

CARACOL WAAM PLATFORM

PLATFORM OVERVIEW

This Wire Arc Additive Manufacturing (WAAM) system is an integrated solution that utilizes an electric arc as a heat source and wire as feedstock to build parts layer by layer, combining principles from welding and 3D printing. This system allows the production of large-scale components with high material efficiency and relatively low cost. The flexibility of this WAAM system enables it to handle a wide range of materials, from stainless steel and aluminum to nickel-based alloys. This system can be used for an array of applications including the manufacturing of new parts or the direct addition of features to existing parts.

CARACOL

BASE CONFIGURATION ELEMENTS

1. CMT Welding System – Fronius TPS 400i + Welding Torch

The Fronius TPS 400i is a versatile CMT (Cold Metal Transfer) welding system, often paired with a high-quality welding torch, specifically tailored for Wire Arc Additive Manufacturing (WAAM) applications. The TPS 400i is renowned for its excellent arc stability and precision, ensuring a controlled and spatter-free process, essential for additive manufacturing. The system allows for adjustments in welding parameters such as wire feed speed, arc length, and heat input, making it highly adaptable to different materials and deposition rates required in WAAM. The welding torch designed to work in conjunction with the TPS 400i ensures optimal results and promotes longevity, even under the intense conditions of the WAAM process.



2. Robotic Arm – KR180 R2900-2

The KUKA KR 180 R2900-2 is a high-performance industrial robot that features a maximum payload capacity of 180 kg, with a total reach of 2900 mm, making it an excellent choice for WAAM. The robot utilizes a 6-axis arm design, which ensures increased flexibility, precision, and efficiency.



3. Robotic Control Panel – KRC4

The KRC4 controller, accompanying the robot, is an advanced robotic controller that is user-friendly, compact, and energy-efficient, boasting faster computing speed and communication abilities.



4. Duke Smoke System – Filter Master XL

The Kemper smoke aspirator is a vital part of the Wire Arc Additive Manufacturing (WAAM) setup, designed to manage the substantial volume of dust and smoke particles generated during the additive manufacturing process. Its high-efficiency, self-cleaning filter system consistently captures hazardous airborne particles, helping to maintain a safe and healthy work environment. The robust design and mobile feature of this station ensures it can withstand the rigorous conditions of WAAM operations and be conveniently moved around different workspaces as needed. Its automatic filter cleaning mechanism is particularly beneficial in WAAM, where extended operations can quickly clog filters; this feature reduces maintenance efforts and sustains optimal aspiration performance.



5. Welding Camera – Cavitar C400 for weld pool monitoring

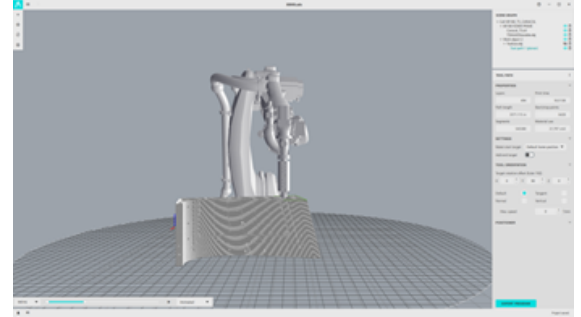
The welding camera integrated with the WAAM system is a specialized, high-tech imaging device designed to capture real-time, high-definition images or video of the welding process. The camera helps in identifying any inconsistencies or anomalies in the weld pool, enabling operators to make timely adjustments, and ensuring optimal quality of the final product. These cameras incorporate specialized filters to handle the extreme brightness of the welding arc and deliver clear images of the weld area. The integration of such a camera in the WAAM system increases the overall control over the manufacturing process, supports automated systems, and promotes higher quality and efficiency.



SOFTWARE

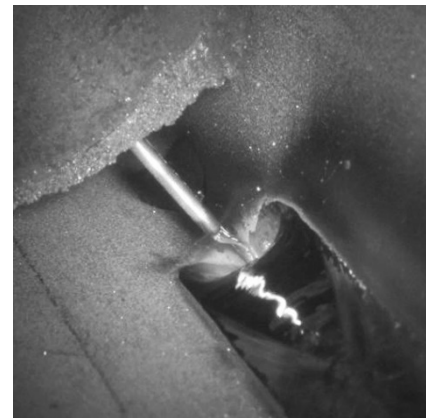
6. Path Planning Software

The robot planning software is an essential tool that enables the precise control and movement of the manipulator along predefined paths. This software allows the generation, optimization, and execution of complex motion trajectories necessary for the WAAM process, contributing to the creation of high-quality, precise components. It incorporates algorithms that consider parameters like speed, and material deposition rates to ensure efficient and accurate additive manufacturing. The software's user-friendly interface enables engineers to easily adjust settings, visualize the planned path, and monitor the real-time status of the manufacturing process.



7. Process Control Software

The welding camera software is a dedicated solution that works in tandem with a welding camera to provide a detailed analysis of the welding process. The software can process live feeds or recorded footage, enabling users to observe the weld pool and surrounding area in real-time or for post-process analysis. Advanced features of this software include image enhancement tools and algorithms to handle the high-intensity brightness of the welding arc, enabling a clear visualization of the welding process.



All raw material used for printing during the training modules will be provided by Caracol free of charge.

OPTIONAL HARDWARE

8. Robot Positioner – KUKA Double-Axis Positioner

The double-axis positioner is a crucial component of the WAAM system as it is designed to accurately manipulate and orient the workpiece during the additive manufacturing process, ensuring optimal access and deposition angles for the welding torch. With its robust build and high load capacity, it can accommodate large and heavy workpieces, making it ideal for industrial-scale WAAM operations. The octagonal welding table attached to the positioner provides a versatile workspace that supports a wide range of component shapes and sizes, further enhancing the flexibility of the WAAM system. The integration of this positioner in the WAAM system significantly improves the precision, versatility, and efficiency of the additive manufacturing process.



9. Robot Plinth

The robot plinth is a structural base designed to elevate and stabilize the robotic system in the WAAM system. It can withstand the weight and dynamic loads of the robot while also minimizing vibration, thus ensuring stable and precise robotic movements during the WAAM process. Its 700 mm height provides an optimum level of elevation, allowing the robot to reach workpieces on the welding table effectively and increasing the overall working envelope. The plinth's design ensures seamless integration with the robot, contributing to a quick and efficient setup of the WAAM system.



INSTALLATION

10. Installation & Calibration

CARACOL's technical team will take care of coordinating with the CLIENT's team to guide them through all the steps necessary to ensure the correct installation and calibration of the system. This will include providing defined project steps and guidelines regarding what actions the customer must undertake to ensure their infrastructure is ready (e.g., floor load) to welcome the selected system, and any other aspect of technical nature that must be set up (i.e., pneumatic system, electrical system, ...).

TRAINING

11. Basic System Training

This training provides the basic knowledge needed to operate the chosen WAAM Beta system. After completion, you will be able to operate and manage the system autonomously including preparation of all equipment and detecting and executing all necessary cleaning and operating routines. Basic maintenance steps will be covered as well. This training module is recommended for all new WAAM users.

Goals:

- Preparation of Caracol system
- Learn about the basic machine settings
- Safe and efficient operation of system
- Unpacking of build jobs
- Cleaning and operating routines

Target Audience: Technicians, Operators, Maintenance Personnel, Engineers

Location: at customer facility or at Caracol HQ

Duration: 2 full days

12. Advanced System Training

This module provides an in-depth training on all aspects needed to master Design for AM techniques and specific AM robotics path planning, as well as use of Caracol WAAM Beta system. After completion, trainees will be able to engineer and slice advanced geometries to be manufactured with the system independently. The syllabus will go through all major dos and don'ts for Large Format AM, allowing the trainees to test different real-life applications. This module is recommended for new users who recently started working with the system and want to step up their efficiency and adoption.

Goals:

- Learn how to program different LFAM toolpaths
- Learn advanced machine settings with different materials
- Develop first planar trial application
- Develop second / others trial applications

Target Audience: Technicians, Operators, Engineer, Designers

Location: at customer facility or at Caracol HQ

Duration: 3 full days