Science Newsletter

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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 **Mechanical engineering**:
We post several papers which are related to the top concerned topics in researches on Mechanical engineering. The papers are classified in 5 categories, and they are: **Robotics, Tribology, Mechatronics, Automatic control** and **Exoskeleton**. 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.

ROBOTICS

ACS NanoIF 17.3 1 区 TOP

Self-Healing Magnetic Materials for Next-Generation Soft Electronics and Robotics.

Xuan Zhang, Eddy Pang, et. al

Abstract:
Bioinspired magnetic soft materials and devices have been widely developed for human-machine interaction, robotic technologies, wearable electronics, and energy harvesting. However, accidental damage and environmental changes often limit their operational durability, giving rise to the need for frequent replacements. To address this issue, this Review emphasizes the importance and advantages of integrating self-

healing capabilities into flexible magnetic devices. We comparatively analyze five core healing mechanisms of the existing self-healing magnetic materials. Subsequently, their design strategies and key properties are outlined according to the major polymer matrices (gels, elastomers, and other polymeric networks). We also discuss the structure-property trade-offs across particle-filled and particle-free material systems, as well as their potential applications in sensing, robotics, energy storage/conversion, and implantable biomedicine. Despite these advances, critical challenges still remain for current self-healing magnetic soft materials and devices in terms of the trade-off between magnetic performance and self-healing capability, durability under extreme environments, long-term sustainability, and commercialization applications. Finally, this Review summarizes these challenges and presents future perspectives of such materials and devices for the fields of intelligent soft electronics and robotics.© 2026 American Chemical Society.

iScienceIF 4.5 2 ☒

How far are vision-free medical robots from achieving trustworthy embodied intelligence?

Jiacheng Liu, Hong Zhang, et. al

Abstract:
Embodied Intelligence (EI) is rapidly reshaping the field of robotic surgery, enabling unprecedented levels of clinical precision while liberating surgeons from excessive cognitive and physical burdens. However, for "vision-free" surgical robots incapable of integrating direct visual sensing-such as endovascular robots and untethered swarms-their persistent reliance on external medical imaging fundamentally impedes their evolution toward safe and trustworthy EI-surgery.© 2026 The Author(s).

Obes SurgIF 3.4 3 ☒

Robotic Assisted SADI-S Using Hugo™–RAS: Step-by-Step Technique

Jorge Febré Sánchez, Christian Esteo Verdú, et. al

Abstract:
Background
This video provides a step-by-step guide on performing SADI-S using robotic-assisted surgery with Hugo-RAS. While this technique has been previously described, the novelty of this video lies in the use of the innovative open console modular system, along with our preferred docking approach. Currently, there is no available literature on how to perform a robotic-assisted SADI-S using Hugo-RAS. We hope our guide helps other surgeons using the platform to implement the procedure.

Objectives
Describe how we perform a robotic assisted SADI-S including patient's positioning,

robotic docking, instruments and step-by-step surgical technique.

Methods

This is a single case (n = 1) presented for demostrative purposes. In January of 2025, a robotic assisted SADI-S using Hugo-RAS was performed on a 57-year-old female patient with hypertension (HTA), obstructive sleep apnea (OSA) and type 2 diabetes (DM2) with suboptimal glycaemic control despite medical therapy. Body mass index prior to surgery was 44. Preoperative tests included hepatobiliary ultrasound, upper endoscopy and barium swallow which showed no evidence of hiatal hernia or gastroesophageal reflux. The patient was examined by an endocrinologist, psychologist, pneumologist and anaesthesiologist prior to surgery. Preoperative nutritional preparation consisted of a supervised very-low-calorie diet (VLCD).

The procedure was conducted using three robotic arms. Two 8 mm trocars for robotic instruments and one 12 mm for the optic. An additional 12 mm trocar was used for laparoscopic assistance. The patient was positioned in anti-Trendelenburg tilt of approximately 15°. The common limb was measured laparoscopically from the ileocecal valve, ensuring a length of 300 cm. We begin by measuring the common limb laparoscopically to avoid patient repositioning, which would require docking and undocking of the robotic platform, thereby reducing operative time and optimizing the surgical workflow.

Following this, robotic arms were docked at appropriate angles, and the procedure was continued robotically. Sleeve gastrectomy was performed using a 36 F Faucher tube as a guide, employing 60 mm purple cartridges of Signia® stapler, with the first staple fired 3–4 cm proximal to the pylorus. Duodeno-ileal anastomosis was created manually end-to-side with a 3–0 barbed slow-absorbing suture, in two posterior and two anterior layers. Anastomotic integrity was verified with methylene blue testing, and vascular perfusion of the duodeno-ileal anastomosis was assessed using indocyanine green (IGC) fluorescence. Total operative time was 116 min, including 10 min for laparoscopic small bowel measurment and 8 min for robotic docking.

Results

No major complications occurred during surgery. The patient was discharged on. postoperative day two without a drain or early complications, tolerating a liquid diet. After 18-month follow-up, the patient had achieved 75% excess weight loss, with no evidence of nutritional deficiencies. Regarding comorbidities, OSA resolved, and HTA and DM2 were under control with decreased requirements for antihypertensive and glucose-lowering medications. Currently, the patient continues follow-up by the bariatric surgery and endocrinology teams, with routine clinical assessment and laboratory evaluation every six months.

Conclusions

We consider SADI-S using Hugo-RAS robotic platform safe and feasible. This video provides a clear Step-by-Step approach which can help other surgical teams replicate our technique.

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TRIBOLOGY

SmallIF 11.8 2 ☒ TOP

A Self-Driven Superlubricated Capsule Enabled by a Chemical-Fluidic-Mechanical Cascade for Effective Gastric Fluid Sampling.

Keyi Huang, Wenze Ren, et. al

Abstract:

Gastrointestinal fluid sampling plays a pivotal role in early detection of gastrointestinal diseases, yet conventional methods are invasive, uncomfortable, and susceptible to sample contamination. Here, we developed a self-driven superlubricated capsule (GFSCap) that achieved autonomous gastric fluid sampling and sealing. A chemical-fluidic-mechanical cascade was implemented, in which dissolution of a trigger film opened the sampling pathway, while a mechanically precompressed collector facilitated fluid uptake. Subsequently, hydrogel swelling drove a piston to close the sampling channels and retain the collected sample. Furthermore, the capsule surface was modified with a superlubricated copolymer, which substantially reduced interfacial friction and cell adhesion. Under in vitro conditions, the GFSCap collected approximately 230 mg of simulated gastric fluid within 30 min, while the proof-of-concept in vivo experiment in an anesthetized pig yielded approximately 127 mg of native gastric fluid. Simulated esophageal retrieval experiments showed that the sealed capsule retained most of the collected sample. Additionally, DNA recovery remained above 93.8% after exposure to individual GFSCap material extracts and reached 98.7% after exposure to combined material extracts, supporting the compatibility of the GFSCap material system with representative downstream nucleic acid analysis. Overall, the GFSCap provided a self-driven platform integrating gastric fluid sampling, sealing, lubrication, and controllable retrieval.© 2026 Wiley‐VCH GmbH.

ACS SensIF 10.9 1 ☒

Ordered Anti-Restacking Three-Dimensional Ti3C2Tx MXene Networks on Silicon Microcone Arrays via Template-Directed Assembly for Highly Efficient Room-Temperature Ammonia Sensing.

Ran Xiong, Xianwu Xu, et al

Abstract:

The realization of room-temperature, low-power chemiresistive ammonia (NH3) sensors is highly desirable yet remains a formidable challenge, primarily hindered by the high activation energy of conventional metal oxides and the severe nanosheet restacking of emerging 2D MXene. Here, we propose a morphology-templated

assembly strategy to construct an antirestacking, highly accessible 3D Ti3C2Tx MXene sensing network using ordered silicon microcone arrays as 3D scaffolds. This architectural design effectively prevents the face-to-face self-assembly of 2D MXene sheets, establishing unobstructed vertical channels for rapid gas molecule transport and maximizing the exposure of active terminal sites. Consequently, the optimized room-temperature sensor delivers an exceptional gas-sensing performance, featuring a broad dynamic range (100-10,000 ppm) and a 10.2-fold response enhancement toward 10,000 ppm NH3 compared to the device without microcones. Moreover, the sensor exhibits rapid signaling kinetics (120 s), excellent selectivity, and durable reliability. This work offers a controllable three-dimensional Ti3C2Tx sensing-layer design for low-power, room-temperature NH3 leakage monitoring.© 2026 American Chemical Society.

Front Bioeng BiotechnolIF 5.8 3 ☒

A framework to assess mechano-tribological, structural and biochemical properties of articular cartilage.

Manoj Rajankunte Mahadeshwara, Hemant Pandit, et. al

Abstract:

Articular cartilage (AC) is a specialized tissue with a unique biphasic structure that enables the high load-bearing ability and near-frictionless joint motion. The macroscale mechanical and tribological behavior of AC is dominated by interstitial fluid pressurization. Hence, microscale studies provide an opportunity to characterise local mechanical, tribological, structural and biochemical properties that may otherwise be limited during macroscale evaluation.This study investigates an integrated assessment of the microscale surface properties of bovine AC by combining microscale indentation and reciprocating sliding experiments alongside Raman spectroscopy, scanning electron microscopy, and histomorphometry.Microscale mechanical testing revealed a uniform effective instantaneous modulus at the surface with varying load (ranging 0.43-0.51 MPa, p = 0.452) and varying indentation rate (ranging 0.38-0.46 MPa, p = 0.621), along with compressive strain dependent viscoelastic behavior. Tribological testing revealed low microscale coefficients of friction with varying load (ranging 0.001-0.036, p = 0.005) and varying speed (ranging 0.002-0.047, p = 0.012). Further, zonal characterization showed uniquely arranged ECM orientation patterns across superficial, middle, and deep zones alongside depth-dependent variations in cellular attributes (cellular density, orientation, and proteoglycan intensity) and biochemical constituents (collagen organisation and proteoglycan distribution).Collectively, these findings highlight the feasibility of combining microscale mechano-tribological testing with structural and biochemical characterisation to assess local properties of AC. The framework demonstrates load and rate-dependent functional behaviour at the surface and cross-sectional variations in cartilage structure and composition that are often dominated by interstitial fluid pressurisation during macroscale evaluation.Copyright

© 2026 Rajankunte Mahadeshwara, Pandit, Al-Jawad, Hall, Bryant and El-Gendy.

J Neuroeng RehabilF 6 1 ☒

Temporal synchrony promotes motor recovery and ipsilesional cortical reorganization in BCI-based stroke rehabilitation: a randomized controlled trial

Yu Wu, Qiumeng Dong, et. al

Abstract:

Background

The therapeutic mechanisms of brain-computer interface (BCI) rehabilitation remain partially understood. Specifically, it is unclear whether functional gains are driven primarily by active neural engagement or strictly by the temporal contingency between motor intention and sensory feedback. This study aimed to deconstruct the BCI paradigm to isolate the specific contributions of these core components to functional recovery and cortical reorganization in subacute stroke.

Methods

Seventy-seven subacute stroke patients were randomized into three intervention arms. Group C (synchronous) received robotic assistance strictly contingent on real-time detection of task engagement during motor imagery; Group B (asynchronous) performed identical motor imagery tasks but received temporally uncoupled robotic assistance; and Group A (sham) received sham motor imagery detection and preset passive robotic assistance. The intervention lasted for 3 weeks. The primary clinical outcome was Fugl-Meyer Assessment-Upper Extremity (FMA-UE) scores. Functional near-infrared spectroscopy (fNIRS) was included as an exploratory neuroimaging measure to provide preliminary information on cortical responses associated with the intervention.

Results

Sixty-eight participants were included in the final analysis. After adjustment for baseline values, Group C showed significantly higher post-intervention FMA-UE scores than both Group A (adjusted mean difference = 7.47, 95% CI [1.94, 13.00], $P = 0.004$) and Group B (adjusted mean difference = 9.72, 95% CI [4.14, 15.30], $P < 0.001$). Group C also showed significantly higher post-intervention MBI scores than both Group A (adjusted mean difference = 21.15, 95% CI [12.49, 29.81], $P < 0.001$) and Group B (adjusted mean difference = 21.27, 95% CI [12.42, 30.12], $P < 0.001$). Exploratory neuroimaging analyses showed that only the change in ipsilesional sensorimotor cortex laterality index during motor imagery was significantly correlated with motor improvement ($\rho = 0.404$, $P = 0.002$, $q = 0.012$), whereas no resting-state or task-related fNIRS group comparisons remained significant after false discovery rate

correction.
Conclusions
Synchronous BCI training was associated with superior clinical improvement compared with asynchronous and sham conditions in subacute stroke. The benefit was observed only when robotic assistance was contingent on real-time task performance, despite all three groups receiving comparable device exposure and motor imagery instruction. The neuroimaging results remain exploratory and should be confirmed in larger studies with prospectively defined imaging endpoints.
Trial registration This trial was registered under the Chinese Clinical Trial Registry (ChiCTR2400091197) and was prospectively registered on October 21, 2024. Ethics Approval: Approved by the Ethics Committee of Xuzhou Rehabilitation Hospital (XK-LSW-20241017-009).

Sensors (Basel)IF 3.3 3 区

A Scenario-Based Hardware-in-the-Loop Platform for Real-Time Road-Load Emulation on Production Micromobility Drives.

Assem Meghawer, Martin Võip, et. al

Abstract:
Software-defined electric vehicles have reached micromobility, creating a growing need to evaluate how controller software shapes drive performance and energy use. This requires experimental platforms with quantified emulation fidelity and measurement performance. This paper presents a scenario-based hardware-in-the-loop platform combining a production e-scooter drive, a controlled magnetic particle brake, and a real-time road-load model. The platform reproduces rolling resistance, aerodynamic drag, and speed-gated inertial demand for a nominal 90 kg vehicle. Across eight repetitions of a scaled ECE-15 urban cycle, including a cold first run, the protective load cap retained 99.51% of the commanded load impulse. A post hoc sensitivity analysis of the seven warm runs gave 99.71%. Measured torque and speed tracking root-mean-square errors over all eight runs were 0.704 N·m and 0.593 km/h. Separate electrical characterization produced a machine efficiency map peaking at 86.3% and cycle-energy measurements with a coefficient of variation of 0.72%. Subsampling unfiltered 200 kHz recordings at every sampling offset gave a maximum absolute cycle-energy error of 0.14% at 2 kHz, a hundredfold reduction in retained samples under the tested conditions. These results provide a quantified experimental basis for micromobility drive testing and subsequent controller-software comparisons.

Sensors (Basel)IF 3.3 3 区

Event-Based Bidirectional People Counting Using a Spatiotemporal Neural Network and a Single 77 GHz MIMO FMCW Radar.

Abstract:
Accurate bidirectional people counting at room entrances is essential for reliable occupancy estimation, yet radar-based methods remain challenged when reflections from multiple individuals temporarily merge or when people move simultaneously in opposite directions. This study presents a hybrid event-based method for bidirectional people counting using a single 77 GHz multiple-input multiple-output frequency-modulated continuous-wave radar. Unlike conventional tracking-based approaches, the proposed method treats a complete doorway passage as one event and does not require continuous individual trajectories or frame-to-frame data association. Each event is represented as a sequence of three-dimensional point clouds with radial velocity information. A PointNet encoder extracts frame-level spatial representations, a bidirectional gated recurrent unit models their temporal evolution, and an attention mechanism emphasizes the most informative event phases. Separate output heads estimate the numbers of entering and exiting individuals, while an auxiliary head identifies the event type. Predictions are accepted using explicit confidence and geometric-consistency criteria. The primary dataset comprised 550 labeled events and an additional 100 events recorded in five continuous sequences. In the held-out test session, entry- and exit-count accuracies were 95.5% and 94.5%, respectively, while joint entry-exit count accuracy reached 92.7%. The mean absolute error in occupancy change was 0.06 person per event, and the mean absolute occupancy error across the continuous sequences was 0.10 person. The proposed method exceeded geometric rules and density-based clustering combined with tracking in joint count accuracy by 37.2 and 24.5 percentage points, respectively. On an independent laboratory dataset comprising 100 events, the model achieved a joint count accuracy of 91.0% without retraining, fine-tuning, or parameter adaptation, providing preliminary evidence of cross-environment generalization.

AUTOMATIC CONTROL

Biomater AdvIF 6.7 2 区

3D bioprinting and scaffold technology applications for the management of lung diseases.

Giuseppina Chiappara, Anna Bonomolo, et. al

Abstract
Lung diseases are now the leading cause of morbidity and mortality worldwide. There is an urgent need to improve knowledge of their pathophysiology to refine therapeutic

strategies. The design and development of increasingly advanced and refined preclinical models of lung diseases may be an effective strategy to address these unmet needs. In this context, 3D bioprinting is an innovative technique that allows the automatic layer-by-layer deposition of biomaterials, bioactive molecules, and cells with accurate spatial control and an architecture that more accurately reproduces the structural and geometric features of a specific tissue or organ. This review links bioprinting strategies and scaffold/bioink properties with lung-specific structural and mechanical requirements and examines their applications in disease modeling, tissue regeneration and organ replacement, and drug discovery and testing. Emphasis is placed on how model design determines physiological relevance, disease-specific performance and translational potential, including personalized medicine.Copyright © 2026 The Author(s). Published by Elsevier B.V. All rights reserved.

Anal Chim ActaIF 6.1 2 区 TOP

Automatic analyses of quantitative dried material spots by on-line coupling of sequential injection to high-performance liquid chromatography: A proof-of-concept.

Miloš Dvořák, Carlos Pagan-Galbarro, et. al

Abstract

The development and integration of platforms for reliable handling of dried material spots (DMSs) as a front-end to advanced analytical instrumentation continues to pose methodological challenges. Although robotic platforms have been developed for autonomous manipulation of dried blood spot (DBS) cards, these systems exhibit limited flexibility regarding ancillary unit operations and remain incompatible with quantitative DMS (qDMS) devices.Leveraging off-the-shelf fluidic components using advanced liquid handling, this proof-of-concept work exploits the versatility of sequential injection-high-performance liquid chromatography (SI-HPLC) coupling for automatic processing and analysis of DMSs. The flow setup features a multi-position rotary valve as the core of the SI manifold connected to two 3D-printed 60-position racks. This hyphenation enables flexible in-vial processing of various DBS, qDBS, qDMS, and volumetric absorptive microsampling (VAMS) samples by controlled dispensing of microliter volumes of methanol for the spot rehydration, protein precipitation, and analyte elution, followed by mixing and homogenization of the eluate with water for the HPLC compatibility. Demonstrated on model non-steroidal anti-inflammatory drugs, the fully synchronized SI-HPLC setup enabled entirely unsupervised analysis of up to 120 DMS samples with triplicate HPLC injections per eluate (8.2 min each). Using a matrix-matched calibration based on spiking 10 µL of analyte-free blood, multiple qDBSs were eluted with 135 µL of methanol, followed by the eluate composition adjustment with 135 µL of water for HPLC compatibility prior to reversed-phase HPLC analysis. Under these conditions, calibrations were linear over 15 - 60, 0.8 - 12, 0.8 - 6, and 6.2 - 100 µg mL-1 ranges, and LODs were 5.7, 0.3, 0.3,

and 1.4 μg mL-1 for ibuprofen, ketoprofen, diclofenac, and naproxen, respectively. The method precision was 2.3 - 12.7% RSD for intra-day and 9.3 - 13.2% RSD for inter-day experiments. The reliability of the proposed automatic SI-HPLC setup was demonstrated for qDBSs with therapeutic naproxen levels, with no statistically significant concentration differences at the 0.05 level when compared to manual qDBS processing with off-line analysis by capillary electrophoresis.For the first time, the proposed analytical concept enables automatic handling and analysis of various DMS and qDMS samples, while using standard off-the-shelf SI and HPLC components and freely available control software.Copyright © 2026 Elsevier B.V. All rights reserved.

Sensors (Basel)IF 3.3 3 区

Panel-Aware Local Background Filtering for Photovoltaic Thermal Anomaly Detection and Automatic Bounding-Box Pre-Annotation.

Gulhan Ustabas Kaya, Esra Aga, et. al

Abstract

Thermal imaging is widely used for identifying abnormal thermal patterns in photovoltaic (PV) systems. However, complex backgrounds, varying thermal conditions, and environmental factors can reduce the spatial reliability of thermal-anomaly localization, particularly under real operating conditions. This study proposes a training-free image-processing framework that integrates panel-centered analysis, inner-panel masking, panel-coverage control, and local-background filtering to detect thermal-anomaly candidates and automatically generate bounding-box pre-annotations for subsequent deep learning applications. The framework was evaluated using five images from a publicly available thermal PV dataset and four independently acquired UAV-based field images from a grid-connected rooftop PV system at Zonguldak Bülent Ecevit University (BEUN). Compared with global thresholding and a panel-constrained Otsu-based baseline, the proposed method generally reduced redundant detections and reduced the absolute number of out-of-region detections while retaining regions showing spatial agreement with the image-derived pseudo-reference. Evaluation on the pseudo-color field images demonstrated promising applicability under real operating conditions. Moreover, a clear domain shift and increased out-of-region detections in some images indicate that further improvement in robustness is required for pseudo-color thermal representations and complex real-world conditions. Therefore, the present results are regarded as preliminary proof-of-concept evidence rather than broad validation of robustness or field-deployment readiness. The framework is computationally lightweight and shows potential for near-real-time processing.

EXOSKELETON

Nat CommunIF 18.1 1 区

Leveraging design for collective phototaxis in morphological swarm robotics

Jeremy Fersula, Nicolas Bredeche, et. al

Abstract

Morphological computing-the use of a robot's physical design to facilitate task execution-has emerged as a promising strategy in swarm robotics. Here, through experiments and simulations, we show that its success critically depends on both the robots' control policy and the details of their physical design. We study a swarm of Kilobots embedded in an exoskeleton whose geometry controls the propensity of robots to align or anti-align with the external force they experience. Experimentally, the contrast between the two morphologies in the success rate of a simple phototactic task becomes dramatic when stopping is forbidden and robots can only slow down. Using a faithful physical model of the robots' self-aligning dynamics, numerical simulations reveal that efficient phototaxis requires fine tuning of the self-alignment strength around a sweet spot. More broadly, varying this parameter unlocks a rich repertoire of collective behaviors.

Nat CommunIF 18.1 1 区

Volitional control of wearable robots

Massimo Sartori, Gregory S. Sawicki, et. al

Abstract:

This Comment motivates the development of human–machine interfaces that decode spinal motor neuron activity and resulting muscle force information in moving humans. Such interfaces could enable users across the neuromuscular functional spectrum to volitionally control wearable robots with muscle-like behaviour.

Data BriefIF 1.9 4 区

I Kinematic and surface EMG data from guided wrist movements using an upper limb exoskeleton by older and young adults.

Manuela Gomez-Correa, Luis Leduc, et. al

Abstract:
This work provides a database of kinematic, and biosignal data collected from young adults (YA) and older adults (OA) while performing wrist movements guided by an upper-limb (UL) robotic exoskeleton. The database includes data from 20 participants (10 YA and 10 OA), with equal numbers of women and men. Inclusion criteria contemplated healthy participants with no neuromusculoskeletal, cardiovascular, pulmonary, or neurological disease. In this work, kinematic data refer to the angular position and velocity collected during wrist flexion, wrist extension, wrist radial deviation, and wrist cubital deviation movements, whereas biosignals refer to the superficial electromyography signals collected from four specific zones on the participants' UL. The experimental protocol includes two graphical user interfaces: one to guide users in executing movements and collecting kinematic data, and a second to collect biosignals. The protocol includes synchronizing both systems. Finally, the database was used in an example of movement classification between both groups of adults.© 2026 The Author(s).

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Ⅱ Concentration

PHYSICS

A fast radio burst at redshift 2, three billion years after the Big Bang

Manisha Caleb, Themiya Nanayakkara, et al.

Abstract

Fast radio bursts (FRBs) are millisecond-duration radio transients from extragalactic sources. Their frequency and polarization properties are affected by plasma and magnetic fields along the line of sight to Earth. We report radio observations of FRB 20240304B and near-infrared follow-up to identify its host galaxy. The host is a low-mass, clumpy, star-forming galaxy at redshift 2.148 ± 0.0013, corresponding to 3 billion years after the Big Bang. This FRB occurred during the peak of cosmic star formation and probes ionized gas over approximately 80% of cosmic history. The highly scattered burst emission implies that there is a population of FRBs that are undetected by current surveys.

Hydrogen bonding in water under extreme confinement

Xu, Xintong, Kuehne, et al.

Abstract

Fluids under extreme confinement or near interfaces exhibit molecular structures and intermolecular bonding distinct from their bulk analogues. Optical vibrational studies have shown that interfacial and confined water can exhibit altered intramolecular O–H stretching frequencies, a sensitive spectral signature of changes in intermolecular hydrogen bonding[1,2,3,4]. Investigating confined water experimentally at the length scale of intermolecular and surface forces has, however, remained a challenge. Here we report direct molecular-level observations of hydrogen bonding in water confined inside individual carbon nanotubes (CNTs), enabled by in situ vibrational electron energy loss spectroscopy (vEELS) with nanoscale resolution. Water in larger CNTs exhibits the bonded O–H vibrations of bulk water, but at smaller diameters, and the frequency blueshifts to near the free O–H stretch found in water vapour and water located near hydrophobic surfaces, indicating a highly dispersed, non-H-bonded environment. Theoretical analysis based on quantum vibrational oscillators links the observed spectral features to local hydrogen-bonding configurations, consistent with the experimental observation. Furthermore, cryogenic experiments provide insights into complex structural phase transitions of confined water. This research reveals the

quantum and dynamic nature of hydrogen bonds under confinement and the potential impact of unveiling molecular-level structure and bonding in confined fluids.

Infrared absorption spectroscopy of a single polyatomic molecular ion

Wu, Zhenlin, Duka, Tim, et al.

Abstract

Absorption spectroscopy is a fundamental tool for probing molecular structure[1]. However, performing absorption spectroscopy on individual molecules is challenging because of the low signal-to-noise ratio[2,3]. Here we report on non-destructive absorption spectroscopy on a mid-infrared vibrational transition in a single molecular ion that is co-trapped with an atomic ion. The absorption of a single photon is detected by the momentum transfer from the absorbed photon onto the molecule. This recoil signal is amplified using a non-classical state of motion of the two-ion crystal and subsequently read out by the atomic ion[4]. We characterize the recoil detection method and use it to investigate the interaction between femtosecond laser pulses and the O–H stretching vibration in individual $CaOH^+$ molecular ions. Furthermore, we present the spectrum obtained for the vibrational transition with single-photon sensitivity. This method can provide a way of performing non-destructive state detection of complex polyatomic molecules, for preparation and measurement of the quantum state of a wide range of molecular species.

MATERIALS

Wafer-scale low-symmetry graphene moiré superlattice for integrated quantum rectifiers

Wenhao Tan, Jiuming Liu, et al.

Abstract

Low-symmetry materials unlock rich Berry curvature physics and anomalous transport phenomena that are forbidden in high-symmetry quantum systems through rigorous crystalline symmetry constraints. Current approaches rely on external fields or complex heterogeneous stacking to break crystalline symmetries, which hinders scalable device integration. In this work, we demonstrate surface premelting engineering to create wafer-scale low-symmetry graphene on germanium-110 [Ge(110)]. Controlled premelting forms striped germanium surface patterns that reduce graphene symmetry from D6h to C1v, producing a room-temperature nonlinear Hall conductivity of ~11

micrometers per volt per ohm. First-principles calculations attribute this to originating from overtilted massive Dirac cones of hybridized germanium bands and the graphene Dirac cone. Integrated nonlinear Hall rectifiers generate >20 millivolts of output from radio frequency input and drive commercial voltage boosters and light-emitting diodes, establishing a complementary metal-oxide semiconductor–compatible route toward wafer-scale nonlinear quantum devices.

Endurance beyond 10 billion cycles in wurtzite ferroelectrics by confining nitrogen vacancies

Ruiqing Wang, Feng Zhu, et al.

Abstract

Wurtzite ferroelectrics could provide a route to wafer-scale integrated ferroelectric memories but are limited by endurance, typically failing at ~10^8 cycles. We identified nitrogen-vacancy (V_N) clustering and long-range percolative migration as the defect-mediated pathways that drive leakage-current growth and dielectric breakdown. We combined a spatially engineered aluminum scandium nitride/aluminum nitride (AlScN/AlN) superlattice with a dynamic recovery protocol to spatially and energetically confine V_N evolution that stabilized defect topology under cyclic electrical stress and suppressed hard breakdown and ferroelectric degradation. We demonstrated endurance beyond 10^{10} cycles in wurtzite ferroelectrics under a complete-switching criterion (remnant polarization ≥ 100 microcoulombs per square centimeter). These findings establish V_N confinement as a scalable defect-topology framework that couples atomic-scale defect stability to reliable ultradense ferroelectric memories and provide guidance for next-generation nonvolatile memory technologies.

Open framework–based Brønsted acid–Lewis base interfaces boost proton transfer in the fuel cells

Qianli Ma, Jiarui Yang, et al.

Abstract

Limited proton conductivity within the catalyst layer induces severe ohmic polarizations and constrains power output at high hydrogen-to-electricity efficiencies in proton exchange membrane fuel cells. We demonstrate that proton transfer can be boosted by constructing Brønsted acid–Lewis base interfaces through integrating organic open frameworks with Nafion. These confined interfaces mediate low-barrier relay pathways, disrupt hydrogen bonding to expedite water network reorganization, facilitate consecutive proton transfer, and enrich protons locally. Compared with Nafion, the complexes exhibit an order-of-magnitude increase in proton self-diffusion coefficient, a 6.5-fold rise in proton conductivity, and a 55% reduction in activation energy. When integrated with commercial platinum on carbon, they deliver a fourfold

increase in rated power output relative to the baseline, outperforming representative state-of-the-art membrane electrode assemblies with advanced catalysts under similar conditions.

CHEMISTRY

Autothermal methane pyrolysis: Scalable heat integration for hydrogen and graphite production

Henry Moise, Sebastian Moll, et. al

Abstract

Methane pyrolysis (MP) offers a compelling opportunity to meet low-carbon hydrogen demand using existing energy infrastructure. A key limitation in scaling MP is the efficient delivery of high-temperature heat into the reactor. We show that hydrogen-fueled autothermal operation overcomes this limitation, enabling an increase of several orders of magnitude in the reactor throughput for commercially relevant bed diameters. It also yields a carbon coproduct of 96.0% degrees of graphitization, meeting graphite precursor specifications and enabling domestic graphite production from natural gas using low-cost iron oxide catalysts. We further demonstrate a strategy to suppress the direct emissions inherent to autothermal operation, reducing them to near zero. A process-level life cycle assessment estimates that carbon intensities for autothermal methane pyrolysis can be as low as 1.9 to 4.5 kilograms (kg) of $CO_{2,eq}$ per kg H_2.

Intrinsic physicochemical activity at microplastic–water interfaces

Naixin Qian, Ruoqi Zhao, et. al

Abstract

Plastics have become an integral part of our modern society, largely because they are generally regarded as chemically inert under normal circumstances. However, plastics fragmented into microplastics (less than 5 mm in size) have recently raised significant public concerns, and have been detected widely across ecosystems and human tissues with increasing environmental and health risks[1,2,3,4,5]. Here we show that commodity microplastics exhibit intrinsic physicochemical activity in water, manifested by the spontaneous generation of reactive oxygen species that increases with interfacial hydrophobicity and strongly correlates with interfacial electrostatics. Ab initio calculations support these observations and reveal that hydroxide oxidation becomes energetically more favourable at increasingly hydrophobic microplastic–water

interfaces through the combined effects of partial solvation and electrostatics. These interfacial properties and the resulting oxidative chemistry have direct implications for biomolecular adsorption, protein aggregation, and even cellular damage. Together, our findings challenge the prevailing paradigm of plastic inertness, identify a possibly overlooked mechanism for the detrimental effects of microplastics on health and the environment, and contribute to a fundamental understanding of the structure–activity relationship of interfacial water, which may inform the design of safer and more sustainable plastic materials.

Electroluminescent photoresists extending lithographic scaling to OLEDs

Lo, Shao-Wei, Shivarudraiah, et. al

Abstract

The miniaturization of organic light-emitting diodes is critical for next-generation ultrahigh-resolution displays and integrated photonics[1,2,3,4,5,6,7,8]. However, traditional vacuum evaporation and inkjet printing methods are incompatible with the lithographic scaling processes that underpin silicon electronics[9,10,11,12,13,14,15,16], hindering true monolithic integration with complementary metal–oxide–semiconductor circuits. Here we present electroluminescent photoresists synthesized via atom transfer radical polymerization that can be directly patterned by ultraviolet and electron-beam lithography. These multi-arm star polymers feature a core–shell architecture designed to embed the thermally activated delayed fluorescence emitters within a protective host shell, segregating them from the reactive photocrosslinking moieties on the surface. The site-specific isolation ensures that crosslinking reactions occur at the periphery, leaving the emissive cores intact and preserving high electroluminescence. We demonstrate robust processing orthogonality in sequential multilayer electroluminescent photoresist photolithography, enabling subdiffraction fluorescence nanopatterns with critical dimensions down to 110 nm. We validate their device performance with multicolour, ultraviolet-patterned organic light-emitting diodes exhibiting external quantum efficiencies exceeding 13%. These results not only pave the way for extending Moore's law to organic optoelectronics but also unlock their potential for monolithic optoelectronic integration.

BIOLOGY

Epigenetic aging and transposon dysregulation reflect size-related lifespan compression in dogs

Abstract

The extraordinary lifespan variation in domestic dogs provides a natural experiment for testing how intrinsic rates of biological aging shape lifespan. Using 1640 methylomes from 894 dogs, we developed an epigenetic clock that predicted mortality and demonstrated that epigenetic aging is fastest early in life. At orthologs of human age-associated genes, dogs exhibited concordant age effects on promoter methylation, highlighting conserved remodeling of immune pathways. We found that larger and male dogs, which are shorter lived, exhibit accelerated molecular aging. Distinct epigenetic architectures mediated these effects: Sex-dependent methylation changes were concentrated on the X chromosome, whereas size-associated methylation was especially pronounced at transposable elements (TEs). These findings show that epigenetics reflects lifespan differences in dogs and identifies TEs as potential mediators of size-associated lifespan.

Chronic type II interferon promotes tumor growth through mitochondrial RNA–induced type I interferon and prostaglandin synthesis

Melissa A. Johnson, Siva Karthik Varanasi, et. al

Abstract

Interferons (IFNs) are proinflammatory cytokines that promote immune cell engagement to eliminate malignant cells. Paradoxically, chronic interferon signaling can also activate anti-inflammatory mechanisms that allow cancer cells to evade the immune system. In this study, we sought to determine the cellular mechanisms underlying this switch from antitumorigenic to protumorigenic interferon activity. We show that chronic type II interferon (IFN-II) exposure distinctively induced tumor growth by activating a type I interferon (IFN-I) response mediated by release of double-stranded mitochondrial RNA (ds-mtRNA) into the cytoplasm. This IFN-I signal synergized with IFN-II to enhance tumor growth by increasing immunosuppressive prostaglandin E2 (PGE2) synthesis through increased cyclooxygenase 2 expression. Elimination of PGE2 synthesis in immunotherapy-resistant melanoma cells restored their responsiveness to anti-PD1 treatment, indicating that this covert mtRNA-IFN-prostaglandin pathway could be a therapeutic target to combat immunotherapy resistance.

Jurassic flightless bird reveals early ecological diversity of avialans

Xu, Liming, Wang, Min, et. al

Abstract

The origin and early diversification of birds remain highly debated in vertebrate evolution. Although estimates of the evolutionary timescales suggest a Jurassic period radiation[1,2], a profound scarcity of fossils from this period has hampered how the distinctive bird bauplan was assembled[3,4,5]. Selection for powered flight has been viewed as the primary driver of early avialan skeletal modifications[3,6,7], attesting to the independent occurrences of aerodynamic features among paravian lineages[8]. Here we report on the discovery of a Late Jurassic avialan, *Yuezhuornis yangyuanensis*, gen. et sp. nov., from the Zhenghe Fauna of southeastern China[9]. As one of the earliest diverging avialans, *Y. yangyuanensis* exhibits a striking mosaic of features, combining a mixture of avialan- and troodontid-like cranial characters, paired with derived postcranial traits and a deinonychosaur-like hyperextensible second pedal digit. Phylogenetically informed analyses show that *Y. yangyuanensis* possesses markedly short forelimbs—a condition present widely among non-avialan theropods. These findings provide strong evidence for a terrestrial, flightless lifestyle of *Y. yangyuanensis*. Our study demonstrates that evolution works intensively as exemplified by the occurrence of several, divergent ecological pathways being exploited in the initial diversification of birds.

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Ⅲ Calling for papers

ICIEA-EU 2027(SPRINGER)

Submission deadline: **Oct 25, 2026**
Conference date: **Jan 13, 2027 - Jan 15, 2027**
Full name: **International Conference on Industrial Engineering and Applications**
Location: **Porto, Portugal**

2027 The 14th International Conference on Industrial Engineering and Applications (Europe) is to be held in Porto, Portugal during January 13-15, 2027, and focuses on the latest achievements in industrial engineering and its applications.

ICIEA-EU is a conference series organized by ICIEA, the premier event for sharing the latest research, theories, and practices with various industries. All submissions undergo thorough review before acceptance. Since 2014, this conference has attracted over 1000 participants from 50 countries and has been successfully hosted in major cities like Sydney, Singapore, Hong Kong, Nagoya, Paris, Rome, Nice, Munich, Milan, etc.

Publication:

All academic papers will be submitted to the technical committee for double-blind peer review according to the reviewing policies. After the reviewing, accepted papers will be invited to be presented either on-site or online, and will be published in the Springer Conference Proceedings-Lecture Notes on Multidisciplinary Industrial Engineering, which can be included in INSPEC, SCImago, SCOPUS, etc.

Call for papers:

Interested topics including, but not limited to:
*Information Industry
*Industrial Production and Sustainability
*Manufacturing Systems and Automation
*Advanced Manufacturing Technology and Application
For more topics, please visit: https://iciea.eu/cfp.html

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ICMRE 2027(IEEE)

Submission deadline:	**Oct 25, 2026**
Conference date:	**Mar 3, 2027 - Mar 5, 2027**
Full name:	**International Conference on Mechatronics and Robotics Engineering**
Location:	**University of Agder, Grimstad, Norway**

2027 13th International Conference on Mechatronics and Robotics Engineering (ICMRE) is set to unfold in University of Agder, Grimstad, Norway, from March 3-5, 2027. Established as a distinguished international academic platform, ICMRE has been bringing together researchers, engineers, academicians, and industry professionals since its inauguration in Kuala Lumpur, Malaysia, in 2015. Following events were hosted in Nice, France (2016), Paris, France (2017 and 2018), and the University of Valenciennes, France. More recently, the conference took place in Rome, Italy (2019), and Barcelona, Spain (2020), ICMRE shifted to an online format, in collaboration with the Southern University of Science and Technology, China from 2021 to 2023, and in Milan, Italy (2024), Lille, France (2025), Oldenburg, Germany (2026). ICMRE 2027 will be sponsored by the University of Agder, Grimstad, Norway.

The conference aims to stimulate interdisciplinary cooperation and create a space to discuss the emerging trends and challenges in mechatronics and robotics engineering. The rich program includes keynote speeches, interactive workshops, paper presentations, and poster sessions.

The University of Agder (UiA) is one of Norway's leading public universities, renowned for its close collaboration with industry and its focus on international research excellence. As the 13th edition of this respected conference series, ICMRE 2027 promises to be an extraordinary assembly, aiming to push the boundaries of mechatronics and robotics engineering further. Join us in 2027, as we collectively strive to shape the future of technology and robotics, and explore innovative solutions for a better world.

Topics of Interest :

- Active vibration control
- Advanced instrumentation and control
- Advanced Motion Control
- Agile Manufacturing
- Autonomous systems
- Bionic robotics, autonomous and evolutionary robotics
- Computer and information technology
- Energy and sustainability
- Humanoid robots, service robots
- Management of Technology
- Manufacturing mechatronics
- Micro and Nano Mechatronics
- Mining robotics
- Mobile robotics

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ICMSR 2026(SCI)

Submission deadline: **Nov 1, 2026**
Conference date: **Dec 18, 2026 - Dec 20, 2026**
Full name: **International Conference on Mechatronics Systems and Robotics**
Location: **Singapore**

2026 12th International Conference on Mechatronics Systems and Robotics (ICMSR 2026) will be held in Singapore from December 18-20, 2026. The conference is co-sponsored by the Sensors and Systems Society of Singapore and the Beijing Institute of Control Robotics and Intelligent Technology, and hosted by the Robotics Society of Singapore.

The primary aim of ICMSR 2026 is to promote and facilitate collaborative, interdisciplinary research in cutting-edge methodologies and technologies within the fields of Mechatronics Systems and Robotics. We hope this conference will serve as a platform for researchers, scientists, engineers, academics, and graduate students to present their findings, exchange ideas, and return home with new insights to advance their research.

On behalf of the organizing committee, we warmly invite you—whether you are a scientist, engineer, technician, or graduate student—to join us in this exciting and innovative conference. We look forward to your enthusiastic participation and contributions as we collectively push the boundaries of Mechatronics Systems and Robotics and explore their diverse applications.

Call for Papers:

- Complex mechanical-electro-liquid System
- Mechanism and Machine Science
- Powder Metallurgy/Casting/Sintering/Thermal Engineering/Welding
- High-speed/precision machining
- Laser Processing Technology
- CAD/CAM Integration Technology
- Computational Mechanics
- Computer-aided Geometric Design & Simulation
- Flexible Manufacturing Technology & System
- Material Engineering
- Bio-inspired robotics
- Control algorithms and control systems

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RAAI 2026

Submission deadline: **Nov 1, 2026**
Conference date: **Dec 18, 2026 - Dec 20, 2026**
Full name: **6th International Conference on Robotics, Automation, and Artificial Intelligence**
Location: **Singapore**

Robotics, Automation, and Artificial Intelligence (RAAI) is an interdisciplinary field that integrates the technologies of robotics, automation, and artificial intelligence. Robotics is concerned with the design, construction, and operation of robots, while automation uses technology to minimize the need for human intervention in processes. Artificial intelligence, on the other hand, focuses on developing machines that can perform tasks typically requiring human intelligence, such as perception, reasoning, learning, and decision-making. Together, these technologies are revolutionizing industries by improving efficiency, precision, and the ability to perform complex tasks autonomously.

The IEEE Robotics and Automation Society is committed to advancing diversity in Robotics and Automation, and to promoting an inclusive and equitable culture that welcomes, engages, and rewards all who contribute to the field, without regard to ethnicity, religion, gender, disability, age, national origin, sexual orientation, gender identity, or gender expression.

2026 6th International Conference on Robotics, Automation, and Artificial Intelligence (RAAI 2026) will be held in Singapore from December 18-20, 2026. This conference aims to provide a dynamic platform for researchers, practitioners, and industry experts to share their knowledge, exchange ideas, and explore the latest advances in the rapidly evolving field of robotics, automation, and artificial intelligence. The event will feature a variety of activities, including keynote speeches, technical sessions, workshops, and exhibitions. It will cover a wide range of topics, such as robotics and automation, machine learning, computer vision, natural language processing, and intelligent control systems, among others. RAAI 2026 promises to be a valuable opportunity for participants to engage with cutting-edge research and foster collaborations across academia and industry.

***Call for papers:**

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

Track 1: Robotics and Automation
Autonomous control and systems
Ground and mobile robotics
Robotic manipulation

Track 2: Control Systems and Theory
Control applications and systems
Hybrid and nonlinear control
Model predictive and robust control

Track 3: Artificial Intelligence
Machine learning and deep learning
Intelligent systems and expert systems

Track 4: Sensors, Measurements, and Signal Processing
Sensor design and measurements
Signal processing and feature extraction

Track 5: Applications and Systems Integration
Industrial and intelligent manufacturing systems
Healthcare and bio-robotics

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AAME 2027

Submission deadline: **Nov 10, 2026**
Conference date: **Mar 26, 2027 - Mar 28, 2027**
Full name: **International Conference on Aeronautical, Aerospace and Mechanical Engineering**
Location: **Ningbo, Zhejiang, China**

The Conference Committee takes the pleasure to invite you to the 2027 the 10th International Conference on Aeronautical, Aerospace and Mechanical Engineering (AAME 2027) to be held in Ningbo, Zhejiang, China during March 26-28, 2027. The AAME 2027 has inherited from the tradition of nine previous AAME conferences promoting an innovative environment for researchers to present their new research and engineering achievements and share their experience with researchers working in similar fields. AAME 2027 will create a global platform for researchers, scientists, academicians, policymakers, industry experts to share experiences, discuss research findings and acquire the desired knowledge in the subject from around the world with many networking opportunities. As the world is becoming more flexible and sophisticated, predictive solutions for the existing problems and future challenges in the field of Aeronautical, Aerospace and Mechanical Engineering need to be focused.

Topics of interest

#Advanced Manufacturing & Intelligent Robotics
Smart manufacturing and industrial automation (including agile/virtual/lean manufacturing)
Industrial robotics, multi-robot cooperation, and real-time kinematics
...
#Aerospace Engineering & Low-Altitude Economy
Aerodynamics, propulsion technologies, and aircraft design (fixed-wing/rotorcraft)
Low-Altitude Economy: eVTOL, Urban Air Mobility (UAM), drone logistics
...
#Thermofluids Science & Clean Energy Systems
Fluid dynamics, heat and mass transfer, and computational thermofluids (CFD)
Clean combustion, hydrogen energy, and low-carbon fuel technologies
...
#Digital Engineering & Intelligent Computing
Computational mechanics, finite element analysis (FEA), and multidisciplinary optimization
Digital twin, virtual commissioning, and web-based design/manufacturing
...

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