

Chapter 3

Transforming Aerospace Design and Manufacturing Through Machine Learning

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ABSTRACT

Machine learning (ML) is driving change in aerospace design and manufacturing in order to increase efficiency, safety, and innovation. Complex designs and requirements required in aerospace industry. ML can improve design quality, support design thinking by generating multiple options, and enhance predictive analytics to detect potential problems. ML makes manufacturing processes smarter by predicting demand and managing resources effectively, increasing operational efficiency and improving product quality. ML helps to prevent errors and increase safety and secu-

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rity through predictive maintenance, non-destructive testing, and anomaly detection. ML can handle challenges such as data collection, interpreting in a safety-critical business context. ML offers great opportunities, from AI-powered innovation and human-machine collaboration to the potential impact of quantum computing in solving complex aerospace problems. Continued advances in machine learning will help to shape the future of aerospace, making machines more efficient, safer, and more innovative.

INTRODUCTION

The aerospace industry (Caliari *et al.*, 2023) is one of the most complex, demanding and high-risk industries in the global economy. Aircraft and its components must meet the latest safety, security and operational standards. Every phase of aerospace manufacturing, from initial design to final production and assembly, requires precision. The design of aerospace systems must take into account not only the mechanical and process complexity, it also the harsh environmental conditions to which these systems will be exposed, such as weather, temperature, pressure and high-speed dynamics. Aerospace manufacturing involves the use of a variety of specialty materials, including composites and alloys, to ensure that the product can withstand operational stresses while minimizing weight and increased workload.

Regulatory bodies (Hartl *et al.*, 2015) such as the Federal Aviation Administration (FAA) in the United States and the European Union Aviation Safety Agency (EASA) in Europe have strict rules that govern all aspects of aviation life, from design and testing to production and maintenance. Compliance with these strict regulations is essential to ensuring the safety and reliability of the aircraft and passenger safety and mission success.

Innovation is the driving force of the aviation industry, with companies and researchers eager to create more efficient, lighter, and more environment friendly aircraft. Balancing innovation with strict regulatory compliance poses a unique challenge for aviation engineers and manufacturers. Achieving both goals requires not only top-notch expertise, but also new technologies that can increase accuracy, reduce costs, and speed up rapid growth.

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