Chapter 7
Investigation of Computer Vision and Machine Learning to Enhance Quality Control Processes in Aerospace Manufacturing:
Innovative Machine Learning Applications in the Aerospace Industry

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ABSTRACT

The integration of computer vision and machine learning (ML) in aerospace manufacturing has revolutionized quality control processes by enabling

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automated defect detection, predictive maintenance, and real-time monitoring. Traditional quality inspection methods often involve manual assessments, Computer vision systems, powered by deep learning algorithms, enhance defect detection accuracy by analysing images and sensor data, Machine learning further optimizes quality control by predicting potential failures through data-driven insights, reducing production downtime, and improving overall efficiency. This paper explores recent advancements in computer vision and ML for aerospace manufacturing, highlighting their impact on defect classification, anomaly detection, and process optimization. The study also discusses challenges such as data availability, model interpretability, and computational resource requirements. By leveraging intelligent automation, aerospace manufacturers can achieve higher reliability, cost efficiency, and compliance with stringent industry standards.

INTRODUCTION

The aerospace industry demands high precision and reliability in manufacturing processes due to the critical nature of its components. Even minor defects in aircraft structures and engine parts can lead to severe safety risks, increased maintenance costs, and operational inefficiencies. Traditional quality control (QC) methods rely on manual inspection, which is labor-intensive, time-consuming, and prone to human error. As aerospace manufacturing processes become more complex, there is a growing need for advanced inspection techniques that enhance accuracy, efficiency, and consistency, (Agarwal *et al.,* 2023).

Computer vision and machine learning (ML) have emerged as transformative technologies in quality control, enabling automated, data-driven decision-making. Computer vision leverages high-resolution imaging, 3D scanning, and advanced signal processing to identify surface defects, geometric deviations, and material inconsistencies with high precision. Meanwhile, ML algorithms, particularly deep learning models, can analyze vast amounts of data to detect patterns, classify defects, and predict potential failures before they occur. This predictive capability helps manufacturers reduce downtime, optimize maintenance schedules, and improve production efficiency. Recent advancements in artificial intelligence (AI)