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CiM Composites in Manufacturing

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ADDITIVE MANUFACTURING: EVERYTHING COUNTS IN LARGE AMOUNTS!

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Pushing the limits of additive

In a Q&A session, leading industrial robotic large format additive manufacturing (LFAM) specialist, Caracol brings ***Composites in Manufacturing*** *up to speed with the latest innovations it will be showcasing at JEC World, Paris.*

Caracol was founded in 2017 in Milan with a vision to push the limits of additive manufacturing (AM) in terms of scale, efficiency, and sustainability. In only a short time, the company has accomplished this by developing an integrated technological platform, including both hardware and software, to produce advanced large-scale components.

Through the integration of a patented extrusion head, the development of dedicated software – Eidos Manufacturing – and the use of robotic arms as movement support, Caracol offers an AM technology for advanced components in industries such as aerospace, marine, energy, design, and architecture.

Firstly, please begin by provide some background to your hybrid/LFAM CNC machine tool products?

Heron AM is Caracol's turnkey LFAM robotic platform for large-scale production of thermoplastic composites from pellets. It can be configured as a hybrid platform, as it can automatically substitute its extrusion head with a milling head or other extruders, enabling both additive and subtractive manufacturing. Featuring three extruders, tailored to different industrial requirements - from precision to speed – and a modular design supporting various robotic arms, rails, and printing beds, it suits applications and materials across a wide array of industries.

As a fully integrated solution, Heron AM combines hardware and software. Its advanced LFAM technology is powered by the Eidos Manufacturing software suite, which includes Eidos Builder for slicing, path and parameters planning, and Eidos IoT for real-time production monitoring and optimisation to ensure maximum efficiency and precision.

Can you briefly outline the cycle time production process?

Starting with composite thermoplastics and high-performance polymer pellets (e.g. ABS, PC), the process builds each component layer by layer. Robotics as motion supports provides 6+ axes of freedom for the extruder, allowing horizontal, 45°, or multi-planar prints, supporting non-conformal, and many other slicing strategies based on design and application requirements. This produces a near-net shape, then refined through post-processing techniques like coating, sanding, milling, or other subtractive processes to achieve the desired dimensions, surface quality, and precision.

Understanding how to integrate of additive and subtractive techniques, or other post-processing steps in industrial production is crucial to deliver high-quality finished parts and optimise material use and production efficiency.

Above
By building near-net shape parts layer-by-layer, Heron AM minimises waste

Left
Caracol's LFAM platforms leverage robotics, automation, and IoT-driven insights

Below
Francesco De Stefano, CEO of Caracol

Will it lower cycle times of difficult to machine and complex parts?

Robotic platforms like ours can significantly reduce cycle times for complex parts that are challenging or impossible with traditional methods. By eliminating several manual steps and tooling, it streamlines production and lead-times. Depending on the part's geometry and material, Heron AM's additive processes with subtractive post-production delivers time savings up to 70% compared to conventional machining.

Will it help reduce the amount of material used?

Heron AM builds near-net shape parts layer-by-layer, reducing material waste by up to 70% compared to traditional subtractive methods, particularly in tools such as trimming and drilling jigs for the aerospace industry.

Additionally, thermoplastic pellets require less processing than filament or powder, enabling the use of sustainable and cost-effective recycled plastic and composite materials.

Will it help reduce customers' power usage when operating?

It is complex to quantify the energy consumption LFAM saves because many variables need to be considered, such as the target industry, materials used, postproduction steps and more.

Traditional manufacturing methods, such as CNC machining, often involve extensive material removal, resulting in high energy consumption; in contrast, LFAM technology builds components layer by layer, depositing material only where it's needed, minimising post-processing, waste and overall energy consumption.

Primarily, what production processes is your LFAM machine tool most suitable for?

Heron AM serves a wide range of industries, including aerospace, automotive, architecture, energy, marine, and industrial machinery, among others. It's suitable for producing large-scale, complex parts such as moulds, tools and jigs, spare parts, custom structural components, and superstructures. In the aerospace sector, LFAM is great to tackle cold tooling such as jigs and fixtures and hot tools such as cure tools and lamination moulds, for example non-structural finished parts for interiors are being explored. In the mobility sector (automotive, marine, railways), LFAM has already proved itself an effective solution for finished parts, particularly superstructural parts and tools. Vipra AM, our recently launched metal LFAM machine, further extends its application reach, particularly for finished parts.

Has the launch originated from any specific types of customers' demands and trends, or have you just spotted a niche in the market?

Developed in 2015 to fill a market gap in large-scale AM, Heron AM emerged from customer demands for improved material range, scale, and production speed in advanced sectors like aerospace. Aircraft OEMs were looking to innovate and streamline their tooling, which was still very artisanal and manual. In the luxury yacht market, a pain point was manually producing fiberglass parts – also hazardous for workers' health. Our background in production allowed us to design solutions to address the growing need for scalable, efficient, and cost-effective AM solutions capable of producing large, complex parts.

What aspects of your latest AM robotic platforms will your customers be most happy with?

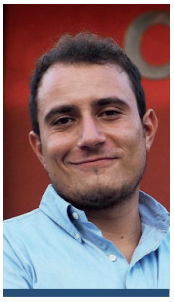
Customers value our full turnkey solutions, including hardware, software, automation, training, and materials or other services to support customers' journey into LFAM. Our application-first approach ensures efficient, flexible operations, while the Eidos IoT platform enables continuous improvement through remote diagnostics, ongoing optimisation, and problem-solving throughout the system lifecycle, improving productivity and minimising downtime.

> *"Our industrial 3D printers stand out for their modular and fully integrated set-up, combining hardware, software and automation integration into one cohesive solution"*

What kinds of productivity benefits will customers enjoy from the implementation and use of the LFAM machines on their shopfloors?

Our LFAM platforms integrate effectively with existing manufacturing technologies and processes, such as automated inspection systems, AI-driven design optimisation tools and traditional subtractive techniques, to streamline production, improve precision and reduce material waste. This flexibility leads to faster production cycles, reducing lead times and enabling on-demand manufacturing. Also facilitating the creation of complex geometries that consolidate multiple parts, it opens new design possibilities, reduces assembly time and improves overall product performance.

Do you foresee traditional CNC machine tool companies moving



into the AM arena to offer LFAM solutions?

Yes, several traditional CNC companies have already entered the AM sector with LFAM solutions, attracted by benefits like reduced manufacturing time and costs, enhanced design flexibility for complex and customised geometries and lighter components, also enabling the use of recycled and recyclable materials. Nonetheless, players from a more traditional background have understood that delivering effective additive technologies requires a different set of machine development capabilities, and it's not just the integration of an end-effector, thus some have seemed to have slowed development.

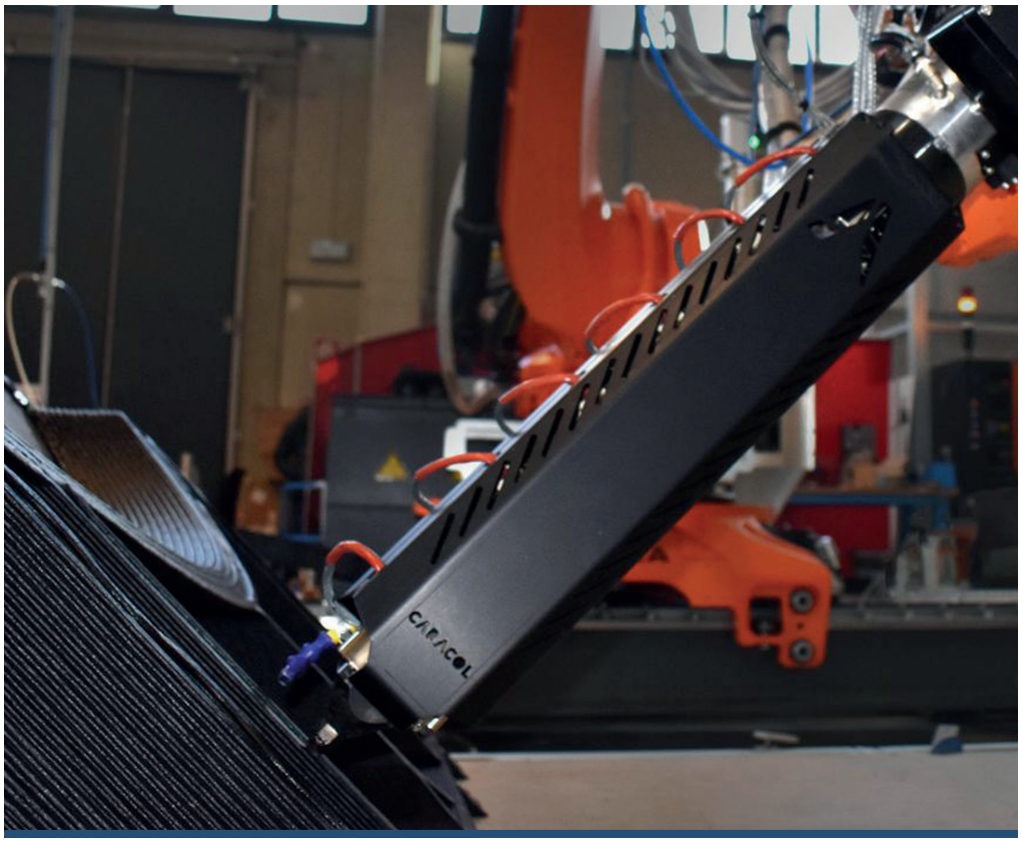
Please provide the latest news on your LFAM products?

We recently launched Vipra AM, a disruptive robotic metal LFAM technology. This Direct Energy Deposition platform uses a wire arc AM process within a proprietary hardware, software, and automation system. Designed to maximise flexibility, control, and performance, it broadens LFAM's applications through two models:

- Vipra XQ (Extreme Quality): Employing plasma arc deposition, it delivers high-precision, high-strength components with exceptional finishing. Suitable for materials like stainless steels and titanium alloys, it targets applications in aerospace (e.g., structural components) and energy (e.g., valves, piping connectors).
- Vipra XP (Extreme Productivity): Focused on maximising throughput and reducing costs, it processes aluminium and nickel-based materials, ideal for lightweight, large-scale parts in transportation (e.g., automotive components, marine propellers) and architectural projects (e.g., sculptures).

Both product configurations are built for advanced applications such as load bearing finished parts, lightweight structures, high-temperature, high durability autoclave and curing moulds, cladding, repair, and on-demand spare parts.

How well does your solution align with Industry 4.0 and the factory of the future philosophies?



Below
Heron AM adapts to complex geometries and diverse industrial requirements

Our solutions align seamlessly with Industry 4.0, integrating robotics, automation, and data-driven insights into a smart manufacturing ecosystem. Supported by the Eidos Manufacturing suite's smart monitoring and IoT functions, our solutions enable localised, customised manufacturing that reduce material waste, logistics emissions, and production times, while improving precision, adaptability, and sustainability.

What differentiates your machine tool from the competition and why should a customer choose it over similar competitor offerings?

Our industrial 3D printers stand out for their modular and fully integrated set-up, combining hardware, software and automation integration into one cohesive solution. As the sole supplier, Caracol delivers unparalleled control and deep process expertise, ensuring streamlined operations and rapid support. Designed with end-user needs at the core, developed from years of experience in producing parts for clients, our application-first approach, comprehensive training programmes, and after-sales services ensure that customers can operate our technology with confidence, precision, and maximum uptime.

Finally, what are your hopes and aspirations going forward?

Our aspiration is to lead a shift toward a manufacturing paradigm focused on efficiency and sustainability. By developing and leveraging new technologies, built to meet specific applications' needs, LFAM is driving part of this shift. We believe that there will be an exponential adoption of LFAM technologies within the manufacturing industry, particularly for small volumes, on-demand and localised productions. By fostering this new approach, we can enhance operational efficiency and reduce the environmental impact of industrial production by cutting waste and logistics-related emissions.

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