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ABSTRACT

PRESENTATION

PAPER

Yusra Abdulrahman received her BSc degree with honors from the University of Arizona in engineering management, industrial and systems engineering. She also received her MSc and PhD degrees in iterdisciplinary engineering from the collaborative programme between the Massachusetts Institute of Science and Technology and the Masdar Institute of Science and Technology. In her doctoral research, she was focused on developing sustainable and efficient non-destructive testing and thermal imaging techniques for defect detection using artificial intelligence and data analysis. She has received many awards in energy and research from the Ministry of Energy and Industry. She also has several engineering research papers in international scientific journals. She is a member of the Young Future Energy Leaders Program (YFEL) and Women in Sustainability, Environment and Renewable Energy (WiSER).

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ENHANCING DEFECT DETECTION AND CLASSIFICATION IN LOW-CONDUCTIVE MATERIALS THROUGH PRINCIPAL COMPONENT ANALYSIS IN INFRARED THERMOGRAPHY

Infrared thermography (IRT) has emerged as a valuable tool for detecting and classifying defects in low-conductive materials, particularly in the context of the aviation industry and the testing of carbon-fiber reinforced plastics (CFRP) in airplanes. This study investigates the application of Principal Component Analysis (PCA) to enhance defect detection and classification accuracy in such materials, with a specific focus on integrating 3D-printed samples.

The research emphasizes optimizing defect detection methodologies for low-conductive materials, underscoring the significance of accurate calibration and classification techniques. By incorporating PCA with IRT data obtained from 3D printed samples, notable advancements are achieved in reducing noise and enhancing the clarity of defect images.

Various PCA manipulation techniques, including frequency filtering and normalization of principal components, are explored to improve defect detection sensitivity, thereby underscoring the effectiveness of PCA in highlighting variance within the data and reducing redundancy for more precise defect classification.

Results showcase the efficacy of PCA-enhanced defect detection in diverse low-conductive materials, highlighting the potential for improved classification accuracy and reliability facilitated by integrating 3D printed samples. Furthermore, the study highlights the importance of understanding the unique thermal characteristics of different materials to optimize defect detection methodologies effectively.

In conclusion, this research contributes to advancing defect detection and classification capabilities in low-conductive materials, especially in the aviation industry, for testing CFRP in airplanes. By integrating PCA with infrared thermography and leveraging the advantages offered by 3D printed samples, the findings provide valuable insights for researchers and practitioners seeking to enhance the accuracy and efficiency of defect detection processes in such materials.