SCHOLARLY PUBLICATIONS
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Journal Name: IEEE Transactions on Consumer Electronics **IF: 10.9**

Title: Next-Gen Smart Healthcare Using UAV Assisted Cooperative Communication: A Deep Learning Approach

Author: Pattepu S.; Datta A.; Appasani B.; Khan M.S.; Mukherjee A.; Novak M.

Details: Volume 71, Issue 1, Feb 2025

Abstract: Unmanned aerial vehicles (UAVs) are evolving rapidly and are revolutionizing the operation of several applications. An important application that can be significantly improved with UAV-assisted communication is healthcare. Wearable devices can be worn on the body and are equipped with sensors that can detect and monitor various physiological parameters. The data collected by these devices can be used to track changes in health status over time, identify potential health risks, and inform clinical decision-making. The novelty of the work is that it considers multi-antenna UAVs for communicating patient data collected from various wearable devices. It also proposes a hybrid relaying scheme incorporating deep learning (DL) for improved performance. The UAVs have pre-trained deep neural networks (DNNs) to process patient data and make accurate decisions without forwarding it to the healthcare facility. A two-layer deep neural network has been used at the UAV with a training accuracy of 99.6%, validation accuracy of 96.6%, and test accuracy of 96.62%. The UAV relays the data to the healthcare facility for expert opinion if it cannot make decisions with the desired accuracy. In this scenario, the optimum UAV and transmit antenna are selected, and a hybrid relaying scheme is used to minimize the network outage and maximize the throughput. The communication model is built, and extensive simulations are performed using patient data to demonstrate the approach. The work will significantly impact the use of UAVs for smart healthcare.

URL: https://ieeexplore.ieee.org/document/10758788

SCHOLARLY PUBLICATIONS
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Journal Name: IEEE Internet of Things Journal **IF: 8.9**

Titles: Responsible Image Communication-Oriented Federated Impulsive Controlled Synchronization Model For IIoT-Coupled Complex Networks

Author: Yang S.; Ruan D.; Chakraborty C.; Guo Z.; Alfarraj O.; Soufiane B.O.

Details: June 2025

Abstract: The Industrial Internet of Things coupled complex networks (IIoT-CCNs) contain a large and diverse number of nodes, whose states are inherently random and complex. In this context, federated learning can play a significant role. It allows different nodes or subsets of the IIoT-CCNs to train local models without the need to transfer all their raw data to a central server. This paper firstly establishes a more general IIoT-CCNs model, where the communication channel may not be completely opened between coupled nodes. When integrating federated learning, the nodes can collaboratively train a global model while safeguarding their own data sovereignty. Secondly, a pinning impulsive controller is designed to make IIoT-CCNs realize synchronization. Thirdly, by utilizing regroup method and step-function methods, some useful and novel synchronization stability conditions have been obtained. Finally, the application of synchronization with regard to responsible image communication is executed. The feature values of node data can be extracted through the image encryption algorithm, and then using synchronized chaotic sequences obtained from encryption to ensure the security of image information in the transmission process. Even in a federated learning-enabled IIoT-CCNs, the encrypted data and synchronized sequences can be managed in a way that respects the privacy and security requirements. It also ensures that legitimate recipients can simultaneously obtain the correct keys according to the image encryption algorithm. By utilizing the histogram and adjacent pixel correlation analysis to verify the effectiveness of the encryption scheme.

URL: https://ieeexplore.ieee.org/document/11045139

SCHOLARLY PUBLICATIONS
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Journal Name: IEEE Journal of Emerging and Selected Topics in Power Electronics **IF: 4.9**

Title: Sector Wise Modified Droop Control to Improve Voltage Regulation and Current Sharing in Parallel Boost Converter Interfaced DC Microgrid

Author: Ramana M.; Santra S.B.; Chatterjee D.; Siwakoti Y.P.

Details: Vol. 13, Issue 3, Jun 2025

Abstract: Photovoltaic (PV) panel interfaced multiple parallel boost converter with storage interface is essential for forming dc microgrid. Impedance shaping or droop coefficient adjustment of individual converters is essential to achieve better voltage regulation (VR) and proportional current sharing. However, the voltage droop with increased loading is not linear even with dual-loop control, where the outer loop is voltage mode with droop coefficient adjustment and the inner one is a current loop. The loading range is narrow to maintain VR within the limit. This nonlinearity in droop coefficient after certainly, enhanced loading is due to load-dependent converter output impedance and converter nonidealities. In this work, a sector-wise modified droop coefficient adjustment control is proposed which ensures enhanced loading operation of individual converters while maintaining the VR constraints. This article also proposes an optimal droop coefficient, enhancing current distribution, which ultimately decreases circulating current and conduction losses. The proposed control method is simulated in PSIM and experimentally validated in 1.5 kW, 48 V extra low voltage dc (ELVdc) Microgrid Set-Up.

URL: https://ieeexplore.ieee.org/document/10735211

SCHOLARLY PUBLICATIONS
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Journal Name: IEEE Transactions on Computational Social Systems **IF: 4.9**

Title: A Robust Aggregation of Federated Large Language Models for Multimodal Knowledge Discovery in Computational Social Systems

Author: Chen J.; Chakraborty C.; Polavarapu A.; Qiu Y.; Zhao Q.; Alfarraj O.; Yu K.

Details: June 2025

Abstract: Amid a rapidly evolving information era, large-scale multimodal knowledge discovery in computational social systems emerges as a key research domain. Large language models (LLMs) play a crucial role in this field, providing contextual understanding and task adaptability. Yet, centralized training of LLM raises privacy concerns. Federated learning (FL) offers a distributed alternative, but it struggles with data heterogeneity and security issues related to model parameters. To this end, we propose a robust aggregation method that leverages the relative total distance of models to improve global model performance in heterogeneous settings, complemented by Cheon-Kim-Kim-Song (CKKS) encryption to secure parameters against parameter stealing without performance loss. Extensive numeric results show our approach excels in LLM testing, scoring 3.74 on MTBenchmark and 8.17 on Vicuna, outperforming state-of-the-art FL methods against data heterogeneity challenges. It also achieves consistent gains on image datasets such as SVHN, CIFAR10, MNIST, TinyImageNet200, and CIFAR100, TinyImageNet200. In summary, our method offers an effective solution for secure multimodal data analysis in computational social systems.

URL: https://ieeexplore.ieee.org/document/11073569

SCHOLARLY PUBLICATIONS
School of Electronics Engineering
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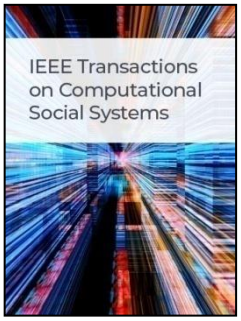
Journal Name: IEEE Transactions on Computational Social Systems **IF: 4.9**

Title: CerviSpectraDiag: An Explainable Privacy-Preserved Federated Framework for Early Detection of Cervical Cancer

Author: Mukhopadhyay S.; Haider N.; Chakraborty C.; Mitra P.; Ghosh S.K.

Details: 03 June 2025, Article

Abstract: The early stages of cervical cancer (CC) cause mainly morphological changes in cellular structures, which biopsy techniques effectively detect with high diagnostic accuracy. However, biopsies can be costly and sometimes painful, with diagnostic reports often requiring several days to weeks, depending on available healthcare resources. These delays and expenses pose significant challenges for women in underserved communities who may have limited access to timely and affordable healthcare. Our CerviSpectraDiag framework and lightweight web app provide painless, cost-effective, and efficient solutions, providing diagnosis reports in just a few seconds while ensuring the privacy of sensitive patient data. The lightweight nature of the app allows functionality even on devices with limited resources. This framework integrates two key components: lightweight personalized federated CerviSpectra you only look once (YOLO) for classification and CerviSpectraLangChain for generating explanations. The lightweight personalized federated CerviSpectraYOLO architecture was deployed across three randomly chosen local network nodes, achieving an average top-1 accuracy of 84.73%, surpassing other lightweight personalized federated YOLO architectures such as YOLOv8 (83%), YOLOv9 (83.4%), and YOLOv10 (83.4%) in classifying earlystage CC. It distinguishes between normal, grade-I, grade-II, and grade-III precancerous cervical spectral samples. The CerviSpectraLangChain component generates detailed explanations for diagnosis and treatment guidance in both English and Hindi. The CerviSpectraDiag app includes separate dashboards for patients and doctors.



URL: https://ieeexplore.ieee.org/document/11022709

SCHOLARLY PUBLICATIONS
School of Electronics Engineering
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Journal Name: Biomedical Signal Processing and Control **IF: 4.9**

Title: Preprocessing and frame level classification framework for cardiac phase detection in 2D echocardiography

Author: Singh G.; Darji A.D.; Sarvaiya J.N.; Patnaik S.

Details: Volume 107, September 2025

Abstract: Accurate detection of end-diastole (ED) and end-systole (ES) frames is a crucial step in cardiac function analysis, enabling precise measurement of ventricular volume, ejection fraction (EF), and stroke volume (SV). However, this task is challenging due to variations in cardiac structure, heart rate fluctuations associated with clinical conditions, and the low-resolution nature of echocardiographic sequences. This study addresses these challenges by introducing three preprocessing steps — noise reduction via heart rate formulation, video frame synchronization, and non-oscillating mean absolute frame difference — to denoise and enhance the EchoNet-Dynamic dataset. Additionally, the echo phase detection problem is reformulated as a frame-level binary classification task to mitigate class imbalance between diastole and systole phases. The proposed architecture employs a time-distributed convolutional neural network (CNN) to extract spatial features, followed by a bidirectional long short-term memory (BiLSTM) network to capture temporal dynamics, and a classification layer for phase prediction. The model achieves an average absolute frame distance of 1.02 and 1.04 frames for ED and ES frames, respectively, on the preprocessed EchoNet-Dynamic dataset. To ensure better generalization, the model was also validated on the CAMUS dataset and private data, where it demonstrated consistent performance and robust results. These findings significantly enhance the reliability of cardiac metrics, offering clinicians a precise and efficient tool for echocardiographic analysis.

URL: https://www.sciencedirect.com/science/article/pii/S1746809425003143?via%3Dihub

SCHOLARLY PUBLICATIONS
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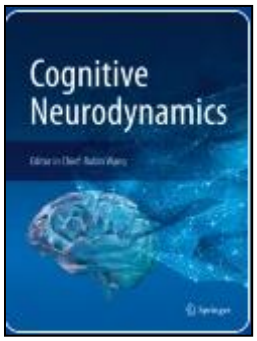
Journal Name: Cognitive Neurodynamics **IF: 3.9**

Title: Convolutional autoencoder-based deep learning for intracerebral hemorrhage classification using brain CT images

Author: Nageswara Rao B.; Acharya U.R.; Tan R.-S.; Dash P.; Mohapatra M.; Sabut S.

Details: Volume 19, Issue 1, December 2025, Article number 77

Abstract: Intracerebral haemorrhage (ICH) is a common form of stroke that affects millions of people worldwide. The incidence is associated with a high rate of mortality and morbidity. Accurate diagnosis using brain non-contrast computed tomography (NCCT) is crucial for decision-making on potentially life-saving surgery. Limited access to expert readers and inter-observer variability imposes barriers to timeous and accurate ICH diagnosis. We proposed a hybrid deep learning model for automated ICH diagnosis using NCCT images, which comprises a convolutional autoencoder (CAE) to extract features with reduced data dimensionality and a dense neural network (DNN) for classification. In order to ensure that the model generalizes to new data, we trained it using tenfold cross-validation and holdout methods. Principal component analysis (PCA) based dimensionality reduction and classification is systematically implemented for comparison. The study dataset comprises 1645 (“ICH” class) and 1648 (“Normal” class belongs to patients with non-hemorrhagic stroke) labelled images obtained from 108 patients, who had undergone CT examination on a 64-slice computed tomography scanner at Kalinga Institute of Medical Sciences between 2020 and 2023. Our developed CAE-DNN hybrid model attained 99.84% accuracy, 99.69% sensitivity, 100% specificity, 100% precision, and 99.84% F1-score, which outperformed the comparator PCA-DNN model as well as the published results in the literature. In addition, using saliency maps, our CAE-DNN model can highlight areas on the images that are closely correlated with regions of ICH, which have been manually contoured by expert readers. The CAE-DNN model demonstrates the proof-of-concept for accurate ICH detection and localization, which can potentially be implemented to prioritize the treatment using NCCT images in clinical settings.



URL: https://link.springer.com/article/10.1007/s11571-025-10259-5

SCHOLARLY PUBLICATIONS
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Journal Name: Scientific Reports **IF: 3.8**

Title: Optimized placement of distributed generators, capacitors, and EV charging stations in reconfigured radial distribution networks using enhanced artificial hummingbird algorithm

Author: Sahay S.; Biswal S.R.; Shankar G.; Jha A.V.; Appasani B.; Srinivasulu A.; Nsengiyumva P.

Details: Volume 15, Issue 1, December, 2025

Abstract: This study presents an assessment of concurrently identifying the best location and size of distributed generators (DGs), shunt capacitors (SCs), and electric vehicle charging stations (EVCSs) in optimally reconfigured radial distribution networks (RDNs). A comprehensive literature review indicates that this multi-unit combination has the potential to enhance RDN performance significantly, but it remains an underexplored area of research. Therefore, further in-depth investigation is necessary to understand and fully maximize the benefits of this method. The optimal placement and sizing (OPS) of the mentioned multi-unit in RDNs is realized by employing a metaheuristic optimization technique subject to the fulfillment of a well-defined fuzzified-objective function comprising of line losses reduction, power factor improvement, voltage deviation reduction, and DG penetration limit. Employing the concept of centroid-based oppositional learning (COL), an improved version of the artificial hummingbird algorithm (AHA), named COLAHA, is proposed to decipher the adopted issue. The results achieved utilizing the offered approach are matched with those of the additional innovative algorithms such as the basic AHA, arithmetic optimization algorithm, genetic algorithm, and whale optimization algorithm. By evaluating it against several benchmark functions, the effectiveness of the proposed COLAHA is established. The performance of the aforementioned studied algorithms is further tested to find the OPS of DGs, SCs and EVCSs in the standard IEEE 69- and 118-bus RDNs. Results obtained conclude that the COLAHA has offered quick convergence and the best results over the others for all the studied combinations of the multi-unit model.

URL: https://www.nature.com/articles/s41598-025-89089-8

SCHOLARLY PUBLICATIONS
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Journal Name: Scientific Reports **IF: 3.8**

Title: Neural network backstepping control of OWC wave energy system

Author: Nath P.; Mishra S.K.; Jha A.V.; Appasani B.; Pati A.K.; Verma V.K.; Nsengiyumva P.; Srinivasulu A.

Details: Volume 15, Issue 1, December 2025

Abstract: This paper investigates the application of Neural Network Backstepping Control (NN-BSC) for enhancing the rotational speed control of Oscillating Water Column (OWC) wave energy systems. Traditional control methods face limitations when dealing with nonlinearities, irregular wave conditions, and actuator disturbances. To address these challenges, this research paper introduces a Chebyshev NN within the BSC framework, leveraging its high approximation accuracy and computational efficiency. The design of the NN-BSC involves estimating the disturbance term using the Chebyshev NN and validating the stability OWC control system through Lyapunov analysis. The proposed NN-BSC law effectively handles nonlinearities and improves system robustness under dynamic conditions. Numerical simulations have been conducted using MATLAB/SIMULINK to compare the performance of the uncontrolled OWC system, conventional PI and BSC, and NN-BSC, under scenarios with and without actuator disturbances. The parameters for PI, BSC, and NN-BSC are optimized using a Particle Swarm Optimization (PSO) algorithm, which minimizes a fitness function defined by the Integral Squared Error (ISE). Results indicate that NN-BSC achieves smoother rotor speed tracking, particularly under actuator disturbances, where the conventional PI and BSC exhibits significant performance degradation in terms of ISE. Under actuator disturbance scenarios: (1) NN-BSC achieved the lowest ISE value of 22.5433, outperforming PI (40.6381) and BSC (37.1192), and (2) NN-BSC demonstrated the lowest maximum peak overshoot (0.9651 rad/s) and fastest settling time (0.0561 s).

URL: https://www.nature.com/articles/s41598-025-87725-x

Journal Name: IEEE Access **IF: 3.4**

Title: Sb-PiPLU: A Novel Parametric Activation Function for Deep Learning

Author: Mondal A.; Shrivastava V.K.; Chatterjee A.; Ramachandra R.

Details: Volume: 13, Article, 2025

Abstract: The choice of activation function—particularly non-linear ones—plays a vital role in enhancing the classification performance of deep neural networks. In recent years, a variety of non-linear activation functions have been proposed. However, many of these suffer from drawbacks that limit the effectiveness of deep learning models. Common issues include the dying neuron problem, bias shift, gradient explosion, and vanishing gradients. To address these challenges, we introduce a new activation function: Softsign-based Piecewise Parametric Linear Unit (Sb-PiPLU). This function offers improved non-linear approximation capabilities for neural networks. Its piecewise, parametric design allows for greater adaptability and flexibility, which in turn enhances overall model performance. We evaluated Sb-PiPLU through a series of image classification experiments across various Convolutional Neural Network (CNN) architectures. Additionally, we assessed its memory usage and computational cost, demonstrating that Sb-PiPLU is both stable and efficient in practical applications. Our experimental results show that Sb-PiPLU consistently outperforms conventional activation functions in both classification accuracy and computational efficiency. It achieved higher accuracy on multiple benchmark datasets, including CIFAR-10, CINIC-10, MWD, Brain Tumor, and SVHN, surpassing widely-used functions such as ReLU and Tanh. Due to its flexibility and robustness, Sb-PiPLU is particularly well-suited for complex image classification tasks.

URL: https://ieeexplore.ieee.org/document/10966899

SCHOLARLY PUBLICATIONS
School of Electronics Engineering
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Journal Name: International Journal of Robust and Nonlinear Control **IF: 3.2**

Title: Fractional Standalone Backstepping Control for Nonlinear Continuous Stirred Tank Reactor

Author: Ramana M.; Santra S.B.; Chatterjee D.; Siwakoti Y.P.

Details: July 2025

Abstract: Controlling the molar concentration in a chemical reactor is a challenging task in the presence of noise and disturbance. Contrary to the reported works based on augmented method, this work proposes a novel fractional order standalone backstepping rule as a feasible alternative to stabilize the concentration of a nonlinear continuous stirred tank reactor process. The novel indirect biquadratic equiripple approximation technique is suggested to realize the behavior of fractional order element in the proposed rule with a suitable integer order process. The proposed approximation method is further modified by an additional exact phase approach to enhance the behavior of fractional order element. A comprehensive simulation study on both frequency and time domain platforms is carried out to establish the suitable fractional order in the proposed law. Closed-loop performance and control efforts obtained through simulation studies vindicate that the proposed technique outperforms existing control strategies without unnecessary overshoots and yields relatively smooth control action in the presence of noise and disturbance. By abruptly altering the system settings, the robust stability investigation of the proposed rule is also carried out in the presence of load disturbance and noise. This proposed technique offers greater accuracy by resulting in less integral errors and total variation of input control action in both nominal and perturbed circumstances.

URL: https://onlinelibrary.wiley.com/doi/10.1002/rnc.70058