Book of Abstracts

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Measuring engagement on Twitter using a composite index: An application to social media influencers

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Abstract. Engagement on social media networks is a complex concept involving numerous interconnected and challenging-to-evaluate elements. It is precisely this nature that served as the driving force behind this research. We propose a composite index as a tool to quantify commitment and use the TOPSIS methodology, a multi-criteria technique that minimizes the distance to the ideal point while maximizing the distance to the anti-ideal point. This composite index uses a blend of indicators derived from two distinct approaches: the tweet approach and the follower approach. The former assesses engagement based on user-generated content, while the latter gauges engagement through popularity metrics. This composite index was applied evaluating a group of Social Media Influencers, resulting in the creation of an overall ranking as well as separate rankings for each approach to measuring engagement. A comparison of the rankings generated by the different approaches shows the suitability and pertinence of both, as it is confirmed that they measure different facets of engagement and that both are essential for providing a comprehensive perspective on the engagement generated by a Twitter user, social network converted into X. This represents a recent finding when contrasted with previous research, which solely focused on either one of the approaches.

Finite element model updating with multi-fidelity surrogate model-accelerated improved termite life cycle optimizer

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Abstract. Finite element (FE) model updating is the first step in ensuring the safety and stability of a structure. However, the computational cost of using a fine FE model to represent the system characteristics of a complex structural is often extremely high. Especially, when solving optimization problems, the repetitive use of expensive FE models can be daunting. This study proposes an intelligent method for quickly updating FE moles by combining multi-fidelity surrogate models and an improved termite life cycle optimizer (TLCO). First, a bit of "input-output" initial dataset of the structure are generated through probabilistic finite element analysis, in order to build a low-cost surrogate model to replace the FE model. Then, various surrogate models are used to expand the initial dataset to improve the predictive accuracy of the fused surrogate model. Finally, the fused surrogate model is used to accelerate the improved TLCO to update the structural FEM. Taking a large real dam as an example, the proposed method not only increases computational efficiency ten-fold compared to the traditional model updating method based on direct iterative optimization, but also enhances the computational accuracy to some extent.

The conditions of convergence of sequences of conditional expectations on a probability space and some applications

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Abstract. Let $\{F_{\mathrm{n}}\}$ be a filtration of sub-sigma-algebras in a probability space (Ω, F, P) and let X be a random variable on (Ω, F, P). The sequence of conditional expectations $\mathrm{E}[X|F_n]$ with respect to each F_n converges to a random variable strongly. If a sequence $\{F_{\mathrm{n}}\}$ of sub-sigma-algebras is not a filtration, the sequence of conditional expectations $\mathrm{E}[X|F_n]$ does not necessarily converge. On the other hand, we can recognize a conditional expectation as a linear contractive projection on $L^p(\Omega, F, P)$. Recently, we have obtained the conditions of convergence of sequences of linear contractive projections on a Banach space. By using this, we show the conditions of convergence of sequences of conditional expectations $\mathrm{E}[X|F_n]$ and we give some applications.

Numerical analysis of residual stress distribution in Fretting Fatigue problem

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Abstract. Fretting fatigue pertains to the behaviour of engineering components subjected to cyclic loading while in contact with each other. This challenging contact-related phenomenon often leads to premature failure compared to typical fatigue issues. To extend the lifespan of components experiencing fretting fatigue, surface strengthening is crucial. One well-established method for enhancing the durability of these components is the application of compressive residual stress to the material's surface, achieved through a process called shot peening. Numerous parameters in shot peening, such as shot speed, ball material, ball diameter, and coverage, must be carefully controlled to cause beneficial compressive residual stress. These parameters significantly affect the residual stress distribution, containing the maximum residual stress, the depth of the residual stress area, and the depth of the maximum residual stress. The Critical Plane (CP) Method is used to calculate the damage parameter, and the Theory of Critical Distance (TCD) method is utilized to average the damage parameter due to the stress concentration resulting from the contact problem to investigate the impact of residual stress distribution on initiation behaviour. Additionally, Linear Elastic Fracture Mechanics (LEFM) criteria, specifically the Extension Maximum Tangential Stress (E-MTS) criterion, is used to study how the residual stress affects crack propagation lifetime under fretting conditions.

It is found that the maximum residual stress plays the most positive role in improving crack initiation and propagation lifetime. However, an increase in the depth of the maximum residual stress has a negative impact on crack initiation lifetime, and it has little effect on crack propagation lifetime. Furthermore, the enhanced lifetime diminishes as the applied loads increase.

Building the Toughest Networks, According to Graph Theory

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Abstract. Given n computers and m cables with which to directly connect pairs of computers, what is the best configuration for forming a communication network? Here, by the best, we mean the network whose communication capabilities are least vulnerable to computer failures. To measure this, we turn to graph theory, regard the network as a graph, and use the parameter called the toughness of a graph. When nodes fail, the network may be fractured into separate components that can only communicate within themselves. To measure the impact on the network of the computer failures we look at the ratio of the number of failures to the number of components left behind. The toughness of the network is then defined to be the smallest that this ratio can be considering all possible disconnecting sets of computer failures. Therefore, to consider our network to be tough, we want our network to have the maximum possible toughness value. Given certain relationships between the number of computers and the number of cables available, we can describe exactly how to build networks that have this maximum toughness. In those cases, we specify those maximally tough networks and their toughness values. In other cases, we present some open problems in our pursuit of maximum toughness.

Fretting wear volume determination using mathematical method

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Abstract. Quantitative measurement of wear amount is a key indicator for analysing fretting wear performance. When performing 3D profile measurements on wear results, it can be very time-consuming, especially when calculating wear volume for multiple sets of experimental specimens. Although there have been some studies on mathematical approximations of the volume of sliding wear, the mathematical analysis of fretting wear has not been studied. Therefore, a simple and fast determination method is urgently needed for fretting wear volume. In this study, a sphere-flat configuration was considered. Based on the geometric characteristics of the wear surface, it is simplified to a semi-ellipsoid surface. The amount of wear can be determined by the modified expression of the ellipsoid volume. By measuring the length of the ellipsoid along the two principal axes of the wear surface, denoted as d_1 and d_2, respectively. In addition, the maximum wear scar cross-section perpendicular to the fretting direction needs to be integrated to obtain W_q. Therefore, the necessary parameters of the expression are summarized as d_1, d_2, and W_q. The calculated results are compared with experimental data and exhibit a high accuracy.

The conditions of convergence of sequences of conditional expectations on a probability space and some applications

Takashi Honda[1] and Yukiko Iwata[2]

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Abstract. Let $\{F_{\mathrm{n}}\}$ be a filtration of sub-sigma-algebras in a probability space (Ω, F, P) and let X be a random variable on (Ω, F, P). The sequence of conditional expectations $\mathrm{E}[X|F_n]$ with respect to each F_n converges to a random variable strongly. If a sequence $\{F_{\mathrm{n}}\}$ of sub-sigma-algebras is not a filtration, the sequence of conditional expectations $\mathrm{E}[X|F_n]$ does not necessarily converge. On the other hand, we can recognize a conditional expectation as a linear contractive projection on $L^p(\Omega, F, P)$. Recently, we have obtained the conditions of convergence of sequences of linear contractive projections on a Banach space. By using this, we show the conditions of convergence of sequences of conditional expectations $\mathrm{E}[X|F_n]$ and we give some applications.

An improved crayfish optimization algorithm with opposition-based learning and modified competition stages

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Abstract. The Crayfish Optimization Algorithm (COA) is a novel meta-heuristic optimization algorithm, inspired by three crayfish's behaviours, including summer resort behaviour, competition behaviour and foraging behaviour. COA shows a nice exploitation ability but exists unsatisfactory abilities of exploration and local optima avoidance. In this study, an improved COA (ICOA) is proposed based on Opposition-based Learning (OBL) and modified competition stages. OBL is added to improve the exploration of COA, while a modified competition stage is also applied to enhance the exploration of COA. In competition stage, crayfish failing in competition explore other cave using Lévy distribution movement, which is regarded as the exploration stage and enhance the exploration ability of COA. The efficiency of ICOA is evaluated by comparing it to COA and other well-known meta-heuristic optimization algorithms using three benchmark functions, including 23 classical benchmark functions, CEC 2014 test functions, and CEC 2019 test functions. The practicality of ICOA is also tested using five classical engineering design problems with inequality constraints. Results show ICOA wins COA and other algorithms and is a potential optimization algorithm for solving real-world problems.

Create a win-win situation between the knowledge diffusion and the benefits by placing the cost at the threshold

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Abstract. Collaboration on knowledge is an essential channel for fostering the production and integration of knowledge. Knowledge collaboration user interactions can evolve into a network for knowledge collaboration. The "resources" variable has a significant effect on knowledge diffusion in the actual world. This paper examines the impact of resource production and consumption processes on the knowledge diffusion. We construct the knowledge diffusion model and determine the threshold for knowledge diffusion's propagation. We analyze the existing collaboration network dataset, Erdos Collaboration Network (ERDOS), and demonstrate that it exhibits clustering and small-world behavior. Using ERDOS data, we investigate the effect of resource generation and consumption processes on knowledge diffusion, as well as the role of self-learning and review mechanisms in this process. In addition, we find that the steady-state density of informed users is insensitive to both the benchmark knowledge diffusion rate and the maximum resource-mediated knowledge diffusion rate. In the actual world, managers can set the cost at the threshold, creating a win-win situation between the degree of knowledge diffusion and the benefits.

Finite element analysis of grain boundary and dislocation interaction in austenitic stainless steel

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Abstract. The complex interaction between dislocations and grain boundaries determines the microstructure evolution and mechanical properties of metal materials during room temperature deformation. However, the existing crystal plasticity models do not fully consider the properties of grain boundaries and dislocations. The aim of this work is to establish a non-local crystal plasticity model by adding edge dislocations, screw dislocations, and mixed dislocations to the model, taking into account the properties of grain boundaries and the interactions between grain boundaries and dislocations. For example, the stacking effect when dislocation slip encounters grain boundaries, and the interaction between different grain boundary properties (twinning) and dislocations. The implementation of this work is conducive to a deeper understanding of the organizational evolution process during material deformation, establishing a more accurate crystal plasticity model, which can simulate the actual material evolution process during production, thereby optimizing the deformation process.

Operator algebra based Hilbert transform and its eigenfunctions

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Abstract. The Hilbert transform H is invariant under the (formally) unitary transformation $H \to H' = e^{iZ} H e^{-iZ}$, where Z is a linear combination of the operators in $C \coloneqq \{P,\ PQ + QP,\ QPQ\}$ over the real numbers, with P and Q being the momentum and position operators, respectively. The invariance is due to the commutativity of H with $c \in C$. Considering that $c \in C$ satisfies the two-dimensional special Lie algebra, isomorphic to the one-dimensional conformal algebra, we find that the eigenfunction of H' is given by a linear fractional transformation of the original eigenfunction of H. As opposed to the ordinary one-dimensional conformal operators in $C' \coloneqq \{P, QP, Q^2P\}$, all the operators in C are commutative with H, so that it can also be rewritten as RHR^{-1}, where $R \coloneqq P + QPQ$. In this case, we can Hilbert transform of a non(square)integrable function $f(x) = O(1)$ $(|x| \to \infty)$, due to the relation $(R^{-1}f)(x) = O(x^{-1})$. In obtaining the integral kernel for the resolvent R^{-1}, it may be convenient to formally expand $f(x)$ in terms of the eigenfunctions of R. We further discuss the eigenvalues of $D \coloneqq PQ + QP$, which are closely related to the zeros of the Riemann zeta function $\zeta(z)$. Expanding the eigenfunction of D in terms of the eigenfunctions of R, we find that the real and pure imaginary eigenvalues of D correspond to the nontrivial and trivial zeros of $\zeta(z)$, respectively.

A simulation study on fretting wear behaviour of high strength alloy steel induced by plasma nitriding and post-oxidation

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Abstract. Fretting wear refers to the small wear caused by the relative movement of the material surface on a small scale. Finding ways to reduce fretting wear is of great significance for extending equipment life and reducing maintenance costs. With the increase of load, the fretting wear adhesion effect of the same surface treatment material becomes more obvious. The materials treated with post-oxidation have stronger wear adhesion than those treated only with plasma nitriding, but the total wear volume is reduced. The fretting wear of high strength alloy steel with different surface treatment is simulated by finite element method. The friction coefficient and wear volume can be obtained from the experimental results, and the wear coefficient is calculated using the wear energy model. The two-dimensional predicted wear profile curves (U-shaped and W-shaped wear profiles) under different wear conditions are compared with the experimental results. The W-shape wear profile is used to describe the adhesion state of the worn surface. In addition, the influence of single-sided wear, double-sided wear and increasing

adhesive effect on the wear profile is analysed by simulation. The simulation results show the importance of double-sided wear and the addition of adhesive layer to wear prediction.

Assessment of localization strategies in a radial basis function meshless method to solve two-dimensional convection-diffusion problems

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Abstract. Two-dimensional Poisson and convection-diffusion problems are solved by using three localization schemes implemented in the context of a Radial Basis Function (RBFs) collocation method. The first scheme uses the traditional RBF superpositions to approximate the problem variable in a defined stencil. The second localization scheme involves the Hermitian (LHRBF) method proposed by Fasshauer, where the internal and boundary operators are included into the interpolation. The superposition is strengthened by enforcing the original PDE operator at auxiliary nodes located within the stencils. These auxiliary PDE centers improve the accuracy of local collocation and are not included as unknowns within the global matrix system. The third scheme is the Partition of Unity strategy, and it is used to obtain a representation of governing equations as a linear combination of RBFs local superpositions evaluated at neighbouring stencils. Weight functions are designed to capture convection term effect on solution. For all schemes, stencils in the form of crosses, circles, and squares are considered, and Root mean square (RMS) is obtained as a function of shape parameter, nodal distribution size and stencil size. In the case of Poisson problems, the use of LHRBF in circular configuration with no more than 13 nodes per stencil is recommended as far as a c suitable range is obtained for each nodal distribution employed in order to avoid ill-conditioning issues.

Plastic deformation mechanism of Fe-TiB2 composites based on crystal plasticity finite element Method

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Abstract. Fe-TiB_2 metal matrix composite materials (called high modulus steel) have broad application prospects in the aviation, aerospace and automotive industries due to their high specific strength, specific modulus and wear resistance. However, the observed embrittlement caused by TiB_2 particles severely limits the applications of these steels. Therefore, the grain size, orientation and other information of the Fe-TiB_2 composite material were obtained through EBSD experiments, and a two-phase crystal plasticity finite element model of the Fe- TiB_2 composite material based on the real three-dimensional morphology of the reinforced phase (dual scale, dual morphology) was established and analyzed. The influence of dislocation evolution, grain size, and twin formation mechanism on the mechanical properties of Fe-TiB_2 composite materials and establish the relationship between the microstructure and its deformation mechanism and macroscopic properties. At the same time, the effects of different reinforcement contents and initial texture on the mechanical properties of Fe-TiB_2 composites were studied, and pole figures were used to characterize the evolution of the texture with loading strain.

Parallel implementations of Riemannian conjugate gradient methods for joint approximate diagonalization

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Abstract. Joint approximate diagonalization (JAD) of multiple matrices is a core problem in many applications. In this work we propose parallel implementations of numerical methods for computing JAD based on Riemannian optimization on two different matrix manifolds, with emphasis on their numerical properties and efficiency. Our goal is to solve efficiently the following problem: given a set of symmetric matrices $A^{(1)}, A^{(2)}, \dots, A^{(m)} \in \mathbb{R}^{n\times n}$, find orthogonal or nonsingular $X \in \mathbb{R}^{n\times n}$ such that $X^T \cdot A^{(p)} \cdot X = D^{(p)}$, for all $p = 1, \dots, m$, where $D^{(p)}$ are either diagonal, or as diagonal as possible according to some criterion. We were focused on approach that is suitable for efficient parallel implementation, especially for larger dimension n and large number of input matrices m. This approach relies on Riemannian optimization by conjugate gradient method on two matrix manifolds: the Stiefel manifold (orthogonal group), when diagonalizing matrix X needs to be orthogonal, and the oblique manifold (matrices with unit column norm), otherwise. The conjugate gradient optimization method requires solution of 1-dimensional optimization problem in each iteration, has superlinear convergence, and is very simple for implementation and suitable for parallelization in our case. We consider relevant and frequently used variants of the conjugate gradient method, and we are particularly focused on variants that are often avoided due to numerical complexity, but on the other hand, which may have better convergence properties. Diagonalization or approximate diagonalization is

represented by minimization problem $min_{X \in \mathcal{M}} F$, where F measures diagonality of transformed input matrices and $\mathcal{M}$ is appropriate manifold. In our implementations of the method, all basic steps, such as: evaluation of $F(X)$, $\text{grad}F(X)$,and $\text{Hess}F(X)$, computing geodesic or retraction, and solving 1-dimensional optimization problem, are explicitly modified and parallelized in order to decrease operation count and increase efficiency. We present extensive numerical comparison of different variants, regarding number of iterations and execution times. Numerical experiments confirmed that our parallel implementations of the conjugate gradient method on two matrix manifolds are more efficient than the original versions, in particular for large n and m.

Optimizing the hyperparameters of 1D-CNN networks using Genetic algorithms

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Abstract. Structural Health Monitoring (SHM) is a wide concept that encompasses a wide variety of fields, like sensors, signal processing and mechanical and civil engineering. Signal based methods for damage detection have gained considerable attention from the research community, especially with the higher use of machine learning based techniques. In this research, a similar signal-based method is optimized using Genetic Algorithm (GA). The 1D-CNN network is used to determine damage in a simple composite beam. The damage is simulated using Finite Element Method (FEM) and the vibration responses are used as input for the 1D-CNN network. In order to get the best results from the 1D-CNN network, GA is used in order to optimize the hyperparameters of the 1D-CNN network. The results show that GA finds better hyperparameters that yield better results.

Monitoring Bambara groundnut canopy state variables at various growth stages using low-cost remote sensing technologies and machine learning techniques

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Abstract. The aim of this study was to assess the efficacy of an unmanned aerial vehicle-based remote sensing system for quantifying Bambara groundnut canopy state variables. Remotely sensed color infrared images and in-situ canopy state variables were collected during Malaysia's 2018/19 Bambara growing season at vegetative, flowering, podding, podfilling, maturity, and senescence stages. Five common vegetation indices (VIs) were derived from the images, yielding to single stage and cumulative VIs (∑VIs). The relationship between canopy state variables and single stage VIs/∑VIs was investigated

using Pearson's correlation. Linear parametric and non-linear non-parametric machine learning (ML) regressions were employed to estimate canopy state variables by using VIs/ ∑VIs as input features. The best correlation were observed at flowering stage. The ∑VIs from vegetative to senescence stage exhibited the most robust relationship with canopy state variables. CatBoostRegressor (CBR) excelled in training for all canopy state variables, however, it showed potential overfitting in testing. In contrast, Huber regression (HR) models provided consistent results in both training and testing. HR performance was comparable to that of the top-performing ML algorithms in estimation of groundnut crop variables.

Application of weighted dual criterion in damage assessment of steel structures

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Abstract. This study investigates the application of weighted dual criterion for the identification of damage in beam-like structures. The weighted dual criterion is used to enhance the weight coefficient of the objective function used in probabilistic-based damage detection process and helps to enhance the precision and resilience of this procedure. To assess the efficacy of the proposed method, numerical experiments are conducted on a simply supported steel beam under various damage scenarios. The results illustrate that the proposed technique that involves coupled weighted dual criterion can surpasses existing method in terms of both accuracy and robustness. In summary, this study offers a promising strategy for damage assessment of steel structures, with its effectiveness substantiated through numerical experiments.

Measuring Vertical Densities of the Upper Atmosphere with X-ray Astronomy Satellites

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Abstract. We show that X-ray astronomy satellites allow us to measure vertical density profiles of the Earth's atmosphere at altitudes between 70 and 200 km, based on atmospheric occultations of extremely bright astrophysical sources such as the Crab Nebula, a supernova remnant occurred in AD 1054. We recently established this method, and applied it to investigate long-term density trends of the Earth's upper atmosphere at altitudes between 71 and 116 km, using X-ray astronomy satellites, ASCA, RXTE, Suzaku, NuSTAR, Hitomi, and NICER. The period covered by our analysis ranges from 1994 to 2022. We found a negative density trend of roughly -5 %/decade at every altitude. This is in reasonable agreement with inferences from settling rate of the upper atmosphere due to "greenhouse cooling". The upcoming X-ray astronomy satellite, XRISM, is scheduled to be launched on August 26, 2023. Its unprecedented spectral resolution will allow us to measure N and O densities individually, by resolving absorption edges from N and O. It is particularly interesting to search for correlations between O/N2 density ratios and the N+O densities, because the O/N2 ratio is thought to be a good indicator of the atmospheric circulation.

A new finite element model to predict high temperature rotating bending fretting fatigue life considering residual stress relaxation

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Abstract. Surface plastic deformation (SPD) treatment can greatly improve the fretting fatigue life of metallic materials mainly by introducing large and deep distributed compressive residual stress. However, under high temperature and cyclic loading the residual stress can relax along time and number of cycles, which can reduce the effect of SPD on improving the fretting fatigue life. In this study, the effect of compressive residual stress and its relaxation on the high temperature rotating bending fretting fatigue of titanium alloy was studied by a self-designed experimental device. The compressive residual stress relaxations along number of cycles were measured by an X-ray residual stress tester. In addition, a new finite element model was established to predict the fretting fatigue life and initial condition subroutine was applied to simulate the residual stress relaxation. Combined critical plane methods and linear cumulative damage theory were used to predict the initiation life of fretting fatigue. The results showed that the models considering residual stress relaxation had better prediction results than the models only used the initial state of residual stress before fretting fatigue or the final state of residual stress after fatigue fracture.

Context-awareness network with multi-level feature fusion for building change detection

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Abstract: Building change detection is critical for urban management. Deep learning methods are more discriminatory and learnable than traditional change detection methods. But in complicated backdrop environments, it is still difficult to precisely pinpoint change zones of interest. Most change detection networks suffer from inaccurate feature characterization during feature extraction and fusion. As a solution to these problems, we propose the use of multilevel feature fusion in conjunction with aware networks to detect building changes. To obtain multi-scale change characteristics, our Context-awareness network employs multi-scale patch embedding. Followed by multi-path Transformers to enhance learning and extract more suitable features. The multi-scale fusion module can ensure semantic consistency of change features, making detected change regions more accurate. Visual comparisons and quantitative evaluations of our method showed that it outperformed seven popular change detection methods on the LEVIR-CD dataset.

Numerical Investigation of process parameter influences on deep drawing plasticity simulation of 5182 aluminum sheet material

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Abstract. The present study investigates deep drawing process, employing the Finite Element Method (FEM). A quarter 3D axisymmetric model is generated to simulate sheet metal forming operations and to optimize computational efficiency. The chosen material for this study is the annealed 5182 aluminum alloy, and the material properties are considered homogeneous. The influence of three critical parameters, such as the coefficient of friction (CoF), punch nose radius, and punch forces, are investigated. A predetermined blank thickness of 0.96 mm was generated across all process trials for uniformity and consistency in the simulation models, accompanied by a singular mesh size. The die, holder, and punch components were modeled as discrete 3D rigid bodies, while the deformable shell element was employed to represent the blank. Material criteria for ductile fracture were specified for the workpiece. Critical findings of the study reveal the preeminence of the punch nose radius as the primary determinant of stress outcomes, with CoF and punch speed parameters as significant parameters. The critical findings of the study are the significant influence of the punch nose radius as the foremost factor determining stress outcomes. It primarily contributes to the stress experienced during the metal-forming process.

Facilitating Thematic Mapping with Eurostat-map.js: Exploring Open Statistical Data

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Abstract. This presentation explores the capabilities of the Eurostat-map.js library for creating thematic maps using open statistical data provided by Eurostat. Open data refers to data that is made available in open formats and machine-readable forms, allowing it to be freely used, reused, and shared by anyone without restrictions. Statistical data, together with other categories, such as geospatial data, Earth observation and environment datasets, meteorological datasets, companies and company ownership, and mobility data, are recognised as high-value datasets, crucial for social, environmental, and economic benefits, that public sector bodies will have to make available for re-use, free of charge, in machine-readable format, via an Application Programming Interface and, where relevant, as bulk download. Eurostat, the statistical office of the European Union, facilitates open access to statistical datasets at the European level. This provides an opportunity for different stakeholders, including statisticians, scientists, and citizens, to actively engage in the open data ecosystem. In order to make open data readable and useful to the wider circle of people, various platforms and libraries are developed. Those platforms enable analysing and visualizing statistical data. Having that objective in mind, the JavaScript library eurostat-map.js, developed in 2022, seamlessly integrates D3.js and GeoJSON, enabling dynamic data retrieval and empowering both programmers and non-programmers to create interactive thematic maps. The library's user-centered design facilitates the creation of interactive maps from open statistical data,

supporting a collaborative and innovative approach to solving societal challenges. In this work, a step-by-step methodology will be presented for creating choropleth and bivariant choropleth maps on the web, for the EU territory and its member states where statistical data and metadata were obtained through a Eurostat API statistic. This presentation focuses on open statistics, emphasizing a data-driven approach, which aims to identify unexplored insights starting from freely available datasets. In this process, eurostat-map.js emerges as a powerful tool, demonstrating its ability to visualize and analyze open statistical data, thereby contributing to innovative solutions and insights through thematic mapping.

Developments in numerical modelling techniques for fretting wear

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Abstract. Fretting is a phenomenon that occurs due to the micro-relative movement of contacting bodies and causes damage to the contacting surfaces. Fretting damage can arise in various mechanical components like bearings, couplings, joints, wire ropes, and orthopedic components. Various factors can affect the fretting process; however, the contact load, fretting amplitude, and friction coefficient are the leading ones. Depending upon the loading conditions fretting phenomena are classified into fretting fatigue and fretting wear. Normally, partial slip conditions lead to fatigue, and gross slip conditions cause fretting wear. This work studies the developments of the numerical methodologies used to solve the fretting wear problems. It describes the developments of numerical methods, especially combining finite element methods with multi-scale numerical models to capture the complexity of contact between the fretted surfaces. These numerical models consider the material properties, contact mechanism, surface geometry, surface characteristics, and micro-relative movements to predict the fretting behaviour of contacting surfaces. These numerical models are used to validate the experimental data and then used to predict the fretting failures in different engineering applications.

Comparison of User Experience and Openness in Google Earth Engine and Open Data Cube for Geospatial Analysis

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Abstract. Geospatial analysis has become an indispensable tool in various domains, from environmental monitoring to urban planning. Two prominent platforms, Google Earth Engine and Open Data Cube, have emerged as powerful tools for conducting geospatial analyses. This research paper provides a comparison of these platforms, focusing on two key aspects: user experience and openness. To evaluate the user experience, a process of calculating the Normalized Difference Vegetation Index (NDVI) was performed for the selected identical area and time interval within both platforms. During the calculation of NDVI, several indicators were carefully selected to make the comparison between these two platforms as representative as possible. These indicators encompass platform ownership and accessibility, data sources, programming language, community and support, and cost. Based on these indicators, the capabilities and limitations of each platform in terms of user experience and openness were described. The findings indicate that Google Earth Engine offers broader accessibility to a wider audience, while Open Data Cube, though open, demands more technical expertise for setup and use. Google Earth Engine employs a proprietary language for data processing, whereas Open Data Cube accommodates various languages like Python and R. In terms of community support, Google Earth Engine boasts a large user community, while Open Data Cube's support is smaller but growing. Regarding platform openness, Google

Earth Engine is owned by Google, while Open Data Cube is an open platform available to a broader community, customizable to user needs. Cost-wise, Google Earth Engine can be expensive for intensive use, while Open Data Cube is open and free to use, with self-management and maintenance costs being the primary expenses. In conclusion, this research offers valuable insights for users, researchers, and decision-makers in geospatial analysis. It provides a structured framework for evaluating user experience and openness in geospatial platforms, enabling more informed decision-making.

Optimization of auxetic Honeycomb sandwich nanoplates for stiffness enhancement

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Abstract. Currently, researchers are becoming more interested in sandwich plates with cellular core structures because of their unique characteristics such as ultra-light weight and stiffness. The combination of auxetic honeycomb sandwich structures with nanoplates opens up a wide range of possibilities across various industries, offering improved mechanical properties, but their full potential has not yet been realized. The sandwich plate structures are constituted by an auxetic honeycomb core layer with a negative Poisson's ratio and two skin layers reinforced by graphene nanoplatelets. The high stiffness of these sandwich nanoplates is important for their structural integrity, preventing excessive bending, buckling, or deformation. The geometrical parameters, such as the cell re-entrant angle, beam length, height, and thickness can have different effects on the overall stiffness of these sandwich nanoplates. Optimization techniques on stiffness enhancement of auxetic honeycomb cells can be employed to get optimal geometric parameters while considering the design constraints and the effect of optimized parameters on the stiffness of overall sandwich plates can be investigated.

A More Promising Prediction Method of Fretting Fatigue Behaviour: Combination of Deep Learning and Numerical Modelling

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Abstract. Fretting fatigue is a highly destructive fatigue phenomenon. It is typically caused by factors such as temperature fluctuations, vibrations, load variations, and others, resulting in small relative micro-slip between closely contacting surfaces. This issue is commonly encountered in crucial components like aero engines and aircraft blades, exhibiting distinctive features such as high gradients, multi-axial stress, and localized effects. In most cases, the service life of components under fretting fatigue conditions is significantly reduced compared to the plain fatigue state, sometimes decreasing by as much as 80%. Therefore, accurately predicting fretting fatigue behaviour has been a prominent research focus in the aviation field. Currently, the majority of prediction methods rely on empirical formulas derived from the observation of fatigue damage phenomena, which are constrained by their less-than-ideal accuracy and limited applicability to specific scenarios. In this work, deep learning is introduced to interpret the complicated relationship between the localized damage parameter and fretting fatigue behaviour. Numerical modelling facilitates it becomes easy to capture the critical damage features around the damage position. By combining deep learning and numerical modelling, the prediction of fretting fatigue behaviour is obtained with higher accuracy and robustness compared to the traditional empirical formula.

Info-Geometric Analysis of Gamma Distribution Manifold with Gamma Distribution Impact to Advance Satellite Earth Observations

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Abstract. This study reveals the revolutionary Gamma Distribution Manifold (GDM) info-geometric analysis combined with potential Gamma distribution (GD) applications to advance Satellite Earth Observations (SEOs). An exposition of the GDM Fisher Information Matrix (FIM) was undertaken, together with the analytic investigation of the existence of FIM's inverse. The derivation of GDM's Geodesic Equations (GEs) is undertaken. Several challenging open problems combined with a conclusion and the next phase of research are given.

How Satellite Imaging and Deep Learning are Influenced by Tensor Decompositions: A review

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Abstract. This study examines the approaches for TDs. Potential TDs applications are covered in satellite imaging (SI) and deep learning (DL). The present research shows the influence of these decompositions on the advancement of both SI and DL is being discussed. This review consolidates more fundamental motives and insights for future TD use to boost research works. Conclusions are provided, along with open problems and future directions.

Threshold and Upper Bound for the Controller's Designed Parameter of Fokker Planck Kolmogorov Probability Density Function with Applications to Cryptocurrency

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Abstract. This work is the first in literature to tackle the difficult open problem of determining the upper bound and threshold theorem for the TDCDP (time-dependent controller parameter) of the (Fokker Planck Kolmogorov) probability density function. After that, some significant applications of (FPK) equations in the context of cryptocurrencies are emphasized. The paper ends with closing remarks combined with some challenging open problems and the next phase of research.

Fractal Dimension of Ismail's Third Entropy with Potential Fractal Applications to CubeSat Technologies and Education

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Abstract. My third entropy formula, namely Ismail's entropy, $(H_{III}^{(\gamma,q,a,b)})$, is a novel generalization to Shannonian entropy with a visionary link to both long- and short-range interactions, (LRIs), (SRIs) respectively. The fractal dimension of $H_{III}^{(\gamma,q,a,b)}$, is identified in this paper. Following this, some potential fractal applications to CubeSat Technologies and Education are highlighted. The paper ends with closing remarks combined with some challenging open problems and the next phase of research.

Lithofacies identification based on wavelet transform, principal component analysis and K-means clustering

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Abstract. A method to extract lithologic interfaces and to identify lithofacies based on the continuous wavelet transform (CWT), principal component analysis (PCA) and K-means clustering is proposed. Well-logs which can reflect lithofacies are selected by correlation analysis of multiple well-logs and their principal components are determined by PCA of them. The CWT of the 1st principal component (PC) based on the Gaussian wavelet at a fixed scale is used to detect temporary interfaces which include lithologic interfaces as well as those reflecting intra-bed variations. Interval signal is formed by averaging the 1st PC values between adjacent interfaces. Accurate and practical lithologic interfaces are reset by considering variances of the interval signal to select interfaces using the difference moduli of the interval signal. The K-means clustering in the main PC space is effectively employed to classify and identify sedimentary lithofacies from well log data. The application to well log data indicates that the method is useful and practical in detecting lithological interfaces and identifying lithofacies.

Modelling of single lap functionally graded adhesive bonded joint using finite element analysis and machine learning

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Abstract. Functionally Graded Adhesive Joints (FGAJs) have strong and efficient mechanical properties that vary gradually along the overlap length. This leads to a reduction in shear and peel stress concentration at the joint edges and an increase in joint failure load. Finite Element Method (FEM) has been widely used for stress analysis and strength prediction of connected structures to obtain more accurate stress distribution. In this study, we propose a new application for predicting the strength of FGAJs efficiently and accurately based on FEM and an Artificial Neural Network (ANN) model that can accurately and effectively predict the stress distribution in FGAJs. The crack initiation critical parameters under different conditions will be obtained, and the relationship between the bonding material and the critical damage parameters will be explored. Reducing or eliminating stress singularity at the bonding ends will be also investigated with the intention to increase failure load.