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WELD DEFECT DETECTION AND CLASSIFICATION USING DEEP LEARNING

Abstract

Welding is a critical process in many industries, but defects can compromise the structural integrity of welded components. Detecting weld defects using X-ray 2D projection film radiography is crucial in manufacturing especially in the area of critical systems like launch vehicle realization,because failure to recognize defects may even result in launch failure or system underperformance. However, the diverse shapes and sizes of defects pose a challenge for detection models as they vary significantly. X-ray 2D projection film radiography (X-ray Radiography in short) is a Non-destructive Evaluation (NDE) technique that is routinely practiced for the qualification of aerospace welds and castings in Indian Space Research Organization. Automated weld defect detection using deep learning techniques has emerged as a powerful solution to address the challenges of traditional manual inspection. We propose an intelligent hybridization of data augmentation techniques and YOLO V8 architecture for defect detection and classification. This augmentation contributes to achieving a generalized YOLO V8 model trained to handle multi-class datasets for welding defect identification. The model is trained using custom generated x-ray images of aluminum alloy tanks with different defect types including isolated pores, aligned pores, clustered pores and lack of penetration . The images are annotated using labelImg annotation tool and uses different augmentation techniques to enhance the dataset. Experiments are carried out to evaluate the performance of the model, by comparing traditional methods like SVN and KNN, CNN, R-CNN. The results demonstrates that this YOLO-based model has substantial potential for integration into current NDE techniques, offering a smart and efficient solution for effective detection of weld defects.