students who wish to learn how to model real entities with 3D-virtual environment. During the workshop, 3D FlexSim Simulation Modelling and Analysis software will be used together with elements of virtual reality (VR). The goal is to gain basic and intermediate knowledge of discrete-event simulations for potential application in scientific research, as well as to learn how to run simulations and modelling for the testing of *what-if* scenarios.

Statistics

The first edition of My First Conference took place at the University of Rijeka, Faculty of Engineering, in September of 2017. At the first conference, two keynote lectures and 29 contributed lectures were presented.

The second edition of My First Conference was held at the University of Rijeka, Faculty of Maritime Studies, in September of 2018. During the conference, 34 papers were presented along with two plenary lectures.

The third edition of My First Conference took place at the University of Rijeka, Faculty of Civil Engineering, in September of 2019. During the conference, 27 papers were presented along with one plenary lecture.

The fourth edition of My First Conference was held at the University of Rijeka, Faculty of Engineering, in September of 2020. For the fourth edition, 33 abstracts were presented together with one keynote lecture.

The fifth edition of My First Conference was held at the University of Rijeka, Faculty of Maritime Studies, on September 23, 2021. 30 abstracts were submitted for the conference along with three plenary presentations and one keynote lecture.

The sixth edition of My First Conference was held at the University of Rijeka, Faculty of Civil Engineering, on September 22, 2022. During the conference, 29 papers were presented as well as one plenary and one keynote lecture.

The seventh edition of My First Conference was held at the University of Rijeka, Faculty of Engineering, on September 14, 2023. It included 19 abstracts, one keynote lecture and one plenary lecture.

This year, the conference takes place at the University of Rijeka, Faculty of Maritime Studies, on September 19, 2024. The programme includes 24 abstracts and two keynote lectures along with two interactive workshops.