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# Section Industrial Electronics



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# Section Information

Industrial electronics play a vital role in improving the efficiency and productivity of industries like energy, transportation, petroleum, chemical, semiconductor, mining, agriculture, and others. As a branch of electronics dealing with power electronic switches, sensors, actuators, meters, intelligent electronic devices (IEDs), automation equipment, semiconductors, nanotechnology, etc., current emphasis is placed on power conditioning using power semiconductor devices in modernizing industry technology.

This Section is devoted to presenting the emerging technologies and trends in the industrial electronics sector, publishing original research and state-of-the-art review articles. The main research area includes applications of industrial electronics and its control, computation, and communication to enrich industrial systems and processes. All submissions are subject to a peer-review process. We encourage the submission of original contributions derived from theoretical- and/or application-oriented research studies.

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**Section Editor-in-Chief**  
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# Selected Papers

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## Multi-Criteria Visual Quality Control Algorithm for Selected Technological Processes Designed for Budget IIoT Edge Devices

**Author:** Piotr Lech

**Abstract:** This paper presents an innovative multi-criteria visual quality control algorithm designed for deployment on cost-effective Edge devices within the Industrial Internet of Things environment. Traditional industrial vision systems are typically associated with high acquisition, implementation, and maintenance costs. The proposed solution addresses the need to reduce these costs while maintaining high defect detection efficiency. The developed algorithm largely eliminates the need for time- and energy-intensive neural network training or retraining, though these capabilities remain optional. Consequently, the reliance on human labor, particularly for tasks such as manual data labeling, has been significantly reduced. The algorithm is optimized to run on low-power computing units typical of budget industrial computers, making it a viable alternative to server- or cloud-based solutions. The system supports flexible integration with existing industrial automation infrastructure, but it can also be deployed at manual workstations. The algorithm's primary application is to assess the spread quality of thick liquid mold filling; however, its effectiveness has also been demonstrated for 3D printing processes....

<https://doi.org/10.3390/electronics14163204>

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## Design Analysis of an Interior Permanent Magnet Synchronous Motor with Hybrid Hair-Pin and Litz Wire Windings

**Authors:** Huai-cong Liu and Minseong Lee

**Abstract:** To meet the demands for weight reduction and cost efficiency, the design of interior permanent magnet synchronous motors (IPMSMs) for electric vehicles is inevitably evolving toward high-speed operation, compactness, and improved efficiency. This paper proposes and analyzes a novel hybrid winding design that combines hair-pin coils and litz wire coils. The objective of this hybrid approach is to leverage the high-fill-factor advantage of hair-pin windings while mitigating the increased high-frequency copper losses caused by skin effect—an area where litz wire excels. Finite element analysis (FEA) is used to evaluate and compare the performance of the proposed hybrid stator design against conventional winding configurations, including round wire windings and pure rectangular windings. Key factors such as fill factor and skin effect are thoroughly considered in the analysis. Additionally, a system-level evaluation is conducted based on assumed electric vehicle parameters, providing a comprehensive assessment of efficiency and energy losses under real-world operating conditions.

<https://doi.org/10.3390/electronics14173350>



## A Comparative Study of Dimensionality Reduction Methods for Accurate and Efficient Inverter Fault Detection in Grid-Connected Solar Photovoltaic Systems

**Authors:** Shahid Tufail and Arif I. Sarwat

**Abstract:** The continuous, effective operation of grid-connected photovoltaic (GCPV) systems depends on dependable inverter failure detection. Early, precise fault diagnosis improves general system dependability, lowers maintenance costs, and saves downtime. Although computing efficiency remains a difficulty, particularly in resource-limited contexts, machine learning-based fault detection presents interesting prospects in accuracy and responsiveness. By streamlining data complexity and allowing faster and more effective fault diagnosis, dimensionality reduction methods play vital role. Using dimensionality reduction and ML techniques, this work explores inverter fault detection in GCPV systems. Photovoltaic inverter operational data was normalized and preprocessed. In the next step, dimensionality reduction using Principal Component Analysis (PCA) and autoencoder-based feature extraction were explored. For ML training four classifiers which include Random Forest (RF), logistic regression (LR), decision tree (DT), and K-Nearest Neighbors (KNN) were used....

<https://doi.org/10.3390/electronics14142916>



## Nominalization of Split DC Link Voltage Dynamics in Three-Phase Three-Level Converters Operating Under Arbitrary Power Factor with Restricted Zero-Sequence Component

**Authors:** Yan Vule and Alon Kuperman

**Abstract:** The paper focuses on linearization of split DC link voltage dynamics and balancing their respective average values in three-phase three-level AC/DC converters. It was recently demonstrated that both AC-side current magnitude and operating power factor impact the dynamics of partial DC link voltage difference, imposing the time-varying behavior of split DC link voltages when a typical linear time-invariant compensator, e.g., proportional or proportional-integrative, is utilized. Consequently, robust split DC link voltage balancing loops would be beneficial. The case of a bandwidth-restricted (DC in a steady state) zero-sequence component employed as a control signal to equalize average partial DC link voltages is considered in this work. It is proposed to nominalize the dynamics of partial DC link voltage difference by means of a linear disturbance observer based on a frequency-selective filter so that the modified dynamics become linear and nearly nominal from a compensator point of view. As a result, the closed-loop response becomes time-invariant—a desirable characteristic of any practical system. Simulations validate the proposed methodology applied to a 10 kVA T-type converter model.

<https://doi.org/10.3390/electronics14132524>

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Guest Editors: Dr. Jincheng Yu, Prof. Dr. Fei Zhao and Dr. Zaixin Song  
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