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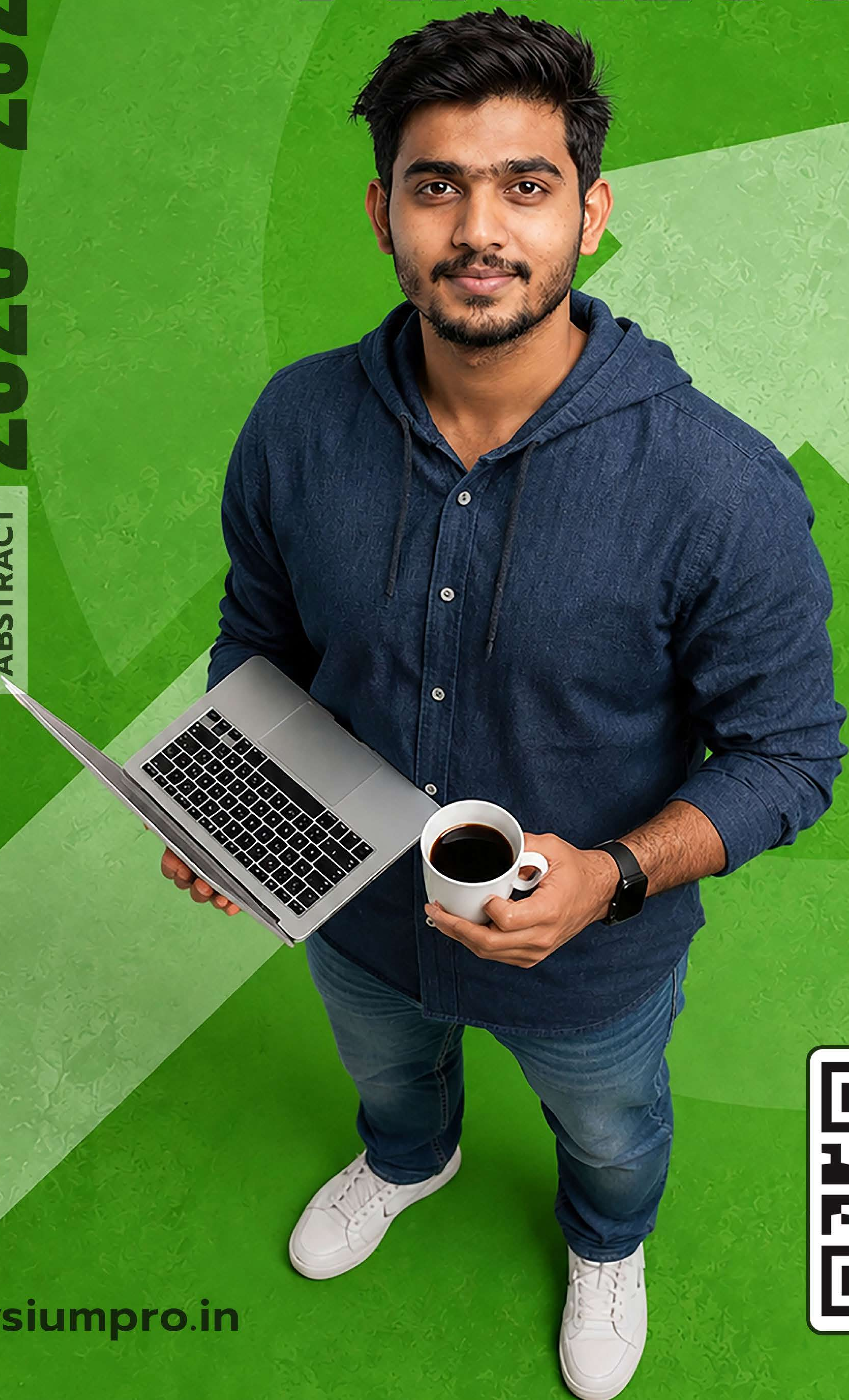
SIGNAL PROCESSING

2026 - 2027

TITLE & ABSTRACT



Advanced Academic Final Year Projects

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Homopolar Rotor Slot Harmonics for Inter-Turn Fault Detection in Induction Motors

PROJ24009

This project develops a signal processing-based system for detecting inter-turn faults in induction motors. Motor current and voltage signals are acquired and analyzed to identify rotor slot harmonic characteristics. Signal preprocessing techniques such as filtering, noise reduction, and spectral analysis are applied to extract fault-related components. MATLAB can be used to analyze frequency-domain variations and identify abnormal harmonic patterns. The system provides an efficient approach for early motor fault detection and condition monitoring.

Machine Learning-Based System for Diagnosing Broken Bars in Three-Phase Induction Motors With Reduced Electrical Sensing

PROJ24020

This project focuses on detecting broken rotor bars in three-phase induction motors using reduced electrical sensing. Motor current signals are collected and processed to extract time-domain and frequency-domain features. Signal processing techniques such as FFT, filtering, and spectral analysis are used to identify fault characteristics. Machine learning models classify healthy and faulty motor operating conditions. The system reduces sensing requirements while providing reliable motor condition diagnosis.

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Density-Based Adaptive Mode Decomposition

PROJ24009

This project develops an adaptive signal decomposition method for separating complex signals into meaningful components. Density-based analysis is used to identify signal characteristics and determine suitable decomposition modes. MATLAB signal processing techniques can be applied for filtering, decomposition, and reconstruction. The extracted modes can be analyzed in both time and frequency domains. The proposed approach helps improve the analysis of non-stationary and nonlinear signals.

Moving Speaker Separation via Parallel Spectral-Spatial Processing

PROJ24020

This project develops a signal processing system for separating speech signals generated by moving speakers. Audio recordings are analyzed using spectral and spatial characteristics to distinguish individual sound sources. Time-frequency transformations and spatial filtering techniques are used to separate overlapping speech signals. MATLAB can be used to visualize spectrograms and evaluate separation performance. The system can support applications such as smart communication devices, surveillance, and speech enhancement.

Multi-Sensor Distributed Fusion Estimation for Tk-Proper Factorizable Signals in Sensor Networks With Fading Measurements

PROJ24009

This project develops a distributed signal estimation framework for sensor networks operating under fading communication conditions. Multiple sensors collect observations that may be affected by noise and transmission degradation. Signal processing techniques combine information from different sensor nodes to estimate the original signal accurately. Distributed fusion reduces dependency on a centralized processing unit. The system improves signal estimation reliability in wireless and distributed sensing environments.

Variational Inference of Structured Line Spectra Exploiting Group-Sparsity

PROJ24020

This project develops a signal processing method for estimating structured spectral components from noisy observations. Group-sparsity techniques are used to identify significant frequency components while reducing irrelevant information. Variational inference estimates the underlying spectral structure efficiently. MATLAB can be used for spectral analysis, optimization, and visualization of reconstructed signals. The approach is useful for applications involving sparse frequency estimation and signal reconstruction.

Manifold Learning Approaches for Characterizing Photoplethysmographic Signals

PROJ24009

This project develops a signal processing framework for analyzing photoplethysmographic signals obtained from wearable or optical sensors. The signals are preprocessed using filtering and noise-removal techniques to reduce motion and measurement artifacts. Manifold learning is used to identify meaningful patterns and low-dimensional representations within the signal data. Extracted features can be analyzed for physiological characteristics and signal quality. The system supports non-invasive monitoring and biomedical signal analysis.

Beamforming Design for Minimizing the Signal Power Estimation Error

PROJ24020

This project develops a signal processing-based beamforming system for improving signal power estimation. Multiple antenna signals are combined using optimized beamforming weights. Signal correlation and interference characteristics are analyzed to minimize estimation errors. MATLAB can be used to simulate antenna arrays, beam patterns, and signal power measurements. The system improves signal quality and estimation accuracy in wireless communication applications.

Neural Audio Synthesis for Sound Effects: A Scope Review

PROJ24009

This project investigates neural audio synthesis techniques for generating realistic sound effects. Audio signals are analyzed in the time and frequency domains to understand their acoustic characteristics. Signal processing techniques such as spectrogram generation, filtering, feature extraction, and audio reconstruction are explored. Machine learning models can learn patterns from existing sound-effect datasets and generate new audio signals. The project demonstrates the role of signal processing in intelligent audio generation.

Deep Learning-Based Inpainting for Sparse Arrays in Ultrafast Ultrasound Imaging

PROJ24020

This project develops a signal processing framework for reconstructing missing information in sparse-array ultrasound measurements. Ultrasound signals are preprocessed to reduce noise and identify incomplete measurement regions. Signal reconstruction and deep learning-based inpainting techniques estimate missing information from available measurements. MATLAB can be used for signal visualization, reconstruction, and quality evaluation. The system aims to improve ultrasound image quality while reducing the number of sensing elements.

SUP-Net: Slow-Time Upsampling Network for Aliasing Removal in Doppler Ultrasound

PROJ24009

This project focuses on reducing aliasing artifacts in Doppler ultrasound signals. Doppler measurements are processed in the slow-time domain to identify insufficient temporal sampling and flow-related distortions. Upsampling techniques reconstruct additional temporal information to improve signal representation. Signal filtering and frequency-domain analysis are used to evaluate the processed Doppler signals. The system provides improved visualization and analysis of blood-flow information.

On the Characteristics of the Conjugate Function Enabling Effective Dual Decomposition Methods

PROJ24020

This project studies signal optimization techniques based on conjugate functions and dual decomposition. Mathematical signal models are transformed into optimization problems to efficiently estimate desired signal parameters. Convex analysis and decomposition techniques are applied to separate complex optimization tasks into simpler components. MATLAB can be used to implement algorithms and compare convergence behavior. The project demonstrates how mathematical optimization can support efficient signal processing solutions.

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Splatting SA: Direct Rendering of Synthetic Aperture Imagery

PROJ24009

This project develops a signal processing framework for generating synthetic aperture imagery from radar measurements. Radar signals are collected and transformed using suitable frequency-domain and spatial processing techniques. Image reconstruction methods combine multiple observations to produce high-resolution synthetic aperture images. MATLAB can be used for signal processing, image generation, filtering, and visualization. The system supports radar imaging and remote sensing applications.

Wide-Band Cyclic Cross-Correlation Processing

PROJ24020

This project develops a signal processing system for analyzing wide-band signals using cyclic cross-correlation. The method identifies statistical relationships between signal components across different frequency ranges. Filtering, correlation analysis, and frequency-domain transformations are applied to extract useful signal characteristics. MATLAB can be used to visualize correlation functions and spectral properties. The approach is useful for communication signal analysis, detection, and synchronization.

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Physiological Denoising Method for Unbiased Analysis of Biomedical Signals: Application on Heartbeat Dynamics

PROJ24009

This project develops a physiological signal denoising system for improving the quality of heartbeat-related biomedical signals. Raw physiological signals are processed to remove noise, motion artifacts, and unwanted interference. Filtering and adaptive signal processing techniques preserve important cardiac characteristics while reducing distortion. Heartbeat dynamics are then extracted and analyzed from the cleaned signal. The system supports reliable biomedical signal analysis and physiological monitoring.

Phase Correction of MR Spectroscopic Imaging Data Using Model-Based Signal Estimation and Extrapolation

PROJ24020

This project develops a signal processing method for correcting phase errors in MR spectroscopic imaging data. Acquired spectral signals are analyzed to identify phase inconsistencies and measurement distortions. Model-based signal estimation is used to predict phase behavior and perform correction. Frequency-domain analysis is applied to compare original and corrected spectral information. The system improves the reliability of MR spectroscopic signal interpretation.

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PSG-MAE: Robust Multitask Sleep Event Monitoring Using Multichannel PSG Reconstruction and Inter-Channel Contrastive Learning

PROJ24009

This project develops a biomedical signal processing system for monitoring sleep events using multichannel polysomnography signals. EEG, ECG, respiratory, and other physiological signals are preprocessed using filtering and artifact-removal techniques. Multichannel reconstruction helps recover missing or noisy signal segments while learning relationships between different physiological channels. Sleep events can then be identified using machine learning-based classification. The system supports automated sleep monitoring and analysis.

Complex-Valued Convolutional Neural Network With Learnable Activation Function for Frequency-Domain Radar Signal Processing

PROJ24020

This project develops a frequency-domain radar signal processing system using complex-valued signal representations. Radar measurements are transformed into the frequency domain to preserve important amplitude and phase information. Complex-valued convolutional processing extracts meaningful signal features for classification or detection. MATLAB can be used for FFT processing, feature visualization, and performance evaluation. The system improves analysis of radar signals containing complex-valued information.

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Nonlinear Sparse Bayesian Learning Methods With Application to Massive MIMO Channel Estimation With Hardware Impairments

PROJ24009

This project develops a signal processing framework for estimating wireless communication channels in massive MIMO systems. Received antenna signals are affected by noise, nonlinearities, and hardware imperfections. Sparse Bayesian learning is used to estimate important channel parameters while reducing unnecessary computations. MATLAB can simulate antenna arrays, channel conditions, hardware impairments, and estimation performance. The system aims to improve channel estimation accuracy for advanced wireless communication systems.

An Efficient and Unified Framework for Downlink Linear Precoding With QoS Constraints

PROJ24020

This project develops a signal processing framework for efficient downlink precoding in multi-user wireless communication systems. Channel information is processed to calculate suitable transmission weights for multiple users. Optimization techniques are applied to satisfy quality-of-service requirements while controlling interference and transmission power. MATLAB can be used to simulate channel conditions and evaluate signal-to-interference-plus-noise ratio and throughput. The system improves communication reliability and resource utilization in multi-user networks.