

Science Newsletter

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Contents

INTRODUCTION:	2
I TOPICS	2
MACHINE LEARNING	2
SELF-SUPERVISED LEARNING	5
NATURAL LANGUAGE PROCESSING	7
DATA MINING	9
INTELLIGENT OPTIMIZATION	11
II CONCENTRATION	15
PHYSICS	15
MATERIALS	16
CHEMISTRY	18
BIOLOGY	19
III CALLING FOR PAPERS	22
ICCEA 2026(IEEE)	22
SMARTIOT 2026(IEEE)	23
AEIIS 2026(EI)	23
ICCTA 2026(IEEE)	25
ICSED 2026(EI)	26

Introduction:

There are 3 main elements in the Science Newsletter which is composed. In the first part, we list the most up to date papers about central issues for each discipline in our university, and they are provided with 5 subjects for a time. In the second part, there are papers from the top journals last month, and most of them are from Nature and Science. In the third part, we post information about calling papers for international conferences. Hopefully, some of the information in this manuscript may be useful for those who are dedicating to scientific career. Besides, the journals are also posted on the website of our library, and they are available to be accessed any time at <https://lib.jsut.edu.cn/2026/0409/c5474a210612/page.htm>. If there are any questions or suggestions, please send e-mails to ccy@jsut.edu.cn in no hesitate.

I Topics

The keywords of this month is **Computer Science**:

We post several papers which are related to the top concerned topics in researches on Computer Science. The papers are classified in 5 categories, and they are: **Machine Learning, Self-Supervised Learning, Natural Language Processing, Data Mining** and **Intelligent Optimization**. Also, the listed papers are all arranged in a descending sort of JCR impact factor. If you want full pages of these papers, please contact us for help.

MACHINE LEARNING

J Med Internet Res (impact factor: 6) 2 TOP


Applications of Natural Language Processing and Large Language Models for Social Determinants of Health: Systematic Review.

Swati Rajwal, Avinash Pandey, et. al

Abstract:

Social determinants of health (SDOH) are the social, economic, and environmental conditions that influence health outcomes. SDOH information is often embedded in unstructured text, such as notes in electronic health records and social media posts. Advances in natural language processing (NLP), including emergent large language

models (LLMs), offer opportunities to extract, analyze, and interpret SDOH expressions from free text for inclusion in downstream analyses. Existing literature on NLP applications for SDOH is dispersed across disciplines and characterized by methodological heterogeneity and variability in study quality and scope, complicating synthesis and cross-study comparison. This study aimed to examine the use of NLP, including LLMs, in SDOH research, and highlight gaps and future research directions. We conducted a systematic review following PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, searching 7 major databases for publications between 2014 and November 2025. We included journal and conference proceedings papers that applied NLP methods to identify, classify, extract, or predict SDOH from text. Three reviewers independently screened studies and extracted data; conflicts were resolved by two senior reviewers. We abstracted study metadata, dataset characteristics, NLP approaches, SDOH domains addressed, and NLP performance metrics. We also conducted risk-of-bias analyses and identified influential studies based on relative citation counts. 142 studies met the inclusion criteria. Nearly two-thirds (89/142, 62.7%) were published between 2023 and 2025, reflecting rapid recent growth. Most studies relied on electronic health records (93/142, 65.5%) and private datasets (81/142, 57.0%), while only 20.4% (29/142) used publicly available data. Commonly studied SDOH domains were housing instability (72/142, 50.7%), employment (65/142, 45.8%), and financial conditions (63/142, 44.4%); structural factors, such as immigration status (5/142, 3.5%), were rarely examined. Of studies that reported evaluation metrics, most focused on classification (26/83, 31.32%) or extraction (38/83, 45.7%), and used cross-sectional designs. Reported model performances were typically strong, with median F1-scores ranging roughly from 0.75 to 0.85 across model categories. Only 49 studies shared code, and fewer than half clearly described model interpretability or reproducibility practices. LLMs (including encoder-decoder models) appeared in 19.7% (28/142) of studies, highlighting emerging interest but also raising new concerns around transparency and governance. This review provides a timely synthesis of NLP and LLM applications across the SDOH research spectrum, addressing an important gap in a topic receiving increasing research attention. By comparing task formulations, data sources, and performance patterns, the review clarifies the research readiness of current approaches and reveals critical gaps. Our findings advance the field by highlighting the absence of a unified SDOH framework, uneven availability of public benchmarks, and limited evaluation of real-world deployment. Addressing these gaps through transparent, inclusive dataset development and implementation-focused evaluation is essential for translating NLP advances into equitable, real-world health impact. © Swati Rajwal, Avinash Kumar Pandey, Ziyuan Zhang, Yankai Chen, Michael X Liu, Sudeshna Das, Hannah Rogers, Abeed Sarker, Yunyu Xiao. Originally published in the Journal of Medical Internet Research (<https://www.jmir.org>).

J Med Internet Res (impact factor: 6) 2  TOP

Machine Learning in HIV Care and Antiretroviral Therapy: Systematic

Review.

Thamina Boudra, Arafate Idrissou, et. al

Abstract:

Artificial intelligence (AI) is expanding across various medical fields, with machine learning (ML) being increasingly used to enhance patient management in diagnosis, prevention, and therapeutic care. This study aims to provide an overview of ML applications in HIV care, focusing on real clinical data to improve health care for people living with HIV and on antiretroviral therapy, while highlighting unexplored areas. Following PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) 2020 reporting guidelines, we analyzed four databases: PubMed, Embase, IEEE, and Web of Science until August 31, 2024. The keywords used were: "Machine Learning," "HIV," and "Antiretroviral Therapy." We excluded from this review studies (1) that were not directly focused on HIV or those that did not apply ML to real clinical data, (2) that focused on pre-exposure prophylaxis, (3) studies involving in silico antiretroviral drug development, and (4) studies on the biological mechanisms underlying HIV diagnosis. Three experts (TB, MBVR, and JLR) screened each article independently. Overall, 476 studies were identified, and after eligibility assessment, 98 were finally analyzed in detail. Three experts (TB, MBVR, and JLR) identified 6 major categories of ML applications used in the clinical field of HIV: consideration of comorbidities for people living with HIV, predicting drug resistance of the virus, monitoring HIV infection itself, predicting treatment outcomes for people living with HIV, treatment adherence for people living with HIV, and treatment recommendation for clinicians. Random forests emerged as the most used algorithm with 17.49% (43/247), proving effective in identifying biomarkers of metabolic syndrome, genetic features of the HIV envelope, and predicting neurocognitive impairment. Random forests model has several advantages: (1) handle linear, nonlinear data, and missing data, (2) reduce overfitting compared to single trees, (3) robust to noise and outliers, (4) provide feature importance measures, and (5) good generalization ability. Support vector machines demonstrated strong abilities in analyzing the associations between HIV-1 genotypes and resistance phenotypes, predicting virological response to therapy based on HIV genotype, detecting mutations associated with HIV drug resistance, and enhancing computational predictions of resistance from genotype data. Logistic regression appears to be most powerful in predicting various treatment outcomes, including virological failure, adverse events, immune changes in people living with HIV receiving antiretrovirals, and biomarkers of mitochondrial toxicity. Depending on the field of application, some ML methods are more suitable and adapt better to certain HIV concerns. However, some areas, such as treatment recommendations, treatment adherence, and treatment optimization, still lack AI algorithms and need further exploration, such as therapeutical optimization. The development of new clinical decision-support systems for people living with HIV is the new challenge for the years ahead, and AI represents one of the most promising tools to address it. © Thamina Boudra, Arafate Idrissou,

Oussama Barakat, Siamak Davani, Marie-Blanche Valnet Rabier, Jennifer Lagoutte-Renosi. Originally published in the Journal of Medical Internet Research (<https://www.jmir.org>).

J Chem Inf Model (impact factor: 5.3) 2 ☒

Polymer-Agent: Large Language Model Agent for Polymer Design.

Vani Nigam, Achuth Chandrasekhar, et. al

Abstract:

On-demand polymer discovery is essential across various industries, from biomedical applications to reinforcement materials. Experiments with polymers involve a long trial-and-error process that consumes extensive resources. For these processes, machine learning has accelerated scientific discovery on the property-prediction and latent-space search fronts. However, laboratory researchers cannot readily access codes, and these models to extract individual structures and properties due to infrastructure limitations. We present a closed-loop polymer structure-property predictor integrated in a terminal for early-stage polymer discovery. The framework is powered by LLM reasoning to provide users with property prediction, property-guided polymer structure generation, and structure modification capabilities. The SMILES sequences are guided by the synthetic-accessibility score and the synthetic-complexity score to ensure that polymer generation is close to that of synthetically accessible monomer-level structures. This framework addresses the challenge of generating novel polymer structures for laboratory researchers, thereby providing computational insights into polymer research.

SELF-SUPERVISED LEARNING

Nat Commun (impact factor: 15.7) 1 ☒

A self-supervised electrocardiogram foundation model for empowering cardiovascular disease prediction and genetic factor discovery

Siyang Lin, Zhaoqi Li, et. al

Abstract:

Electrocardiogram (ECG) has been widely used in the diagnosis of cardiovascular disease (CVD). Current deep learning methods for CVD prediction using ECG often lack generalizability and interpretability, resulting in limited performance. Here, we have developed a self-supervised Electrocardiogram Large-scale Foundation Model (ECG-LFM) through pre-training over ten million 12-lead ECGs from multiple ECG datasets. To enhance ECG representation, ECG-LFM integrates contrastive learning with masked language modeling in a self-supervised manner, enabling the model to capture both global contextual information and fine-grained patterns within ECG

signals. It was fine-tuned to predict eight types of CVDs and achieved an average area under the receiver operating characteristic curve (AUROC) of 0.930 from multiple datasets, which demonstrates improved performance compared to existing methods. The important ECG-LFM derived features (EDFs) are able to represent known CVD biomarkers, indicating the high interpretability of ECG-LFM. Applications of the EDFs in genome-wide association study identified 24 significant single nucleotide polymorphisms (SNPs) (P -value $< 5 \times 10^{-8}$, LD $r^2 < 0.01$) associated with ECG, including 8 novel findings. The genetic causal effects of EDFs on the CVDs were evaluated by Mendelian randomization, indicating 2 CVDs and 4 EDFs having causal relationships. Overall, ECG-LFM provides accurate prediction for CVDs and novel genetic insights for ECG.

IEEE Trans Image Process (impact factor: 13.7) 1 [☒](#) [TOP](#)

SMFormer: Empowering Self-supervised Stereo Matching via Foundation Models and Data Augmentation.

Yun Wang, Zhengjie Yang, et al

Abstract:

Recent self-supervised stereo matching methods have made significant progress. They typically rely on the photometric consistency assumption, which presumes corresponding points across views share the same appearance. However, this assumption could be compromised by real-world disturbances, resulting in invalid supervisory signals and a significant accuracy gap compared to supervised methods. To address this issue, we propose SMFormer, a framework integrating more reliable self-supervision guided by the Vision Foundation Model (VFM) and data augmentation. We first incorporate the VFM with the Feature Pyramid Network (FPN), providing a discriminative and robust feature representation against disturbance in various scenarios. We then devise an effective data augmentation mechanism that ensures robustness to various transformations. The data augmentation mechanism explicitly enforces consistency between learned features and those influenced by illumination variations. Additionally, it regularizes the output consistency between disparity predictions of strong augmented samples and those generated from standard samples. Experiments on multiple mainstream benchmarks demonstrate that our SMFormer achieves state-of-the-art (SOTA) performance among self-supervised methods and even competes on par with supervised ones. Remarkably, in the challenging Booster benchmark, SMFormer even outperforms some SOTA supervised methods, such as CFNet.


IEEE J Biomed Health Inform (impact factor: 6.8) 2 [☒](#)

TFDF: Self-Supervised Time-Frequency Dynamic Fusion with Dual Constraints for Atrial Fibrillation Detection.

Abstract:

Atrial fibrillation (AF) is the most common paroxysmal cardiac arrhythmia, requiring continuous wearable electrocardiogram (ECG) monitoring for early detection. Supervised AF detection methods rely on extensive annotated ECG data, which is a costly barrier for real-world applications. Self-supervised learning (SSL) leverages unlabeled data for representation learning. However, existing SSL methods often fail to effectively model the cross-domain structural dependencies between temporal and spectral characteristics of AF under label-free conditions. To address this challenge, we propose a self-supervised Time-Frequency Dynamic Fusion (TFDF) with dual constraints for label-efficient AF detection. The TFDF takes temporal RR interval rhythm features as stable guidance and integrates multi-scale spectral representations of the RR and P-wave bands. A directional consistency constraint is introduced as the core objective to achieve adaptive cross-domain feature fusion, ensuring coherent latent representations between temporal and spectral modalities. Meanwhile, a cluster-guided constraint is designed to provide soft structural priors, stabilizing feature alignment during unsupervised pretraining. The TFDF was pretrained on the MIT-BIH AF Database and fine-tuned on the CPSC2018 dataset. When evaluated on the Chapman-Shaoxing 12-lead ECG dataset, TFDF achieved an average F1-score of approximately 0.920 and AUC of approximately 0.979, outperforming state-of-the-art SSL baselines. These results demonstrate that TFDF provides a generalizable and label-efficient solution for ECG-based AF detection.

NATURAL LANGUAGE PROCESSING

Sci Data (impact factor: 6.9) 2 

China's carbon peaking policy intensity dataset across national, provincial, municipal to county-level over 2021 to 2025

Mengmeng Zhen, Huimin Li, et. al

Abstract:

Policy texts serve as the carriers of policy content and hold unique value in the research of policy differences, policy diffusion, and inter-governmental relations. Carbon peaking is a key strategic goal for China to address global climate change. The carbon peaking implementation plan provides a carrier for exploring China's carbon peaking path and actions. However, at present, there is relatively little research on the policy text of the carbon peaking implementation plan. In this study, for the first time, a systematic collection of publicly available carbon peaking implementation plans in China was conducted, and the policy intensity was quantified by applying a

combination of natural language processing and machine learning methods. This dataset includes 316 national, provincial, municipal and county-level policies during the period from 2021 to 2025, and quantifies the policy intensity from the dimensions of three policy instruments: legal, market and supervision, as well as three policy targets: precise, general and vague. This dataset can help researchers further understand China's carbon peaking policy system and provide basic information for subsequent policy comparative studies and policy evaluations.

Comput Biol Med (impact factor: 6.3) 2 ☒

HeartBERT: A self-supervised ECG embedding model for efficient and effective medical signal analysis.

Saedeh Tahery, Fatemeh Hamid Akhlaghi, et. al

Abstract:

The analysis of Electrocardiogram (ECG) signals is critical for clinical applications, but current machine learning methods often face limitations when dealing with smaller datasets or intricate signal patterns. We introduce HeartBERT, a novel model designed to enhance ECG signal analysis using self-supervised learning. Drawing inspiration from Bidirectional Encoder Representations from Transformers (BERT) in natural language processing and leveraging the RoBERTa architecture, HeartBERT generates sophisticated embeddings optimized for biomedical signal analysis. To demonstrate the efficacy of the proposed model, two key downstream tasks are selected: sleep-stage classification and heartbeat classification. HeartBERT-based systems, utilizing bidirectional LSTM heads, are designed to tackle complex challenges. A series of practical experiments is conducted to reveal the superiority and advancements of HeartBERT, particularly in its ability to perform well with smaller training datasets. The code and data are publicly available at: <https://github.com/ecgResearch/HeartBert>. Copyright © 2026 Elsevier Ltd. All rights reserved.

PLoS One (impact factor: 2.6) 3 ☒

Evaluation and enhancement of suspected opioid overdose definitions in emergency medical services data using machine learning with natural language processing.


Peter Rock, Svetla Slavova, et. al

Abstract:

Fatal and non-fatal drug overdoses have evolved into a critical public health crisis, with over a 50% increase in the rate of fatal drug overdose since 2019. Emergency Medical Services (EMS) data has advantages over traditional emergency department data,

including timeliness and captured non-transport encounters. However, there is no consensus EMS definition for suspected opioid overdose (SOO), and currently implemented knowledge-based (KB) definition may miss ambiguous cases. Machine learning with natural language processing (ML-NLP) has the potential to enhance SOO identification. Secondary data originated from an oversampled dataset of 2,327 weighted encounters from Kentucky State EMS data (2018-2022). EMS experts manually reviewed the records and determined ground truth SOO labels. We examined five commonly accepted KB definitions, ranging from narrow to highly inclusive criteria, spanning from structured-only data to combinations of structured and unstructured data. ML-NLP models were developed considering various EMS data fields and KB indicators. The models and KB definitions were evaluated using sensitivity, specificity, accuracy, precision, and F1-score. The ML-NLP models outperformed the KB definitions with the structured plus KB model achieving the highest F-score (0.81). Structured-only approaches demonstrated low sensitivity (0.30-0.45). The inclusion of patient care narratives and additional structured fields improved model performance with the ML-NLP models demonstrating high sensitivity (89.1%) and precision (89.0%). Integrated ML-NLP approaches offer significant improvements in opioid overdose surveillance compared to structured-only, unstructured-only, and KB-only approaches. Future research should explore the generalizability of these models across different populations and geographic areas. Copyright: © 2026 Rock et al. This is an open access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

DATA MINING

Neural Netw (impact factor: 6.3) 2 


GeoMAE : Masking representation learning for spatio-temporal graph forecasting with missing values.

Songyu Ke, Chenyu Wu, Yuxuan Liang, et. al

Abstract

The ubiquity of missing data in urban intelligence systems, attributable to adverse environmental conditions and equipment failures, poses a significant challenge to the efficacy of downstream applications, notably in the realms of traffic forecasting and energy consumption prediction. Therefore, it is imperative to develop a robust spatio-temporal learning methodology capable of extracting meaningful insights from incomplete datasets. Despite the existence of methodologies for spatio-temporal graph forecasting in the presence of missing values, unresolved issues persist. Primarily, the

majority of extant research is predicated on time-series analysis, thereby neglecting the dynamic spatial correlations inherent in sensor networks. Additionally, the complexity of missing data patterns compounds the intricacy of the problem. Furthermore, the variability in maintenance conditions results in a significant fluctuation in the ratio and pattern of missing values, thereby challenging the generalizability of predictive models. In response to these challenges, this study introduces GeoMAE, an enhanced spatio-temporal representation learning model with a self-supervised auxiliary loss. The model comprises three principal components: an input preprocessing module, an attention-based spatio-temporal forecasting network (STAFN), and an auxiliary learning task, which inspired by Masking AutoEncoders to enhance the robustness of spatio-temporal representation learning. Empirical evaluations on real-world datasets demonstrate that GeoMAE significantly outperforms existing benchmarks, achieving up to 13.20% relative improvement in MAE over the best baseline models (e.g., 22.42 vs. 25.01 MAE at 25% missing rate). Copyright © 2026 Elsevier Ltd. All rights reserved.


Sci Rep (impact factor: 3.9) 3 

A unified privacy-preserving data mining framework with multi-noise injection and hybrid deep learning for robust privacy-utility trade-offs

R. Arun, K. Premalatha, et. al

Abstract

This paper introduces a single Privacy-Preserving Data Mining (PPDM) framework that attempts to balance the privacy-utility dilemma between privacy and utility of the data. This methodology will combine a stringent preprocessing pipeline, which uses k-NN imputation and Tomek Link SMOTE to balance the classes and a multi-regularized approach to feature selection (L1, L2, and Elastic Net) to boost the significance of the attributes. As an extensive multi-noise injection layer is required to offer strong privacy assurances, Laplace, Cauchy, t-distribution, intuitionistic fuzzy, exponential, speckle, and Gaussian perturbations are adopted. Studying is carried out through a hybrid 1D CNN-LSTM system, which was designed to identify patterns in perturbed high-dimensional data. Comparison between the Breast Cancer, Adult, and Customer Churn datasets demonstrate that the framework has high predictive accuracy and Kappa scores with a minimum variance in the data utility. Experimental findings show that such multi-layered construction has a better defence-in-depth mechanism than traditional PPDM pipelines, which are capable of ensuring strong performance in sensitive analytical conditions.


Sci Rep (impact factor: 3.9) 3 

Blockchain-based fairness preservation for IoT security implications of the verifier's dilemma

Abstract

Block verification is very important in order to get people to agree on blockchain systems that use Proof-of-Work (PoW). In platforms like Ethereum, miners don't get paid directly for verifying transactions. This is called the Verifier's Dilemma since miners have to choose between putting their computing power toward honest verification or more profitable mining activities. This paper provides a comprehensive analysis of the Verifier's Dilemma and its consequences for the fairness and efficacy of decentralized networks, especially those that provide nascent Internet of Things (IoT) security frameworks. Data from around 200,000 smart contracts has been utilized to model the costs of verification in the actual world. This data includes the CPU execution times of the contracts. Gaussian Mixture Models is used to improve these data distributions, and XGBoost is used to estimate CPU time from Used Gas values. This made it possible to simulate verification behavior in a realistic way. Three mitigation strategies—parallelization, deliberate invalid-block insertion, and the integration of ommer blocks are analyzed in order to determine their efficacy in diminishing miners' incentives to avoid verification. Our results show that the severity of the Verifier's Dilemma is greatly affected by the choice of mitigation method and other factors like miner hash power and ommer block rates. These findings not only help us understand how verification works in PoW blockchains, but they also help us design secure and durable blockchain-based IoT systems, where integrity, transparency, and strong consensus are all important.

INTELLIGENT OPTIMIZATION

Science (impact factor: 45.8) 1  TOP


A Survey on Autonomy-Induced Security Risks in Large Model-Based Agents.

Hang Su, Jun Luo, et. al

Abstract

Recent advances in large language models (LLMs) have catalyzed the rise of autonomous AI agents capable of perceiving, reasoning, and acting in dynamic, open-ended environments. These large-model agents mark a paradigm shift from static inference systems to interactive, memory-augmented entities. While these capabilities significantly expand the functional scope of AI, they also introduce qualitatively novel security risks—such as memory poisoning, tool misuse, reward hacking, and emergent misalignment—that extend beyond the threat models of conventional systems or

standalone LLMs. In this survey, we first examine the structural foundations and key capabilities that underpin increasing levels of agent autonomy, including long-term memory retention, modular tool use, recursive planning, and reflective reasoning. We then analyze the corresponding security vulnerabilities across the agent stack, identifying failure modes such as deferred decision hazards, irreversible tool chains, and deceptive behaviors arising from internal state drift or value misalignment. These risks are traced to architectural fragilities that emerge across perception, cognition, memory, and action modules. To address these challenges, we systematically review recent defense strategies deployed at different autonomy layers, including input sanitization, memory lifecycle control, constrained decision-making, structured tool invocation, and introspective reflection. While these techniques provide partial mitigation, most operate in isolation and lack the integrated coherence required to manage emergent, temporally extended, and cross-module threats. Motivated by these limitations, we introduce the Reflective Risk-Aware Agent Architecture (R2A2)-a unified cognitive framework grounded in Constrained Markov Decision Processes (CMDPs), which incorporates risk-aware world modeling, meta-policy adaptation, and joint reward-risk optimization to enable principled, proactive safety across the agent's decision-making loop. This survey provides a structured understanding of how autonomy reshapes the security landscape of intelligent systems and offers a blueprint for embedding safety as a core design principle in next-generation AI agents.

Insights Imaging (impact factor: 4.5) 2 

Enhancing radiology workflows through collaborative AI-assisted chest X-ray reporting using large vision-language models: a proof-of-concept study

Chantal Pellegrini, Ege Özsoy, et. al

Abstract:

Objectives

To evaluate whether collaborative assistance from an artificial intelligence-based tool that proposes partial radiology report content can improve reporting efficiency and radiologist satisfaction in chest X-ray interpretation, without compromising report quality.

Materials and methods

In a retrospective study, three radiologists reported 50 MIMIC-CXR chest X-rays twice, once with artificial intelligence (AI) assistance and once without. A specialized large vision-language model (LVLM) provided real-time suggestions, which could be accepted, modified or rejected. The study evaluated writing time, suggestion acceptance, report length and quality and assessed usability and suggestion quality on a 5-point Likert-scale questionnaire. Statistical analysis used paired t-tests or Wilcoxon signed-rank tests based on normality.

Results

AI assistance reduced mean writing time by 7.80% ($p = 0.08$), with significant gains for


complex reports (18.34%, $p < 0.001$). Efficiency improvements correlated with suggestion acceptance and were user-dependent, with benefits up to 27.24% (CI: [17.34, 37.14], $p < 0.001$) for radiologists with high acceptance. Report quality and length remained stable, indicating preserved diagnostic accuracy without degradation. Radiologists rated the tool highly for ease of use (mean: 4.33) and desired regular use (mean: 4), noting minimal errors (mean: 1.67).

Conclusion

Collaborative AI assistance with an LVLMM can improve reporting efficiency if well adopted, particularly for complex cases, without compromising quality, and is well-received by radiologists. These exploratory findings suggest potential to optimize radiology workflows through collaborative reporting and warrant prospective validation in clinical settings.

Critical relevance statement

This study critically evaluates a collaborative AI-assisted reporting tool for chest X-rays, demonstrating its potential to enhance radiologist efficiency without compromising automatically measured report quality, thereby demonstrating a potential path for practical integration of AI into clinical radiology workflows.

PLoS One (impact factor: 2.6) 3 

Behavioral mechanisms and learning outcomes of University Students' GAI-assisted learning in human-AI collaboration.

Yixuan Zeng, Jing Kang, et. al

Abstract:

With the rapid advancement of Generative Artificial Intelligence (GAI) technologies, their integration into higher education is becoming increasingly widespread. This transformation is not only reshaping students' learning approaches but also redefining the collaborative dynamics between humans and AI. Based on the triadic framework of Exploration-Exploitation-Adaptation, this empirical study (207 valid questionnaires from Chinese university students, analyzed via structural equation modeling) investigates the behavioral mechanisms and pathways influencing learning outcomes among university students engaged in GAI-assisted learning. It examines how role adaptation, self-efficacy, task-technology fit, and institutional support affect learners' exploration and exploitation behaviors, and how these behaviors in turn impact learning effect. The findings reveal that role adaptation and self-efficacy are the primary internal drivers of GAI-related learning behaviors, while institutional support and task-technology fit serve as essential external enablers. Both exploration and exploitation behaviors significantly enhance learning outcomes, with exploitation showing a more pronounced effect. The model demonstrates good fit and significant path relationships among variables. While the results are consistent with the proposed adaptation-exploration/exploitation-effectiveness pathway, they only reflect correlational evidence and do not establish a causal mechanism. Theoretically, this study enriches insights into

human-AI collaboration in higher education. Practically, it offers guidance for the optimization of intelligent educational systems and the design of behavior-guided strategies. Copyright: © 2026 Zeng et al. This is an open access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

II Concentration

PHYSICS

Experimental evidence of a liquid-liquid critical point in supercooled water

Seonju You, Marjorie Ladd-Parada, et al.

Abstract

The search for the liquid-liquid critical point in supercooled water is challenging owing to rapid crystallization. We studied supercooled water at timescales before ice formation by heating high- and low-density amorphous ices using infrared ultrafast laser pulses, followed by x-ray scattering. By varying the pump laser fluence, we accessed liquid states straddling the predicted critical point. We observed a crossover from a discontinuous to a continuous transition at which broad and slow structural variations occurred, consistent with critical fluctuations and slowing down. We also observed a rapid increase in the heat capacity indicating a critical divergence at 210 ± 8 K coincident with enhanced density fluctuations. These results suggest that our experiments have directly probed the vicinity of a critical point in supercooled water.

Superluminal correlations in ensembles of optical phase singularities

Bucher, T., Gorlach, A., Niedermayr, et al.

Abstract

Phase singularities—points carrying quantized topological charge—are universal features found across diverse wave systems from superfluids and superconductors to acoustic and optical fields^{1,2,3,4}. Ensembles of these singularities exhibit distance correlations resembling particles in liquids^{5,6,7,8}, extensively studied for their role in exotic material phases^{9,10,11}. By contrast, the full correlations in phase space that govern the system evolution have remained unexplored and experimentally inaccessible. Here we directly measure the ultrafast dynamics of optical singularity ensembles, capturing their full phase-space correlations, presenting the joint distance–velocity distribution. Our observations show a breakdown of the particle-singularity analogy¹²: phase singularities accelerate towards formally divergent velocities in the moment before annihilation^{7,13,14}, indicated by measurements of velocities exceeding the speed of light. These apparent superluminal velocities are paradoxically amplified by the slow group velocity of hyperbolic phonon polaritons in our material platform, hexagonal boron nitride membranes^{15,16,17,18,19}. We demonstrate these phenomena using combined hardware and algorithmic advances in ultrafast electron microscopy^{18,20,21,22,23,24,25},

achieving spatial and temporal resolutions, each an order of magnitude below the polaritonic wavelength and cycle period. Our findings deepen our understanding of phase singularities and their universality, enabling to probe topological defect dynamics at previously unattainable timescales.

Magnetic resonance control of spin-correlated radical pair dynamics in vivo

Burd, Shaun C., Bagheri, et al.

Abstract

Magnetic fields can influence reactions involving spin-correlated radical pairs (SCRPs)^{1,2}. This provides a mechanism by which both static and time-varying magnetic fields can affect living systems at the biomolecular level³. However, an engineered SCRPs system conferring magnetic sensitivity to a non-native biochemical process in a multicellular organism has not yet been demonstrated. Here we demonstrate control of SCRPs dynamics using magnetic resonance in a live transgenic animal. We show that the emission of various red fluorescent proteins (RFPs), in the presence of a flavin cofactor, can be modified by a combination of static and radiofrequency magnetic fields applied near the electron spin resonance frequency. This effect was measured at room temperature both in vitro and in the nematode *Caenorhabditis elegans*, genetically modified to express the RFP mScarlet⁴. These observations suggest that the magnetic field effects measured in RFP-flavin systems⁵ are due to quantum-correlated radical pairs with a coherence time larger than 4 ns. Our experiments demonstrate that radiofrequency magnetic fields can influence dynamics of reactions involving SCRPs in vivo, potentially enabling new methods for remotely controlling biomolecular processes, such as gene expression, and suggest broader potential for quantum tools in biology.

MATERIALS

Super-nano domains enable strength-conductivity synergy in copper foils

Zhao Cheng, Linhai Liu, et al.

Abstract

The development of copper foils that simultaneously exhibit ultrahigh strength, high electrical conductivity, and thermal stability remains a major challenge for advanced electronics and energy storage systems. We report a 10-micrometer-thick copper foil featuring nanoscale grains and periodically distributed gradient super-nano domains

(approximately 3 nanometers in size) throughout its thickness that was produced by an industrially scalable electrodeposition process. This copper foil demonstrates a combination of approximately 900-megapascal tensile strength, 90% standard electrical conductivity, and exceptional thermal stability. These superior properties originate from a dual strengthening-stabilization mechanism in which the periodically distributed super-nano domains both enhance strength and stabilize grain boundaries. This strategy not only advances copper foil technology but also provides a general design pathway for developing other scalable, high-performance metallic materials.

Ferroelectricity in atomic-scale titanium dioxide dielectric films

Koushik Das, Kate Reidy, et al.

Abstract

Ferroelectricity at atomic-scale thickness would have important applications in next-generation electronics. Here, we report that a ferroelectric phase can be stabilized in titanium dioxide (TiO₂) films, a commonly known dielectric that is widely used in semiconductor technologies, by reducing thickness to <3 nanometers. Importantly, this ferroelectricity persists down to 1-nanometer thickness, approximately twice the unit-cell dimension. This thickness-dependent dielectric-to-ferroelectric phase transition demonstrates that an otherwise centrosymmetric, nonferroic fluorite-structure oxide can undergo structural inversion-symmetry breaking and exhibit voltage-switchable polarization. Atomic layer deposition–based low-temperature (<400°C) synthesis and the stability of this ferroelectricity on both silicon (Si) and amorphous surfaces [such as amorphous silicon dioxide (SiO₂) and amorphous carbon films] demonstrate the feasibility of integration with a large variety of materials.

Superconductivity and electronic structures of nickelate thin film superstructures

Nie, Zihao, Li, et al.

Abstract

Ruddlesden–Popper nickelates have emerged as a crucial platform for exploring the mechanisms of high-temperature superconductivity^{1,2,3,4,5,6,7}. However, the Fermi surface topology required for superconductivity remains unknown. Here, beyond the superconducting pure bilayer (2222) phase, we report the thin film growth and ambient-pressure superconductivity of monolayer–bilayer (1212) and bilayer–trilayer (2323) superstructures, together with the absence of superconductivity in monolayer–trilayer (1313) superstructure, under identical compressive epitaxial strain. The onset superconducting transition temperatures range from 46 K to 50 K, exceeding the McMillan limit. Angle-resolved photoemission spectroscopy shows key Fermi surface differences in these atomically engineered structures. In superconducting 1212 and

2222 films, a dispersive hole-like band (γ^{II}) forms an underlying Fermi pocket, surrounding the Brillouin zone corner. By contrast, the top of the flat band (γ^{III}) is observed at about 70 meV below E_F in the non-superconducting 1313 films. Particularly, the superconducting 2323 films host both γ^{II} and γ^{III} bands. The polarization dependence of the γ bands reveals their Ni $\backslash(\{d\}_{\{z\}^{\{2\}}}\backslash)$ origin. Our findings expand the family of ambient-pressure nickelate superconductors and establish a connection between structural configuration, electronic structure and the emergence of superconductivity in nickelates.

CHEMISTRY

Modular enantioselective photocatalysts from privileged pybox scaffolds

Riley M. Kelch, Lea Hämmerling, et. al

Abstract

Modern organic synthesis relies upon the availability of chiral catalysts to control the stereochemistry of bond-forming reactions. Several families of chiral catalysts have become recognized as “privileged” structures because of their notable generality for diverse transformations with different reaction mechanisms. However, examples of highly enantioselective photocatalyst structures remain scarce. We have designed a family of enantioselective photocatalysts by modifying the structures of privileged pyridine bis(oxazoline) complexes with electron-donating carbazole units. The chiral ligands are accessible through a three-step synthetic sequence starting from commercially available chiral pool materials, and their charge-transfer photochemistry can be rationally tuned to optimize photocatalytic activity. We demonstrate the generality of these new chiral photocatalyst structures in a series of three model asymmetric reactions, which includes both photoredox and excited-state photoreactions.

Atomic-resolution imaging of gold species at organic liquid-solid interfaces

Sam Sullivan-Allsop, Nick Clark, et. al

Abstract

The structure and dynamics of adsorbed atoms (adatoms) at solid-liquid interfaces determine the performance of advanced catalysts, electrochemical devices, molecular separation technologies, and metal extraction from waste streams. However, in situ investigations of atomically dispersed metals in various chemical environments have been prevented by insufficient imaging resolution and solvent incompatibility. In this

study, we combined a specimen design that provides atomic resolution in liquid-phase electron microscopy with deep learning-enabled analysis to explore the interactions between gold adatoms, graphite support, and the solvent collectively. We tracked the locations of >10⁶ graphite-supported gold adatoms, dimers, and larger clusters in five solvents. Although their initial atomic dispersion was determined by the solvent polarity, fast drying kinetics at low temperature was required for optimizing catalytic performance.

Bromine-mediated electrochemical propane dehydrogenation by self-assembled ionic liquid-SnO₂ hollow spheres

Jiarui Yang, Zhihao Pei, et. al

Abstract

Conventional thermal propane dehydrogenation (PDH) faces several notable drawbacks, including high energy requirements, coking-induced catalyst deactivation, and the need for product separation. An electrocatalytic approach, using self-assembled ionic liquid (IL)-tin dioxide (SnO₂) hollow spheres as the electrocatalyst, enables efficient PDH at ambient temperature. In this process, bromopropane formed in the anolyte from propane reacts with hydroxyl anions from the cathode to yield propene. The propene selectivity exceeds 98%, and the continuous production of high-purity (>99%) propene gas from the anolyte eliminates the need for downstream separation. The IL-SnO₂ catalyst maintains its activity and selectivity for more than 6000 hours, with a small voltage increase rate of 3.16 microvolts per hour. Mechanistic studies suggest that the IL layer enhances propane adsorption and facilitates the carbon-hydrogen bond activation step on adjacent Sn sites. After reaction, the IL layer promotes propene desorption and suppresses deep dehydrogenation.

BIOLOGY

Sex effects on gene expression across the human cerebral cortex at cell type resolution

Alex R. DeCasien, Pavan Auluck, et al.

Abstract

Sex differences in neurodevelopmental, psychiatric, and neurodegenerative disease susceptibility may arise from sex chromosome and hormonal influences on cell type-specific gene expression. We present a single-cell transcriptomic analysis of adult

human cortex performed using 169 samples from 15 females and 15 males (age 26 to 78 years) across six regions selected according to their sex-biased volumes. Sex-based analysis identified the strongest differences in the fusiform cortex, glia, and excitatory neurons and among sex-chromosome genes. More than 3000 genes showed sex-biased expression, including 133 with consistent effects across regions and cell types. Core autosomal signatures linked sex differences to cortical architecture, hormone-responsive regulation, and genetic risk for sex-biased brain disorders. This study advances our understanding of sex differences in human brains and provides a valuable resource to support future research.

Chromothripsis and ecDNA initiated by N4BP2 nuclease fragmentation of cytoplasm-exposed chromosomes

Ksenia Krupina, Alexander Goginashvili, et. al

Abstract

Genome instability, including chromothripsis, is a hallmark of cancer. Cancer cells frequently contain micronuclei—small, nucleus-like structures formed by chromosome missegregation—that are susceptible to rupture, exposing chromatin to cytoplasmic nucleases. Through an unbiased, imaging-based small interfering RNA screen that targeted all 204 known and putative human nucleases, we identified a previously uncharacterized cytoplasmic endonuclease, NEDD4-binding protein 2 (N4BP2), that enters ruptured micronuclei and initiates DNA damage, leading to chromosome fragmentation. N4BP2 promoted genome rearrangements (including chromothripsis), formation of extrachromosomal DNA (ecDNA) in drug-induced gene amplification, tumorigenesis, and tumor cell proliferation in an induced model of human high-grade glioma. Analysis of more than 10,000 human cancer genomes revealed elevated N4BP2 expression to be predictive of chromothripsis and copy number amplifications, including ecDNA.

Rapid evolution predicts demographic recovery after extreme drought

Daniel N Anstett, Julia Anstett, Seema N Sheth, et. al

Abstract

Populations that are declining as a result of climate change may need to evolve to persist. Although evolutionary rescue has been demonstrated in theory and in the laboratory, its relevance to natural populations facing climate change remains unknown. Here we link rapid evolution and population dynamics in scarlet monkeyflower, *Mimulus cardinalis*, during exceptional drought. We leverage whole-genome sequencing across 55 populations to identify climate-associated loci. Simultaneously we track demography and allele frequency change throughout the

drought. We establish range-wide population decline during the drought, geographically variable rapid evolution, and variable population recovery that is predictable by standing genetic variation in, and rapid evolution at, climate-associated loci. These findings demonstrate the possibility of evolutionary rescue in the wild, showing that genetic variation at adaptive, but not neutral, loci predicts population recovery.

III Calling for papers

ICCEA 2026(IEEE)

Submission deadline: May 8, 2026
Conference date: May 15, 2026 - May 17, 2026
Full name: International Conference on Computer Engineering and Application
Location: Chongqing, China

Welcome to the official website of 2026 7th International Conference on Computer Engineering and Application (ICCEA 2026).

2026 7th International Conference on Computer Engineering and Application (ICCEA 2026) will be held on May 15-17, 2026 in Chongqing, China. ICCEA 2026 is a major academic event focused on computer engineering and applications. The conference aims to provide a platform for academics, researchers, engineers and industry professionals from all over the world to share their latest research findings, experiences and innovative ideas. Participants will have the opportunity to listen to and participate in high-quality academic presentations, technical presentations and panel discussions to promote knowledge dissemination and technological innovation between academia and industry, and to promote the development of computer engineering and applications. Experts and scholars interested in these fields are welcome to attend and contribute their wisdom and experience to the conference.

Call for papers:

The topics of interest for submission include, but are not limited to:

1. Computer Science and Engineering
2. Application Technology
3. Information Science
4. Industrial Engineering
5. Electronic Engineering
6. Software Engineering
7. Intelligent System
8. Image Processing
9. Control Technology
10. Computer Network and Security
11. Computer Graphics and Image Processing
12. Other related topics

SMARTIoT 2026(IEEE)

Submission deadline: May 1, 2026
Conference date: Aug 21, 2026 - Aug 24, 2026
Full name: International Conference on Smart Internet of Things
Location: Shenyang China

Internet of Things (IoT) plays an important role in the current and future generation of information, network, and communication developing and applications. Smart IoT is an exciting emerging research field that has great potential to transform both our understanding of fundamental computer science principles and our standard of living. IoT is being employed in more and more areas making “Everything Smart”, such as smart home, smart city, intelligent transportation, environment monitoring, security systems, and advanced manufacturing. IEEE International Conference on Smart Internet of Things (IEEE SmartIoT) focuses on these challenges.

Topics of Interest :

- Track 1. IoT Sensing, monitoring, networking and routing
- Track 2. Big data analysis and Cloud computing
- Track 3. Edge computing/Fog computing
- Track 4. Smart cities, intelligent transportation and internet of vehicles
- Track 5. Artificial Intelligence, machine learning and evolutionary computing
- Track 6. Social networks, multimedia and mobile computing
- Track 7. Blockchain and emerging research or technologies
- Track 8. Industrial 4.0 and Industrial IoT
- Track 9. Control and decision making for smart IoT or CPS
- Track 10. Security and privacy for smart IoT or CPS

AEIIS 2026(EI)

Submission deadline: May 8, 2026
Conference date: May 15, 2026 - May 17, 2026
Full name: International Conference on Aerospace Electronics Information and Intelligent Systems
Location: Zhengzhou, China

2026 International Conference on Aerospace Electronics Information and Intelligent Systems (AEIIS 2026) will be held in Zhengzhou, China from May 15 to 17, 2026, focusing on research areas such as Aerospace Science, Artificial Intelligence and Information Systems; it aims to establish an international platform for collaboration and exchange where experts, scholars, and industry representatives can share research achievements, discuss existing challenges, and explore cutting-

edge technologies in aerospace and intelligent systems. Scholars worldwide are cordially invited to actively contribute submissions and participate in the conference.

This conference seeks to foster international academic exchange and collaboration, providing delegates with a platform to present research outcomes and explore cutting-edge advancements and future trends in the discipline; we cordially invite researchers, engineers, and academic peers worldwide to join us at this prestigious gathering, collectively advancing environmental monitoring and ecological restoration to address emerging technological challenges and serve societal needs.

Call for Papers:

The topics of interest for submission include, but are not limited to:

● Track 1: Aerospace Electronic Information Systems

- Aerospace Electronic Information Systems
- Avionics Systems and Airborne Electronics
- Radio Communication Technology
-

● Track 2: Photoelectric Sensing and Imaging Technology

- Photoelectric Detection and Sensing
- Optical Imaging Technology
- Laser Detection and Lidar
-

● Track 3: Remote Sensing, Radar, and Space Exploration

- Satellite Remote Sensing Technology
- Remote Sensing Data Processing and Applications
- Radar Detection and Imaging
-

● Track 4: Signal and Image Processing

- Signal Processing Theory and Methods
- Image Processing and Analysis
- Target Detection and Recognition
-

● Track 5: Navigation, Positioning, and Timing Technology

- Inertial Navigation Systems
- Autonomous Navigation Algorithms
- Integrated Navigation Technology
-

● Track 6: Intelligent Systems and Unmanned Platforms

- Intelligent Sensing Systems
- Unmanned Systems and Autonomous Control
- UAV Perception and Navigation
-

ICCTA 2026(IEEE)

Submission deadline: May 10, 2026
Conference date: Jun 17, 2026 - Jun 19, 2026
Full name: International Conference on Computer Technology Applications
Location: Vienna, Austria

The 12th International Conference on Computer Technology Applications (ICCTA 2026) will be held on June 17-19, 2026 in Vienna, Austria, organized by FH JOANNEUM University of Applied Sciences, Austria.

ICCTA is a premier forum for presenting new advances and research results, as well as exchanging experiences, in the field of computer technology applications. The conference welcomes contributions that promote the exchange of ideas and encourage international dialogue among academics, researchers, and industry professionals worldwide. Please submit your contribution and take part in making ICCTA a successful event.

You can be encouraged by the fact that the best presentation award will be granted. View History

***Call for papers:**

Topic about:

Track 1: Software Engineering

Chair: Elmar Krainz, FH JOANNEUM University of Applied Sciences, Austria

Requirements Engineering

Software Architecture and Design

Modern Programming Techniques

Track 2: Computer Applications

Operating Systems

Cyber-Physical Systems

Information Systems

Track 3: Computational Intelligence and AI techniques

Chair: Rahmat Ullah, University of Essex, UK

Chair: Wan Mimi Diyana Wan Zaki, University Kebangsaan, Malaysia

Algorithms and Protocols

Parallel and Distributed Computing

Big Data Analysis

Track 4: Smart Production

Chair: Bianca Wiesmayr, Johannes Kepler University Linz, Austria

Business Digitalisation

IT-based Business Models

Optimisation of Product design, Manufacturing and Services

ICSED 2026(EI)

Submission deadline: May 15, 2026
Conference date: Oct 24, 2026 - Oct 26, 2026
Full name: International Conference on Software Engineering and Development
Location: Okinawa, Japan

2026 8th International Conference on Software Engineering and Development (ICSED 2026) aims to provide a forum for researchers, practitioners, and professionals from the industry, academia and government to discourse on research and development, professional practice in Software Engineering and Development. ICSED 2017 was held in Bangkok, Thailand, ICSED 2018 was held in Chengdu, China, ICSED 2021 and ICSED 2022 were held online because of the covid-19, ICSED 2023 was held online and offline combination in Singapore. ICSED 2024 was held in Hong Kong during May 29-31, 2024. ICSED 2025 was held in Bangkok, Thailand during October 29-31, 2025. ICSED 2026 will be held in University of the Ryukyus, Okinawa, Japan during October 24-26, 2026.

ICSED 2026 is sponsored by University of the Ryukyus, ACM Singapore Chapter and Singapore Institute of Electronics.

Submissions will be peer reviewed by conference committees members, and accepted and registered papers will be published in the ICSED 2026 Conference Proceedings , which will be submitted for indexing to Ei Compendex, Scopus.

Topics of interest

Track 1: Artificial Intelligence and Machine Learning in Software Development

Track 2. Software Architecture and Design

Track 3. Agile, DevOps, and Continuous Delivery

Track 4. Software Testing and Quality Assurance

Track 5. Cloud Computing and Distributed Systems

Track 6. Cybersecurity in Software Engineering

Track 7. Internet of Things (IoT) and Embedded Systems

Track 8. Blockchain and Software Development

Track 9. Human-Computer Interaction and UX/UI Design

Track 10. Emerging Trends in Software Engineering