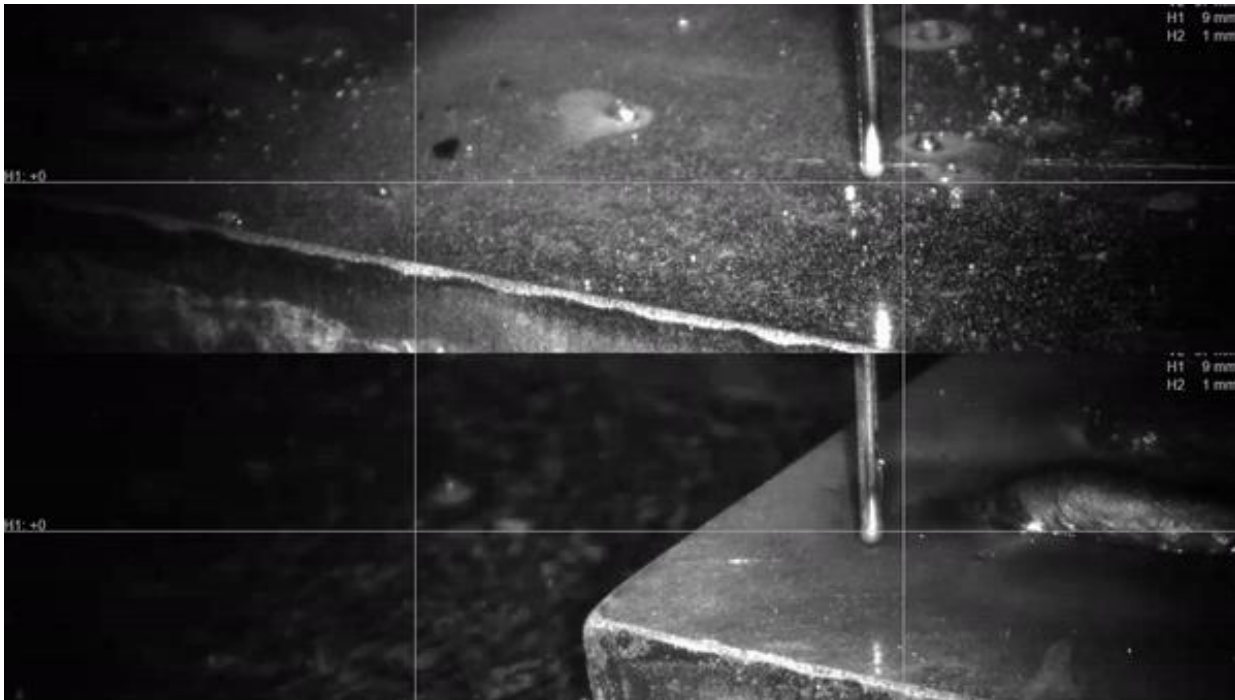


## Monitoring Wire Arc Additive Manufacturing with Cavitar Welding Camera C300

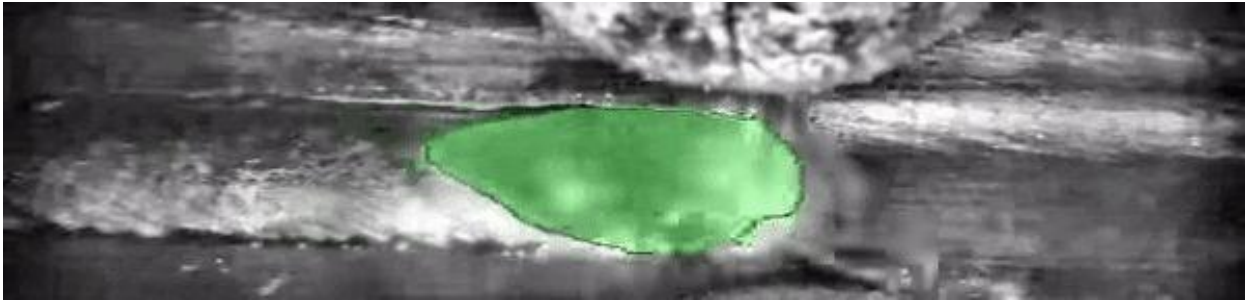
Author: RAMLAB

RAMLAB has a strong focus on material quality and quality assurance. Our WAAM processes are continuously being monitored and adjusted live when necessary. In the exceptional case that the process gets outside its operational bounds due to a malfunction, the process is stopped promptly in order to minimize the amount of deposited material that needs to be removed.

Recently, we added the Cavitar Welding Camera C300 to our range of monitoring sensors. This camera is able to visualize the product surface, the weld pool and the arc in a single image. This gives us a detailed insight into the process stability, the weld pool, and its context such as neighboring weld beads, product edges, spatter and silicates.



In our automatic monitoring environment, we can continuously keep track of key process properties, such as the weld pool size and shape, by applying image processing and machine learning techniques. This is of great use in verifying bead width, fusion with previous beads and process stability in general.



*Machine learning applied to monitor the weld pool. Courtesy of Mavisoft.*

In addition, when we perform process optimization in our lab, a detailed view of the arc and the weld pool is very helpful in adjusting the process parameters towards perfection. The camera software comes with a neat calibration feature that allows you to define the absolute pixel size in the focus plane. After calibration, one can make absolute measurements in the camera images.

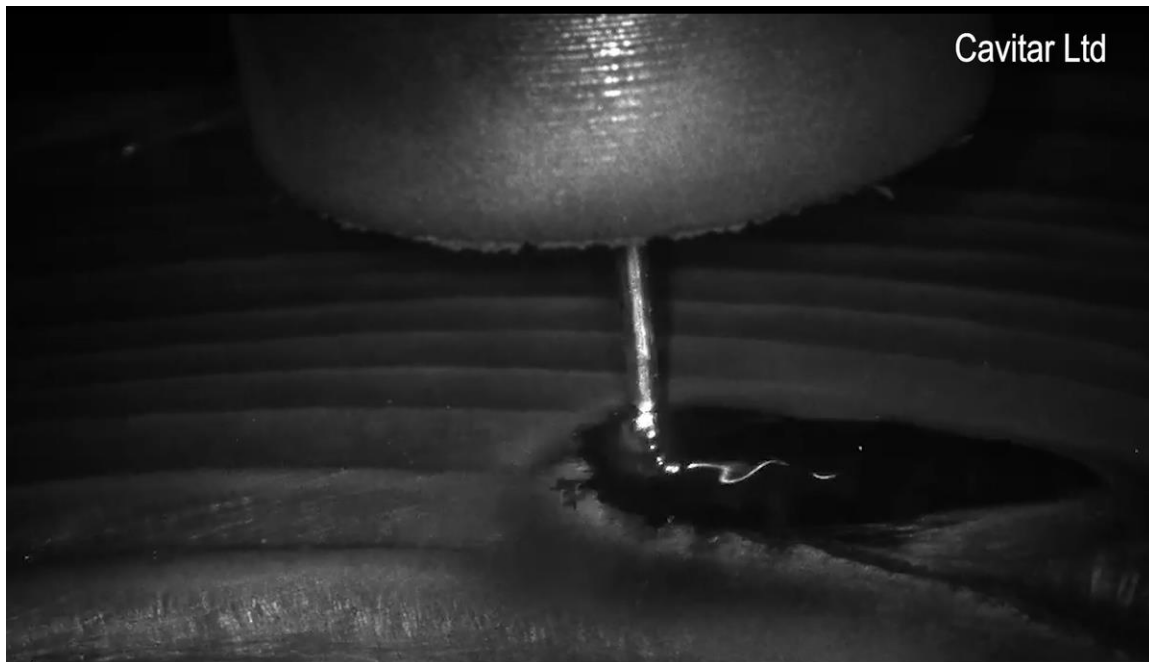
Generally, the Cavitar Welding Camera is very easy to use. One of the nice properties of this camera is that it needs very little configuration: it just works. Perhaps the most important parameter that needs to be set by the user is the shutter time. A short shutter time puts an emphasis on the camera's own light source, while a long shutter time collects more external light, predominantly generated by the arc. The longer the shutter time, the more the arc becomes visible in the images. As a result, it is possible to tune the shutter time in such a way that both the outline of the arc and the metal droplets inside the arc are visible at the same time. This is a great feature that makes the most out of a single recording.





That said, there are several options available to tune the visual appearance of the image, which gets the most out of the camera for different materials and viewing angles. The camera's sensor general gain factor, grayscale histogram tuning and gamma correction can be interactively tuned with a preview of the adjusted image.

Below is an example video of the WAAM process after multiple created layers.



<https://youtu.be/YZhUWfpThSc>



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