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Research Bulletin

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May 2026

SAFE LOCATIONS ARE BEING IDENTIFIED FOR WIND TURBINES

For renewable energy planning, wind turbine sites on the Gallipoli Peninsula were examined. A new method was used in which earthquake and landslide hazards were evaluated together. Historical landslide data and environmental factors were modeled using an artificial intelligence algorithm, and a high-resolution susceptibility map was produced. This map was combined with earthquake-prone areas and technical constraints. When both hazards were considered simultaneously, the areas identified as highly suitable for wind turbine installation were found to decrease by approximately 20%.

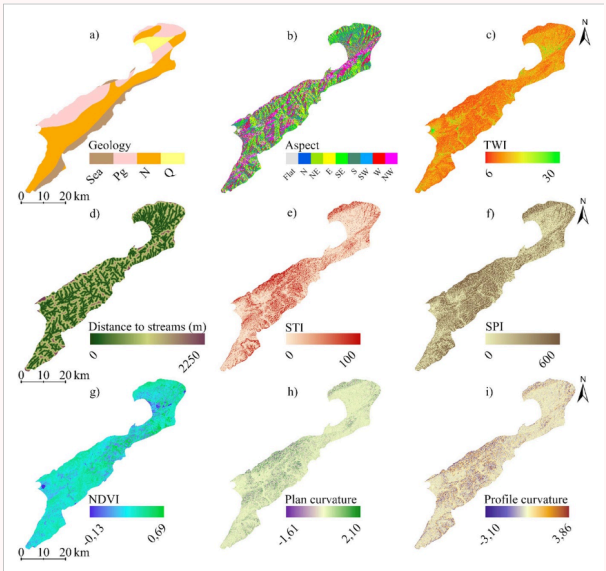
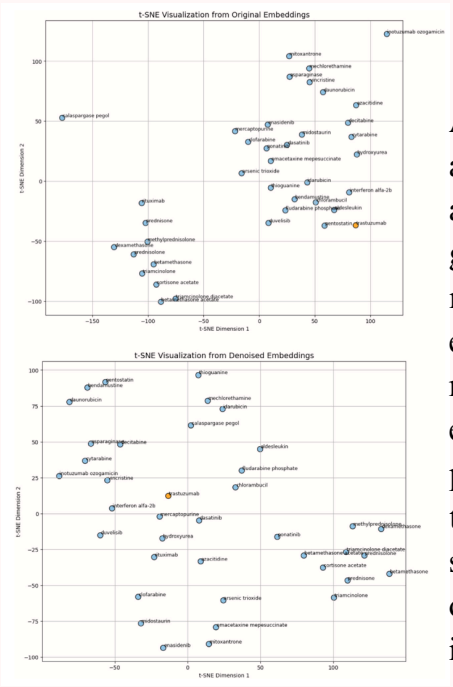


Figure 3. The criteria for landslide susceptibility mapping (a) geology, (b) aspect, (c) TWI, (d) distance to streams, (e) STI, (f) SPI, (g) NDVI, (h) plan curvature and (i) profile curvature.

Dilmen, Ö., Demir, A., Dinçer, A. E., Öztürk, Ş., & Kalpakcı, V. (2026). A Machine-Learning-Based Multi-Hazard GIS-AHP Framework for Wind Turbine Siting Under Earthquake–Landslide Coupling. *Environmental Research Communications, 8*(5). https://doi.org/10.1088/2515-7620/ae69a0

THE REPURPOSING OF CANCER DRUGS IS BEING ACCELERATED WITH ARTIFICIAL INTELLIGENCE



An artificial intelligence-based framework was developed to accelerate the repurposing of existing drugs for new applications in cancer treatment. Drug embeddings were generated using biomedical knowledge graphs and relational graph convolutional networks, and these embeddings were further enhanced through a flow-matching-based diffusion model. The framework was evaluated across seven different cancer types, with a particular focus on leukemia. Experimental results identified trastuzumab as a promising candidate for leukemia, supported by 156 co-citations in PubMed. The study demonstrated that the proposed model significantly improved the accuracy of drug repurposing predictions.

Erkantarci, B., Şen, T. Ü., & Bakal, G. (2026). AI-driven drug repositioning: A diffusion model approach on knowledge graphs. *Journal of Computational Science, 97*, 102862. https://doi.org/10.1016/j.jocs.2026.102862

FAIRNESS AND PRIVACY HAVE BEEN ACHIEVED TOGETHER IN FEDERATED LEARNING

A new aggregation weighting method called FairWeight was developed to address bias in distributed machine learning systems. Using the Shapley value, a model interpretability technique, model weights contributing to bias were identified. Coordinate-wise penalization was then applied while preserving privacy through secure aggregation protocols. The method was evaluated on five real-world datasets and was shown to achieve better performance than existing approaches in terms of balanced accuracy and fairness metrics. It was also demonstrated that the proposed approach significantly reduced computational costs while maintaining privacy protection.

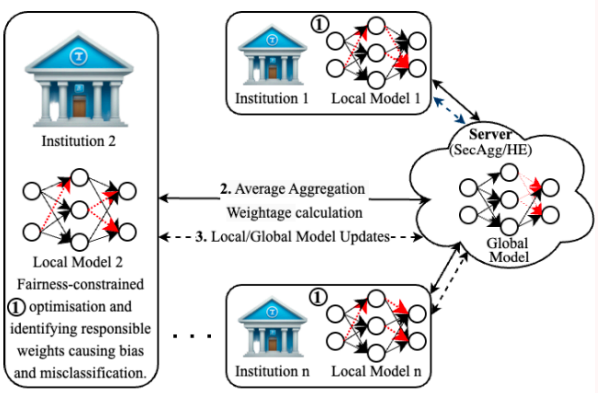
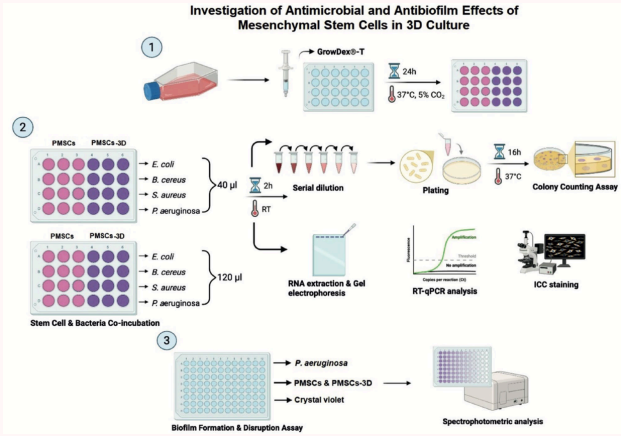


Fig. 1: FairWeight: Workflow diagram.

Kasyap, H., Atmaca, U. I., Maple, C., & Lane, N. (2026). FairWeight: Private fairness-aware aggregation using model interpretation based weightage in federated learning. *IEEE Transactions on Services Computing.* https://doi.org/10.1109/TSC.2026.3686323

A 3D HYDROGEL MATRIX ENHANCED THE ANTIBACTERIAL EFFECT OF STEM CELLS



A study investigated the antimicrobial activity of palatal mesenchymal stem cells (PMSCs) cultured within a three-dimensional cellulose-based hydrogel against four clinically important pathogenic bacteria. After a 2-hour incubation period, bacterial loads were reduced by 14 logs in E. coli and 12 logs in P. aeruginosa. RT-PCR and immunocytochemical analyses revealed a significant increase in the antimicrobial peptide Cathelicidin (LL-37) in the three-dimensional culture system. In addition, biofilm formation was reduced by 57.65%, demonstrating the enhanced antibacterial potential of stem cells cultured within the hydrogel matrix.

Bicer, M., Sener, F., Öztürk, E., & Fidan, Ö. (2026). Cellulose-based hydrogel matrix enhances antimicrobial and biofilm-inhibitory responses of palatal mesenchymal stem cells. *3 Biotech, 16*, 197. https://doi.org/10.1007/s13205-026-04852-6

THE DAMAGE BEHAVIOR OF GEOPOLYMER CONCRETE BEAMS WAS INVESTIGATED USING A NUMERICAL METHOD

The damage mechanisms and fracture behavior of geopolymer concrete (GPC) and conventional ordinary Portland cement (OPC) reinforced concrete beams were investigated using a combination of experimental methods and ABAQUS-based finite element analysis. Displacement and crack propagation were monitored through high-precision total station measurements, while the effects of reinforcement ratio, curing method, and mixture composition were evaluated. The results showed that GPC beams exhibited approximately 50% narrower maximum crack widths compared to OPC beams and developed about 15% greater deformation capacity in the compression zone.

Özbayrak, A., Kucukgoncu, H., Aslanbay, Y. G., Aslanbay, H. H., & Altun, F. (2026). Failure mechanisms and damage evolution of geopolymer concrete beams under flexural loading: Experimental investigation and finite element analysis. *Advances in Structural Engineering*. https://doi.org/10.1177/13694332261452286

AUTOPHAGY REGULATORS WERE COMPARED IN CISPLATIN-INDUCED HEART DAMAGE

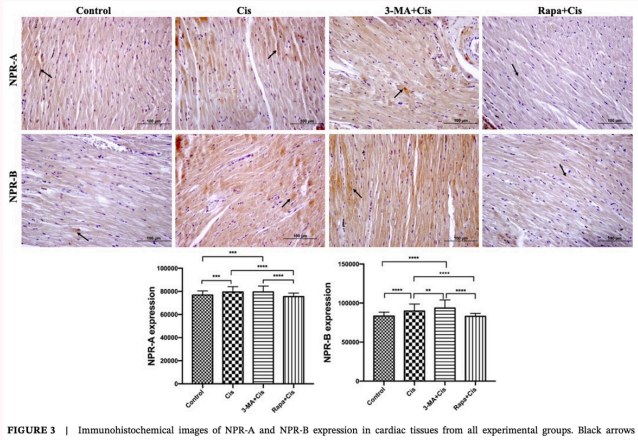


FIGURE 3 | Immunohistochemical images of NPR-A and NPR-B expression in cardiac tissues from all experimental groups. Black arrows indicate NPR-A and NPR-B expression. Statistical differences between groups in the graphs of NPR-A and NPR-B expression are indicated with (*). Scale bar 100 μm. $^{**}p < 0.01$, $^{***}p < 0.001$, $^{****}p < 0.0001$. 3-MA, 3-methyladenine; Cis, Cisplatin; NPR-A, natriuretic peptide receptor-A; NPR-B, natriuretic peptide receptor-B; Rapa, Rapamycin.

Cisplatin-induced cardiotoxicity was investigated through a comparative evaluation of rapamycin (Rapa), an autophagy activator, and 3-methyladenine (3-MA), an autophagy inhibitor. Rapamycin and 3-MA were administered for 15 days, while a single dose of cisplatin was given on the seventh day. The findings showed that cisplatin impaired the endocrine function of the heart and significantly increased the levels of natriuretic peptide receptors. Rapamycin was found to maintain NPR-A and NPR-B expression levels close to those of the control group, whereas the 3-MA group exhibited results similar to those observed in the cisplatin-treated group.

Karabulut, D., Kaymak, E., Öztürk, E., Ayaz Güner, Ş., Boyvat, D., Fındık, F., Akin, A. T., Sayan, M., Öztürk, T. M., & Yalçın, B. (2026). Comparison of Rapamycin and 3-Methyladenine in Cisplatin-Induced Experimental Cardiotoxicity. *Journal of Biochemical and Molecular Toxicology, 40*, e70906. https://doi.org/10.1002/jbt.70906

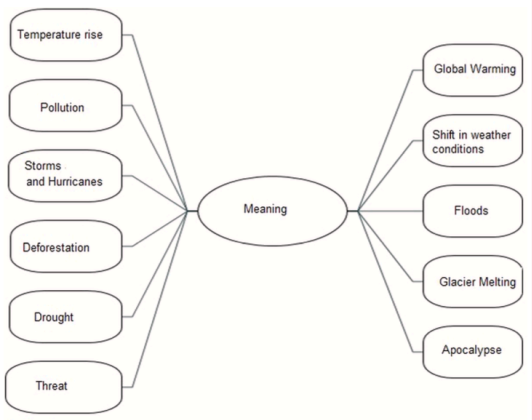


Fig. 1. Negative environmental events.

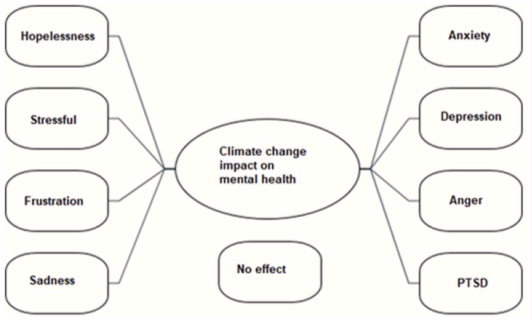


Fig. 2. Negative impacts on mental health.

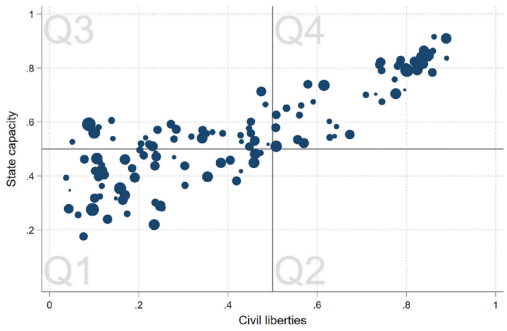
DEPRESSIVE SYMPTOMS DOUBLED CLIMATE CHANGE ANXIETY

Semi-structured interviews were conducted with 27 young adults between the ages of 18 and 25 to examine the relationship between depressive symptoms and climate change anxiety. Participants with current depressive symptoms were found to have anxiety levels related to climate change that were twice as high as those of the control group. Using thematic analysis, eight major themes were identified. Individuals in the depressive-symptom group were observed to hold a more pessimistic view regarding the prevention of climate change. The findings suggest that climate communication strategies should be designed in ways that help protect and support the mental well-being of young people.

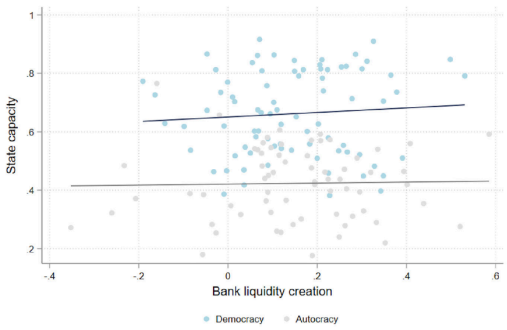
Kaya, M. S., Hawkins, E., & McCabe, C. (2026). Views on climate change, climate action and mental health, in young people with and without existing depression symptoms: A qualitative study. *The Journal of Climate Change and Health, 27,* 100606. https://doi.org/10.1016/j.joclim.2025.100606

DEMOCRACY WAS SHOWN TO INCREASE BANKS' FINANCIAL INTERMEDIATION CAPACITY

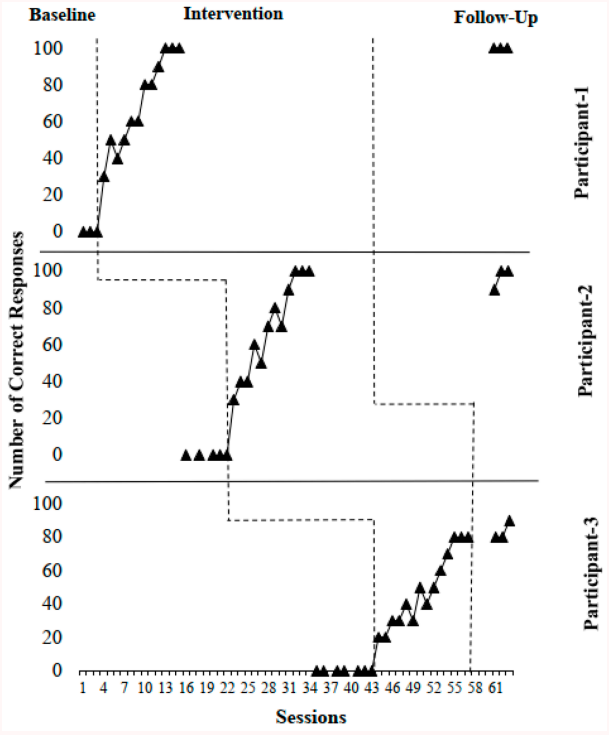
The impact of state capacity and civil liberties on the banking sector was examined using data from 7,994 banks across 148 countries between 2011 and 2019. The findings showed that strong state capacity increased bank liquidity, but this effect was significant only in democratic countries where civil liberties were highly protected. Trust in the banking system was identified as a key mediating factor in this relationship. In contrast, patronage-based structures commonly observed in autocratic regimes were found to hinder the development of sustainable financial intermediation.



(a) Scatter plot of state capacity vs civil liberties



Raz, A. F., & Gokmen, S. (2026). Institutions and bank intermediation: The joint role of state capacity and civil liberties. *Financial Management.* . https://doi.org/10.1111/fima.70050



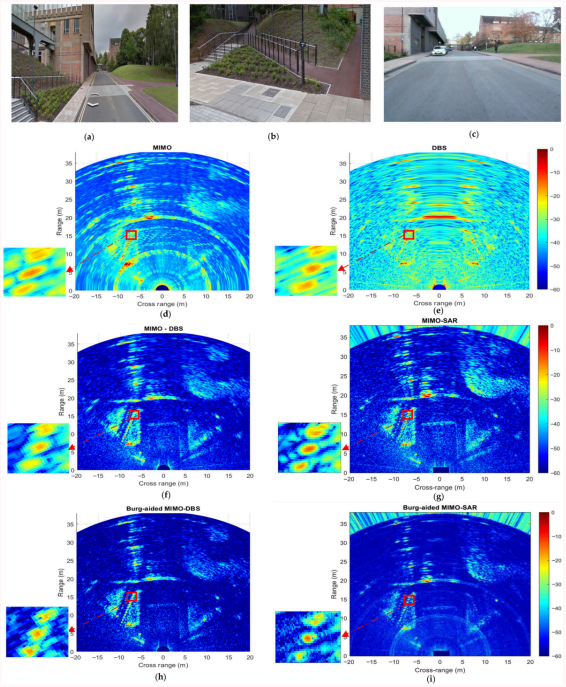
GYMNASTICS SKILLS WERE TAUGHT TO CHILDREN WITH AUTISM THROUGH VIDEO MODELING

Preschool children diagnosed with Autism Spectrum Disorder were taught somersault skills using a video modeling approach. In the single-subject study conducted with three children with mild autism, the percentage of correct responses increased from zero before the intervention to between 80% and 100% for all participants. The acquired skill was also found to be maintained after the intervention period. Interviews conducted with teachers and parents indicated that the method was both effective and practical for teaching gymnastics skills to children with autism.

Sönmez, H. G., Ergin, M., Koçak, Ç. V., Bozdağ, B., Kılınç, Ö., Turan, E., Canlı, U., & Aldhahi, M. I. (2026). The effect of video modeling on gymnastics-based motor skills in children with autism spectrum disorder. *Healthcare, 14*(8), Article 1009.

RADAR IMAGE QUALITY FOR AUTONOMOUS VEHICLES WAS DOUBLED WITHOUT HARDWARE MODIFICATIONS

A method combining the Burg algorithm with multiple-input multiple-output (MIMO) radar data was proposed and comprehensively evaluated to improve the clarity of road-scene imaging in autonomous vehicles. The approach aimed to enhance cross-range resolution through data extrapolation in both Doppler and angular dimensions. Its performance was validated through simulation studies, laboratory experiments, and real-world testing. Experiments conducted with a 77 GHz radar system demonstrated that the proposed method doubled angular resolution without requiring any modifications to the existing hardware.



Bekar, M., Bekar, A., Pirkani, A., Baker, C. J., & Gashinova, M. (2026). Radar resolution enhancement based on Burg-aided MIMO-DBS and Burg-aided MIMO-SAR. *Sensors, 26*(9), Article 2698. https://doi.org/10.3390/s26092698

A NEW MODEL REVEALED THE RISKS OF AI SECURITY THREATS IN AUTONOMOUS VEHICLES

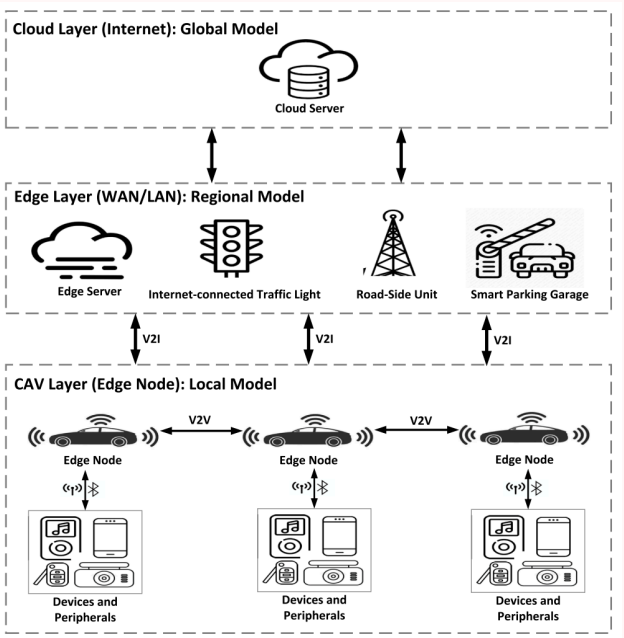


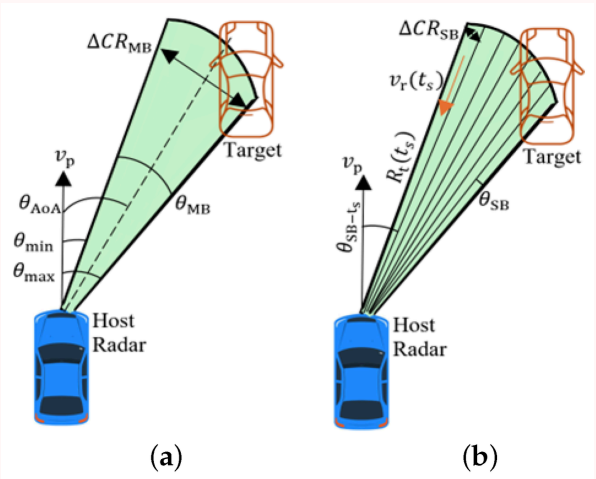
Fig. 1. Reference architecture of Edge-AI-assisted CAVs, based on [14].

Security vulnerabilities in connected autonomous vehicle systems using artificial intelligence-based federated learning were examined through the STRIDE threat modeling framework. A threat map was developed across four stages: data input, model training, aggregation, and inference. Experimental results showed that gradual data poisoning attacks were more difficult to detect than sudden attacks. These attacks were also found to bypass Byzantine-resilient defense mechanisms and degrade overall model performance, highlighting a significant security challenge for distributed AI systems in autonomous vehicles.

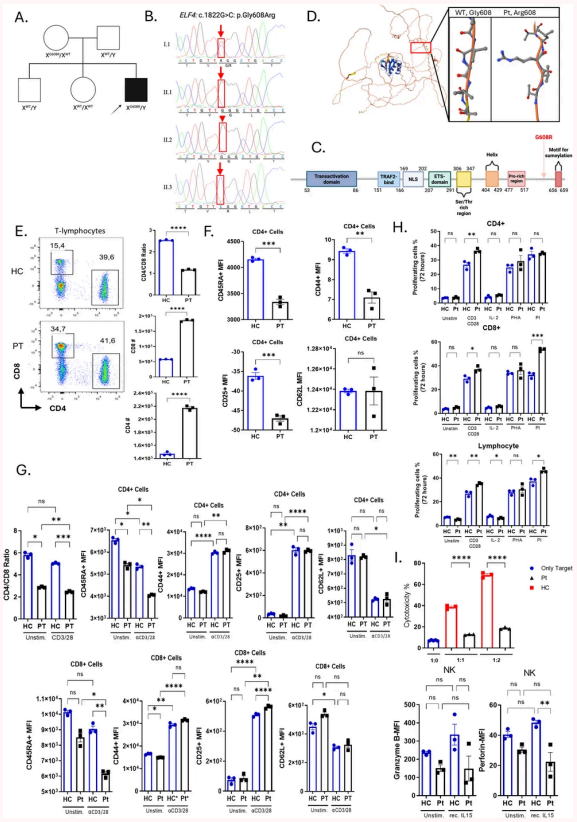
Nezhad, M. M., Atmaca, U. I., Kasyap, H., Maple, C., & He, L. (2026). Threat landscape of Edge-AI-assisted connected autonomous vehicles (CAV). *Internet of Things, 38,* Article 101973. https://doi.org/10.1016/j.iot.2026.101973

NEW RADAR INTERFERENCE MITIGATION TECHNIQUE PROVEN EFFECTIVE IN CONGESTED ENVIRONMENTS

A multimodal beamforming approach was evaluated to suppress radar interference in dense environments where multiple radar systems operate simultaneously on the same frequency. The framework combined multiple-input multiple-output (MIMO) array processing with Doppler-based angular resolution enhancement techniques. Its effectiveness was validated using real measurement data collected from both automotive and maritime environments. According to simulation and experimental results, the proposed method achieved up to 35 dB improvement in interference suppression compared with conventional approaches,



Pirkani, A., Norouzian, F., Bekar, A., Bekar, M., & Gashinova, M. (2026). Performance evaluation of multi-modal radar signal processing in dense co-existent environments. *Sensors, 26*(8), Article 2317. https://doi.org/10.3390/s26082317



A RARE ELF4 GENE VARIANT WAS ASSOCIATED WITH FUNCTIONAL IMPAIRMENT IN IMMUNE CELLS

A novel hemizygous variant in the X-linked ELF4 gene (c.1822G>C; p.Gly608Arg) was identified in a 14-year-old male patient diagnosed with chronic immune thrombocytopenia. The potential impact of the variant was evaluated using whole-exome sequencing and computational structural modeling, which predicted the mutation to be harmful. Immune cell analyses performed by flow cytometry revealed an increased proportion of CD8+ T cells, reduced cytotoxic activity of natural killer (NK) cells, and enhanced T-cell proliferation. These findings suggest that the rare ELF4 variant may be associated with functional abnormalities in immune cell regulation.

Kendirli, P. K., Erdem, Ş., Kısaarslan, A. P., Gök, V., Kayhan, E., Özcan, A., Dogan, M. E., Klein, C., Ünal, E., & Eken, A. (2026). A novel ELF4 gene variant disrupts T and NK cell function in a patient with immune thrombocytopenia (ITP). *Inflammation Research, 75*(1), Article 115. https://doi.org/10.1007/s00011-026-02270-1

A NEW INVERTER CONTROL METHOD FOR PHOTOVOLTAIC SYSTEMS ACHIEVED HIGH EFFICIENCY

A study was conducted to improve mode-transition dynamics in four-switch buck–boost inverter circuits used in solar energy systems. Five different modulation techniques were comparatively evaluated to eliminate signal distortions occurring in the transition region between buck and boost operating modes. Experimental tests were carried out on a 2 kW prototype system. The results showed that the four-mode control technique delivered the best overall performance, achieving an efficiency of 95.49% and a total harmonic distortion (THD) value of 2.97%. These findings demonstrate the potential of the proposed control strategy to enhance the performance of photovoltaic power conversion systems.

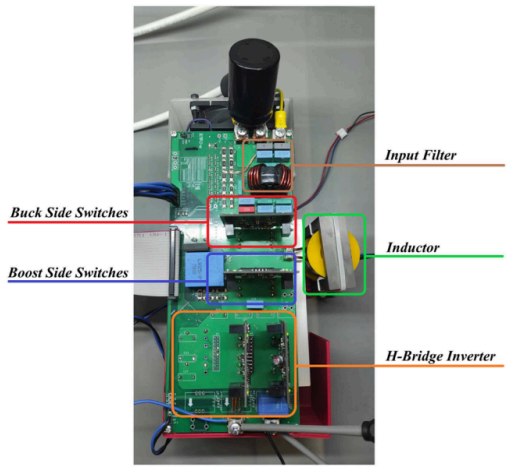


Fig. 10. Experimental setup of the FSBBI.

Keskinkilic, E., & Tekgun, B. (2026). Enhancing mode transition dynamics in noninverting buck-boost inverters for PV systems. *IEEE Transactions on Power Electronics, 41*(7), 11740–11752. https://doi.org/10.1109/TPEL.2026.3661576

NEW PHOTOVOLTAIC CELL DESIGN DEVELOPED FOR WEARABLE ELECTRONICS

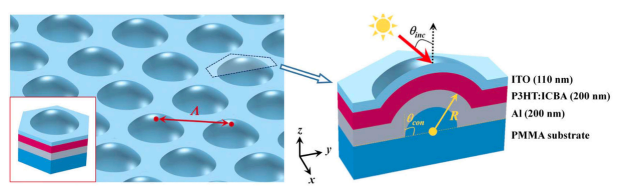
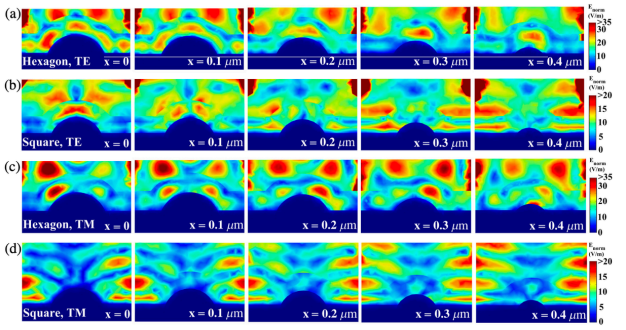


Fig. 1 HSS OPV cell structure. (Left) bird's-eye view. Inset: a unit cell in hexagonal periodicity. (Right) A cutaway view revealing a layer structure.

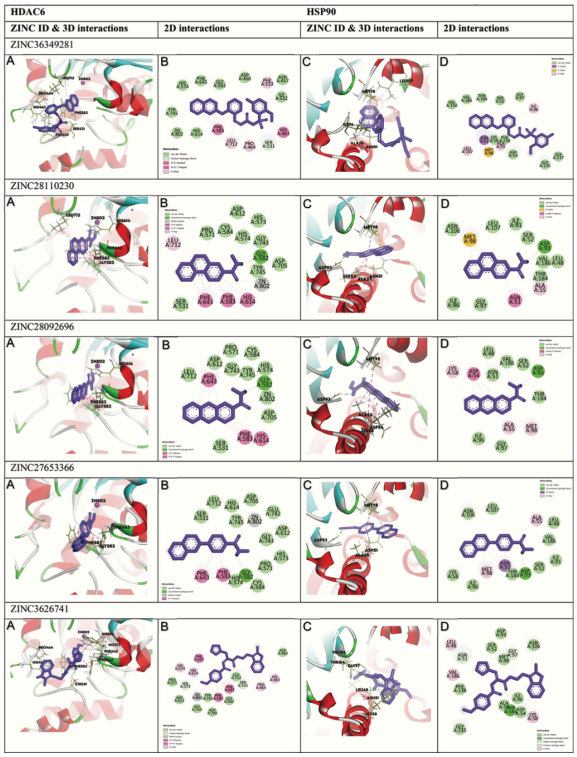


A hemispherical-shell-shaped active layer structure was investigated to enhance light retention performance in organic photovoltaic cells designed for wearable electronics applications. Using finite element analysis, hexagonal periodicity was found to yield higher absorption compared to square periodicity. The contact angle was determined to improve absorption performance up to 80 degrees, beyond which saturation was reached. Reducing the cell period was identified as increasing overall absorption performance.

Hah, D. (2026). Effects of a period and a contact angle on absorption performance of hemispherical-shell-shaped organic photovoltaic cells. *Journal of Photonics for Energy, 16*(1), Article 018501. https://doi.org/10.1117/1.JPE.16.018501

NEW DUAL-TARGET INHIBITOR CANDIDATE FOR CANCER TREATMENT IDENTIFIED COMPUTATIONALLY

A comprehensive computational study was conducted to identify compounds capable of simultaneously inhibiting HDAC6 and HSP90 proteins, which are effective therapeutic targets in cancer treatment. A total of 791 molecules obtained from the ZINC15 database were evaluated through molecular docking and 300-nanosecond molecular dynamics simulations. The compound coded ZINC27653366 was determined to exhibit the highest inhibition potential against both target proteins and to satisfy drug-likeness properties.



Yücel, M. S., & Akçok, İ. (2026). Identification of potential dual HDAC6 and HSP90 inhibitors for the treatment of cancer using molecular docking, molecular dynamics and MM/PBSA studies: A comprehensive in silico study. *Medicinal Chemistry, 22*(2), 212–229. https://doi.org/10.2174/0115734064388900250625121927