SCHOLARLY PUBLICATIONS
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Journal Name: Bioactive Materials **IF: 23.6**

Title: Recent advances in functionalized electrospun nanofibers for biomedical and therapeutic applications: A comprehensive review

Author: Deshmukh K.; Pandey M.; Moulahoum H.; Ghorbanizamani F.; KovÃ¡Å™Ãk T.; Przekora-KuÅ›mierz A.; Jena H.; Vora M.; Patel G.; Pradhan P.

Details: Volume-69, March 2027

Abstract: Electrospun nanofibers (ESNFs) have become a major focus of modern research given their adaptable architecture, extensive interface, and distinctive physicochemical characteristics, making them appropriate for varied applications such as catalysis and environmental cleanup, drug delivery (DD), tissue engineering (TE), sensing, actuation, and various energy-related technologies. As a result, electrospinning (ES) has emerged as a versatile manufacturing technique, driving intensive efforts to engineer nanofibrous structures specifically for biomedical purposes. Functionalization of ESNFs can be achieved by embedding functional agents or altering surface chemistry to introduce specific functionalities. This review discusses the fabrication methods, optimization techniques, and broad biomedical applications of modified ESNFs, emphasizing their key properties, including biocompatibility, degradability, and safety profile. The article outlines various strategies for creating and modifying ESNFs, followed by a comprehensive analysis of their applications in tissue regeneration, DD, wound repair, antimicrobial therapy, cancer diagnostics and treatment, and biosensing. By critically evaluating recent advances, highlighting future directions, and addressing ongoing challenges about ES, this review underscores the transformative potential of functionalized ESNFs as efficient and adaptable biomaterials for biomedical technologies. The Authors This is an open access article under the CC BY license.



URL: https://www.sciencedirect.com/science/article/pii/S2452199X26005918?via%3Dihub

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Journal Name: Tribology International **IF: 7.6**

Title: Development of novel Al 7075/Fe-Cr/GO hybrid nanocomposites through stir-ultrasonication-squeeze cast process: Microstructure, mechanical and tribological properties and MQL assisted sustainable machinability investigation

Author: Sethy P.; Sahoo A.K.; Kumar R.; Panda A.; Das D.

Details: Volume-226, February 2027

Abstract: Integrating solid waste ferrochrome slag with graphene oxide reinforcements in Al7075 hybrid nanocomposites opens new avenues for the aerospace, marine, automobile applications. This study addresses the critical research gap by synthesizing, characterizing, and assessing the machinability of Al7075/Fe-Cr slag (5 wt%)/GO (0.5, 1, and 1.5 wt%) hybrid nanocomposites which have been fabricated through novel ultrasonic-stir-squeeze casting method and machined under sustainable dual-nozzle MQL environment. Microstructure analysis of 0.5 wt% GO shows a dendritic structure with fine, uniform grains, indicating significant grain refinement during solidification. This composition yielded improved mechanical and tribological properties with microhardness of 165 HV, an UTS of 226 MPa, an elongation of 8.17%, low wear coefficient of 0.098–0.2174, and coefficient of friction of 0.307–0.346 respectively. Machinability investigations revealed acceptable ranges of flank wear from 0.03 to 0.078 mm, surface roughness from 0.403 to 1.293 µm, temperature from 56.3 to 92.70C, power consumption from 0.334 to 0.507 kW, carbon and noise emission from 0.00412 to 0.02105 kgCO2, and 74–78.9 dB respectively. Circularity and cylindricity remained well below 0.1 mm tolerance zone, producing saw tooth chips. The lowest tensile residual stress was observed for 1 wt% GO composite (181.06 MPa) post-machining due to the self-lubricating effect of GO paired with MQL. The optimal parameters are found to be w: 1.1061 wt%, v:76.1616 m/min, f: 0.05 mm/rev, and d: 0.1101 mm with composite desirability 0.9878. The synergistic effect of the inherent solid nano-lubricant layer from the GO, squeeze casting structure, and the MQL fluid film significantly improves overall manufacturing sustainability.



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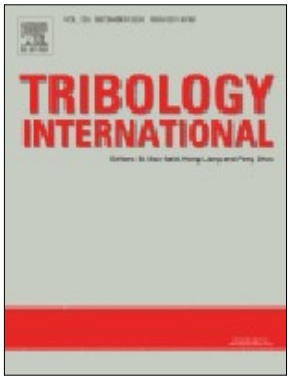
Journal Name: Tribology International **IF: 7.6**

Title: Synergistic effect of SiC and MoS2 on the tribological performance of Al-based composites

Author: Jha P.; Gautam R.K.S.; Tripathi V.M.; Kumar R.; Gupta G.; Ali S.

Details: Volume-224, December 2026

Abstract: This study investigates the friction and wear properties of aluminum (Al)-based composites, reinforced with a fixed amount of SiC (5 wt%) and varying amounts of MoS_2 (2, 4, and 6 wt%), and processed via powder metallurgy route. Microstructural examination has confirmed the formation of a dense, well-bonded structure consistent with the measured density and micro-hardness. The wear tests were conducted using a pin-on-disk test rig against EN31 steel under normal loads of 10, 20, and 30 N, with a constant sliding speed of 1 m/s. Among all the tested materials, the hybrid compositeAl - SiC (5 wt%) - MoS_2 (2 wt%) demonstrated most superior tribological performance, exhibiting the lowest coefficient of friction (0.20) at 20 N and the lowest wear rate (2.24×10^{-4} mm^3/m) at 10 N. FESEM analysis of the worn surfaces revealed that the dominant wear mechanism got transitioned from predominantly adhesive wear in pure Al to abrasive wear in the Al-SiC-MoS_2 composites. In the Al-SiC (5 wt%)-MoS_2 (6 wt%) composite, mild delamination was identified as the dominant wear mechanism under a relatively high load of 30 N. Furthermore, the wear tracks and surface morphology of the hybrid composite Al-SiC (5 wt%)-MoS_2 (2 wt%) exhibited the formation of a dense and compacted tribolayer. This layer consisted of an optimal content of MoS_2 acting as a solid lubricant, Al_2O_3 and MoO_3 forming a passivation layer, and SiC serving as a load-bearing constituent within the mechanically mixed layer, thereby reducing the coefficient of friction and wear rate.



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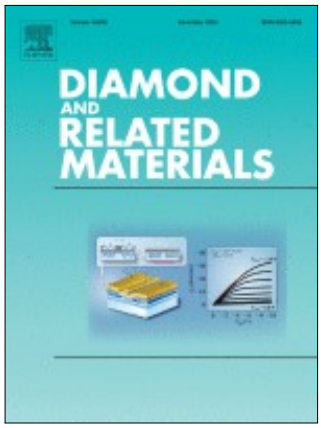
Journal Name: Diamond and Related Materials **IF: 5.2**

Title: Multifunctional enhancement of glass fiber-reinforced epoxy composites through multi-walled carbon nanotube reinforcement

Author: Jha P.; Singh M.; Gautam J.K.; Dodla S.; Gautam R.K.; Gautam R.K.S.

Details: Volume-170, December 2026

Abstract: The aim of this study is to examine the impact of adding multi-walled carbon nanotube (MWCNT) on mechanical and tribological properties of glass fiber-reinforced polymer (GFRP) composites. Three different laminates of 0, 0.45, and 0.90 wt% MWCNTs (GC0, GC1, and GC2) were prepared by hand lay-up method and characterized for their physico-mechanical and tribological properties, as well as, worn surface morphology (SEM), in accordance with ASTM standards. The fabricated composites showed that the composite with 0.45 wt% MWCNT (GC1) outperformed the other fabricated composites as well as the neat GFRP composite with respect to hardness, tensile strength, flexural strength, interlaminar shear strength and impact strength by 24.90%, 40.39%, 51.79%, 41.74% and 42.38%, respectively. Additionally, GC1 achieved a specific wear rate approximately 30% lower than GC0, and the lowest coefficient of friction due to improved fiber-matrix interfacial bonding and stable tribolayer formation. However, increasing the MWCNT content to 0.90 wt% led to nanotube agglomeration, resulting in partial degradation of the composite properties. The results showed that an optimum MWCNT loading of 0.45 wt% significantly enhanced the multifunctional performance of GFRP composites, making them suitable for automotive, aerospace, marine, and industrial applications requiring lightweight, structurally robust, and wear-resistant materials.



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Journal Name: Scientific Reports **IF: 4.9**

Title: Performance and surface integrity studies in electric discharge machining on Ti-6Al-4 V using neem oil dielectric and 3D Printed SS316L electrode

Author: Barik S.; Nanda B.K.; Mishra S.B.; Satpathy M.P.; Debebe S.T.

Details: Volume-16, Issue-1, December 2026

Abstract: Bio-dielectric fluids and advanced 3D printed electrodes are essential for sustainable, precise Electric Discharge Machining (EDM) of critical Ti-6Al-4 V aerospace components. In this study, neem biodiesel dielectric and a precisely manufactured 3D-printed stainless-steel electrode were used to identify optimal EDM parameters that maximize material removal rate (MRR) and minimize tool wear rate (TWR) and surface roughness (SR). The experiments were carried out using response surface methodology (RSM) with Box–Behnken design (BBD). Regression models showed high predictive accuracy ($R^2 > 0.98$). An integrated MEREC-CoCoSo multi-response optimization approach was subsequently applied to the experimental results to obtain the best output values. The results revealed the optimal setting as current (I_p) of 30 A, pulse-on time (T_{on}) of 0.3 s, and voltage gap (V_g) of 60 V. The interaction between T_{on} and V_g strongly influenced MRR, TWR, and SR. MRR first increased and then slightly decreased as V_g was raised from 60 V to 80 V. It also showed a marginal increase as T_{on} increased from 0.2 s to 0.4 s. In contrast, both TWR and SR increased sharply with higher V_g and longer T_{on}. Surface morphology analysis at the optimal setting showed fewer surface flaws, smaller craters, thinner recast layers, and lower porosity. Energy-dispersive X-ray spectroscopy (EDX) analysis confirmed the transfer of material from the 3D-printed electrode to the workpiece. This work provides a practical guide for industrial applications, demonstrating the feasibility and benefits of using novel electrode materials and eco-friendly dielectrics in sustainable EDM.

URL: https://www.nature.com/articles/s41598-026-51103-y

SCHOLARLY PUBLICATIONS
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Journal Name: Scientific Reports **IF: 4.9**

Title: Correlation of ultrasonic welding parameters with microstructural evolution and mechanical-electrical reliability of Al-CuNi joints for energy storage systems

Author: Das S.; Routara B.C.; Nayak S.K.; Nanda B.K.; Mishra S.B.; Satpathy M.P.; Debebe S.T.

Details: Volume-16, Issue-1, December 2026

Abstract: In the automotive industry, ultrasonic welding (USW) stands out as a highly effective solid-state welding technique. It is specifically designed for joining components within lithium-ion battery modules and energy storage systems. To achieve an optimal weight-to-body ratio, dissimilar materials like aluminum, copper, and nickel are joined to reduce the weight of electrical and electronic devices. This study presents a systematic analysis of aluminum (Al) and cupro-nickel (CuNi) dissimilar joints using USW, with variations in welding parameters. The lap shear strength results show that sonotrode pressure and welding energy have a greater impact on joint strength than the amplitude of vibration at all tested levels. Joint strength reached peak values of 942 N and 236 N, respectively, before declining sharply as weld energy increased due to the high interfacial temperature. Resistance measurements revealed that resistance decreased with increasing welding energy. Additionally, Al-CuNi specimens exhibited higher hardness values at the faying surface compared to their base metals. A metallographic analysis of the weld cross-section was conducted to evaluate diffusion across the joint interface, supported by X-ray energy-dispersive spectroscopy, electron backscatter diffraction, and X-ray diffraction to assess weld quality.

URL: https://www.nature.com/articles/s41598-026-57408-2

SCHOLARLY PUBLICATIONS
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Journal Name: Scientific Reports **IF: 4.9**

Title: Exploring tribo-mechanical behavior of B4C Reinforced LM25 aluminum matrix composites for structural applications

Author: Rao P.S.R.; Arunkumar D.T.; Pattanaik A.; Satpathy M.P.; Pati P.R.; Debebe S.T.

Details: Volume-16, Issue-1, December 2026

Abstract: This study reports a comprehensive evaluation of the impact on the mechanical and tribological properties of boron carbide (B4C) particles reinforced with aluminum (LM25) metal matrix composites (MMCs). The synthesis of four different MMCs using the stir casting method and modifying 3, 6, and 9 wt% of 50 µm B4C particulates ensured the reliability of the results. Tensile strength and hardness increased with the rise in B_4C content. 9 wt% B_4C particulates to the LM25 matrix enhanced the hardness from 54.69 BHN to 68.54 BHN and increased the tensile strength from 198.48 MPa to 273.27 MPa. Various tribological (specific wear rate (SWR) and coefficient of friction (COF) characteristics were investigated. A novel hybrid metaheuristic sparrow search algorithm (SSA) was applied in the current study to provide the optimum process parameters and desired SWR and COF values of 2.102 mm3/Nm and 0.476, respectively. Scanning electron microscopy coupled with energy dispersive spectroscopy was used to assess the indigenously developed composites and understand the wear mechanism. The fabricated composites exhibited enhanced mechanical and tribological properties under specified experimental conditions, suggesting their suitability for further exploration in wear-resistant engineering applications.



URL: https://www.nature.com/articles/s41598-026-56791-0

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Journal Name: International Journal of Adhesion and Adhesives **IF: 4.0**

Title: Adhesion and fracture behaviour of curved FRP composite single-lap joints using 1D and 2D functionally graded adhesives: A 3D finite element study

Author: Behera R.K.; Parida S.K.

Details: Volume 150, September 2026

Abstract: This paper presents Three-Dimensional (3-D) non-linear Finite Element (FE) analyses to assess the structural behaviour of curved laminated Fibre Reinforced Plastic (FRP) composite panel-based Single Lap Joints (SLJs) with Functionally Graded Adhesive (FGA) featuring pre-embedded adhesion failure. The principle of the fracture mechanics concept is used to investigate the behaviour of interfacial stresses (peel and shear stresses) along the adhesion failure fronts at critical locations. Corresponding three modes of Strain Energy Release Rates (SERRs) are considered as the damage growth parameters and are evaluated using Linear Elastic Fracture Mechanics (LEFM) based Virtual Crack Closure Technique (VCCT). One of the most significant benefits of FGAs over homogeneous adhesives is that the material properties change continuously in the desired direction from point to point, although these materials are microscopically inhomogeneous. FGA bonded joints have a continuous change in the adhesive properties throughout the bonded region, allowing for the homogeneity of stress distribution and load transmission to increase the load-carrying capacity. A series of numerical simulations has been performed using both unidirectional (1D) and bidirectional (2D) FGA gradation schemes to identify effective material grading profiles for reducing interfacial stresses and fracture driving forces. The optimum FGA configurations reduced the peak peel stress by up to 68.44%, the longitudinal shear stress by 41.18%, the transverse shear stress by 56.15%, and total SERR by 11.61% compared with the homogeneous adhesive. These results demonstrate the effectiveness of adhesive property gradation in mitigating adhesion failure, enhancing damage tolerance, and extending the service life of curved composite bonded joints.



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Journal Name: Next Nanotechnology **IF: 3.7**

Title: Nanostructured titanium composites in dental implantology: Design, structure-property relationships, biological safety and clinical translation

Author: Panda S.R.; Mishra P.C.; Kar A.K.

Details: Volume 10, December 2026

Abstract: Titanium and titanium alloys remain the dominant dental implant materials because of their strength, corrosion resistance and capacity for osseointegration. However, conventional titanium surfaces do not fully solve clinically relevant problems such as delayed integration in compromised bone, peri-implant infection, stress shielding, aesthetic grey shine-through, corrosion-assisted ion release and limited capacity for local drug delivery. Nanostructured titanium composites and nanocomposite coatings are therefore being developed to combine the mechanical reliability of titanium with nanoscale bioactivity, antibacterial function and controlled surface chemistry. This revised review addresses the specific gap left by earlier reviews: it classifies titanium-based nanocomposites by reinforcement chemistry and implant function, and connects nanoscale reinforcement size, morphology, dispersion and interfacial stability with mechanical, corrosion, osteogenic and antibacterial performance. Key aspects of ceramic, metallic, carbon-based, polymeric and bioactive and functionally graded (FG) titanium nanocomposites are critically analysed in terms of hydroxyapatite crystallinity, phase stability, coating adhesion as well as surface roughness, wettability, nano-topography and passive oxide-layer protection in oral environments. The quantitative findings of representative studies are summarized differentiating experimentally achieved performance gains from those proven clinically beneficial. It also reviewed the cytotoxicity and long-term risks of silver, nickel/cobalt, graphene derivatives, nanotubes and detached nanoparticles. While in vitro and animal studies support enhanced osteoblast response, corrosion protection and antibacterial activity, clinical evidence is thin, heterogeneous, and insufficient to confidently assert 3D-printed metal structures offer improved long-term implant survival - hydroxyapatite [HA]-coated or micro-rough titanium systems have well-established results. Next steps toward translation will require standardized assays, reproducible manufacturing, validated sterilization process and in vivo studies with proper power that would allow clinical trials.



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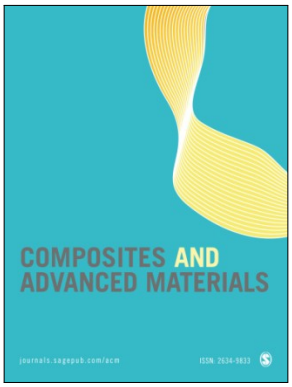
Journal Name: Composites and Advanced Materials **IF: 3.4**

Title: Machine learning-driven design and mechanical performance evaluation of sustainable bamboo wood/LD sludge reinforced epoxy composites

Author: Purohit A.; Pati P.R.; Kumar S.S.; Parida R.K.; Kumar A.; Jena H.

Details: Volume-35, January- December, 2026

Abstract: This research presents a report on synergetic effect of hybrid fillers, i.e. bamboo wood dust (BWD) and Linz-Donawitz sludge (LDS) on the mechanical behavior of epoxy-based composites. The neat epoxy has a density of 1.1 g/cc and it decreases with the incorporation of BWD and LDS. The increase in BWD content to 6 wt.% clearly causes an improvement in microhardness, flexural, tensile and impact strengths. The tensile strength increases from 48.25 MPa for neat epoxy (EP) to 59.18 MPa for epoxy with 10 wt.% LDS and 6 wt.% BWD addition (EP-LD-6BWD). In the same way, flexural strength increases from 22.62 MPa for EP to 27.27 MPa for EP-LD-6BWD composite. The strength of the composite under impact load and the micro-hardness also increase significantly, from 12.32 kJ/m2 and 13.31 Hv for EP to 23.55 kJ/m2 and 22.23 Hv for EP-LD-6BWD and EP-LD-8BWD composites, respectively. The three machine learning models, decision tree, random forest and support vector regression (SVR), are also used to analyse and compare the density, tensile, flexural, impact and micro-hardness properties of the epoxy-based composites. Of these, the SVR model best predicted tensile strength and flexural strength with R2 values of up to 0.9238 and 0.9404, respectively, and prediction errors <1.5 MPa.



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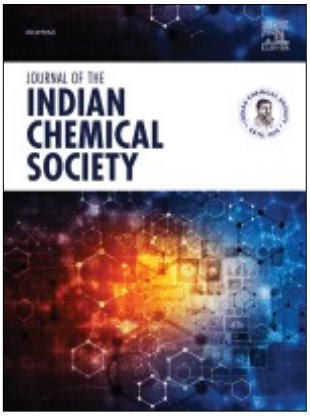
Journal Name: Journal of the Indian Chemical Society **IF: 3.4**

Title: Crystallographic evolution and oxide chemistry controlling the microstructural stability and functional performance of CeO2-and Ta-reinforced HVOF-sprayed NiCoCrAlY coatings on Inconel-625

Author: Anusha K.; Dash A.S.; Chakrabarty S.; Das S.; Routara B.C.; Guha S.

Details: Volume-103, Issue-11, November 2026

Abstract: This study highlights a comparative material design approach to customize the structural, tribological, and corrosion performance of HVOF-sprayed NiCoCrAlY coatings deposited on Inconel-625 substrate through the reinforcement of CeO2 and Ta. NiCoCrAlY was modified by the 1 & 2 wt% of CeO2 and Ta to explore the influence of ceramic and metallic reinforcement strategies on coating evolution and degradation behaviour. A combination of XRD, FESEM/EBSD, Raman spectroscopy, XPS, Wear Analysis, and electrochemical behaviour was utilized to establish a structure–microstructure–surface chemistry–property relationship. All coatings retained the characteristic γ-Ni/β-NiAl phase constitution without detectable undesirable secondary phases. CeO2 promoted crystallite refinement as the crystallite size decreasing from 32.4 nm for unreinforced NiCoCrAlY to 23.7 nm at 2 wt% CeO2, accompanied by increased peak broadening and lattice distortion. Conversely, Ta enhanced the crystallite size to 39.6 nm and reduced the FWHM to 0.22° at 2 wt% Ta which indicates crystallographic stabilization through solid-solution strengthening. Surface chemical analysis further revealed distinct reinforcement-dependent oxide chemistry, with CeO2 promoting a Ce3+/Ce4+-associated, oxygen-vacancy-mediated oxide environment, while Ta favoured the development of a Ta2O5-rich protective layer. The 2 wt% CeO2 coating displayed the most favourable tribological performance as it achieved a CoF of approximately 0.48 and a specific wear rate of 2.17 × 10−4 mm3/Nm, whereas 1 wt% Ta provided the lowest corrosion rate of 2.14 × 10−3 mm year−1. The results establish that reinforcement chemistry and concentration can be used as independent materials-design parameters to preferentially fit NiCoCrAlY coatings for wear and corrosion resistance.



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Journal Name: IEEE Journal on Exploratory Solid-State Computational Devices and Circuits **IF: 3.1**

Title: Defect-Engineered Mn-Doped ZnO Memristors for Hardware-Aware Neuromorphic Image Classification

Author: Bharti R.; Sasmal L.; Chaturvedi S.; Thakur A.D.

Details: 2026

Abstract: The practical deployment of neuromorphic hardware requires active materials with precisely controlled defect dynamics to govern charge transport and synaptic plasticity. While pristine ZnO offers a structurally favorable switching platform, the stochastic distribution of native defects often results in poor switching uniformity and compromised retention. In this study, we utilize Mn incorporation as a defect-engineering strategy to spatially tailor the defect landscape of ZnO, significantly enhancing its resistive switching and neuromorphic capabilities. Sol-gel synthesized Mn-doped ZnO (Mn:ZnO) thin films were integrated into Ag/Mn:ZnO/ITO memristive stacks, exhibiting robust bipolar resistive switching mediated by the reversible formation of oxygen vacancy-based conductive filaments. The optimized devices demonstrate stable and repeatable switching behavior, maintaining distinct high- and low-resistance states over 500 cycles with retention exceeding 104 s. Furthermore, the devices successfully emulate critical synaptic functionalities, including short-term potentiation/depression (STP/STD), paired-pulse facilitation/depression (PPF/PPD), and long-term potentiation/depression (LTP/LTD). By mapping the experimentally extracted conductance values and non-linearity indices to off-chip artificial neural networks (ANN) and convolutional neural networks (CNN), we achieved hardware-constrained image classification accuracies of 93.4% on Fashion-MNIST and 90.8% on CIFAR-10 datasets. These findings highlight doping-controlled defect modulation as a highly viable pathway for developing reliable, hardware-oriented neuromorphic computing platforms.



URL: https://ieeexplore.ieee.org/document/11711128

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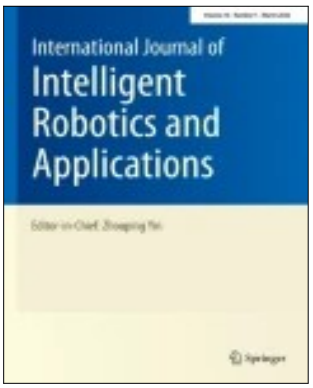
Journal Name: International Journal of Intelligent Robotics and Applications **IF: 3.0**

Title: Semi-supervised adversarial autoencoder for real-time gait phase detection in lower-limb exoskeletons for post-stroke rehabilitation

Author: Rana R.K.; Pandey A.; Satapathy S.

Details: 16th October, 2026

Abstract: Accurate real-time detection of the lower limb gait phase is imperative to the safe and effective control of robotic exoskeletons, especially those used by post-stroke individuals with hemiparetic gait patterns; yet, current data science algorithms that are supervised-based are highly dependent on large amounts of labeled training data acquired from healthy subjects, thereby unable to generalize well to pathologies, while fully supervised deep learning models need more than 90% pathological data to ensure acceptable accuracy above 90%, with heuristic thresholds not being robust enough to cope with inter-subject variations and gait variations due to fatigues or compensations. Therefore, in this paper, we introduce a novel approach to four-class gait phase detection called Semi-Supervised Adversarial Autoencoder (SS-AAE), including stance, push-off, swing, and heel-strike phases on a powered exoskeleton, and hosting our entire deep learning algorithm in Google Colab (Tesla T4 GPU, 16 GB VRAM), receiving streaming sensor data sent by a light edge client on the exoskeleton over WebSocket. Our framework introduces three major components: first, the multi-modal sensors that measure inertial measurement units from thigh, shank, and foot regions at 200 Hz, surface electromyogram (sEMG) of the rectus femoris, biceps femoris, and gastrocnemius muscles at 1 kHz, and plantar pressure with four zones in each foot at 200 Hz; second, an adversarial autoencoder that learns a complex latent space from unlabeled training data gathered from both healthy subjects (n=20) and stroke patients (n=10), with no need for any ground truth label; third, a semi-supervised classification scheme that is trained based on merely 10% of labeled data acquired from stroke patients (five minutes of walking) and can provide generalization to pathologies along with an online domain adaptation mechanism using entropy thresholding (0.3) and buffer-based re-labeling of samples to update the classifier in a continual manner every 500 time steps.



URL: https://link.springer.com/article/10.1007/s41315-026-00605-z