



ROBOTIC ADDITIVE
MANUFACTURING:

CHARTING NEW
WATERS IN
MARINE
ENGINEERING

Introduction

The marine industry is undergoing a significant technological transformation driven by the need for enhanced performance, sustainability, and cost efficiency. Advanced Robotic Additive Manufacturing represents a pivotal innovation that combines the precision, and flexibility of robotic systems, with the capabilities of additive manufacturing. This white paper delves into the role of Advanced Robotic Additive Manufacturing in the marine industry, highlighting the current traditional manufacturing challenges, the promise of additive manufacturing and the applications within the marine industry.

The Paradigm Shift in Marine Engineering

Traditional Manufacturing Challenges

The maritime industry has relied on traditional manufacturing techniques to produce the essential components and structures used in marine engineering. While these methods have proven effective over time, they often hinder efficiency and innovation. The key issues include long lead times, high costs, and limited product customizability.



Long Lead Times: Custom parts require extensive setup and tooling, leading to prolonged production timelines.



High Costs: The bespoke nature of marine components results in high material wastage and labor costs.



Limited Customizability: Modifying existing designs is often complex and expensive.

The Promise of Additive Manufacturing

Advanced robotic additive manufacturing answers many challenges being faced by the marine industry. The primary benefits of this powerful alternative include cost efficiency, rapid prototyping and production, and design flexibility.



Rapid Prototyping and Production: Significant reduction in lead times from design to final product.

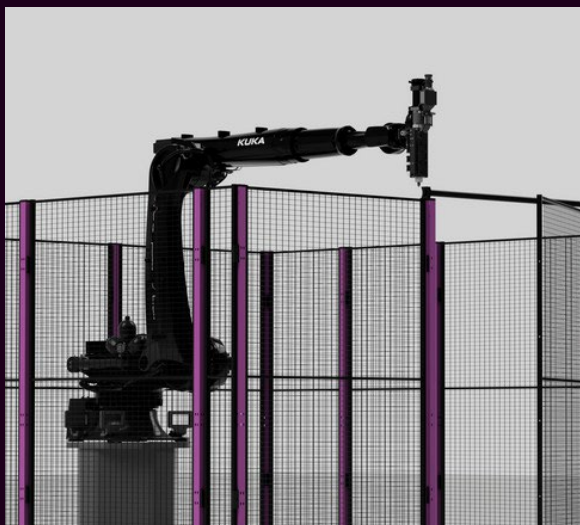


Cost Efficiency: Lower material wastage and reduced labor requirements.



Design Flexibility: Easy customization and iteration of designs without retooling.

Introduction to Rapid Fusion



Rapid Fusion is transforming the large-format additive manufacturing industry with versatile, efficient, and sustainable solutions within the marine sector. Apollo is the principal Additive manufacturing platform from Rapid Fusion, offering the design freedoms of high deposition pellet additive manufacturing using our state-of-the-art range of extruders and the reliability of KUKA robotics.

Core Features

Robotic Precision: The robotics within the Apollo system are optimized for dynamic performance, ensuring high-quality robotic precision.

Versatile Material Use: The PE320 Pellet Extruder allows for efficient extrusion of various materials, including abrasive materials such as carbon fiber.

Scalability: The extruder offers plug-and-play convenience, allowing you to integrate and scale your current setup seamlessly.

Technological Innovations

- ♦ **Tailored Retraction Algorithm:** Offering dynamic retraction control and real-time adjustments, our retraction algorithm minimizes material waste by precisely controlling the retraction process. The improved capabilities in retraction enable faster printing speeds without compromising on quality.
- ♦ **Real-Time Synchronization:** The introduction of an algorithm that dynamically adjusts the extrusion rate ensures consistent layer width and eliminates issues like oozing and stringing. The seamless integration of the algorithm maintains optimal performance throughout the process.
- ♦ **Multi-Axis Printing:** Utilizing the 6-axis robot arm, Apollo offers multi-axis printing, delivering quality, and efficiency. The Kuka KR 120 R3900 2 K 1 Robot is suited to both additive and subtractive milling.

Applications in Marine Manufacturing

There are a number of applications and advantages of manufacturing components in the marine industry. Below are a few examples of how advanced robotic additive manufacturing can produce various marine components.

Shipbuilding and Repair

Custom Components: Production of bespoke parts such as propellers, hull components, and internal fixtures with precise dimensions and material properties.

Maintenance and Repairs: Immediate production of parts for maintenance and repairs reduces downtime and logistical costs. The ability to quickly produce replacement parts also minimizes the need for extensive inventories.

Lightweight Structures: Manufacturing lightweight, yet durable components enhance fuel efficiency and reduces emissions for marine vessels.

Offshore Structures

Complex Geometries: Enabling the production of intricate and optimized shapes that are difficult or impossible to produce with traditional methods. These designs are often found in offshore structures, including offshore platforms.

Enhanced Durability: The use of high-performance, corrosion-resistant materials tailored to withstand harsh marine environments, improves durability and longevity.

Rapid Deployment: Fast-tracking the production and installation of offshore structures, meeting tight project timelines.



The Benefits of ARAM in the Marine Industry

Advanced robotic additive manufacturing brings a host of benefits to the marine industry, transforming traditional processes and enabling new possibilities.

Sustainability

Reduced Material Waste

Compared to traditional subtractive methods, additive manufacturing techniques minimize material waste.

Energy Efficiency

Lightweight components contribute to fuel savings and lower emissions, while additive manufacturing processes are often more energy-efficient than traditional manufacturing.

Recyclable Materials

Many additive materials can be recycled, further reducing environmental impact.

Cost Efficiency

Lower Production Costs

Due to increased efficiency, and reduced waste, both labor and material costs are reduced.

Inventory Reduction

On-demand manufacturing decreases the need for large inventories.

Lower Tooling Costs

Eliminate the need for expensive molds and tooling required in traditional manufacturing processes.

Performance Enhancement

Improved Design

Ability to create optimized and customized designs for performance, efficiency and client satisfaction.

Material Properties

Advanced materials with superior strength and durability.

Conclusion

The benefits of advanced robotics additive manufacturing offer transformative potential for the marine industry, enabling the production of high-performance, customized, and sustainable components. Rapid prototyping and production, cost efficiency, and design flexibility position it as a transformative technology for the maritime industry. By leveraging the capabilities of Rapid Fusion, marine engineers can overcome the limitations of traditional manufacturing, driving innovation and enhancing the performance and sustainability of vessels. The efficiency, durability, and environmental sustainability are paving the way for a new era of maritime engineering.

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