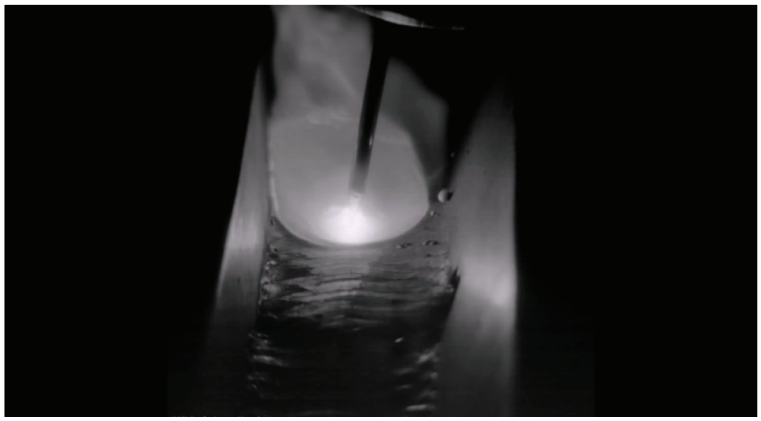
Improving Productivity with a Weld Camera

XIRIS
Inspection Solutions with Vision

Background

During automated welding processes, key features of the weld head and its immediate environment need to be monitored for process and quality control. But how to do it?

Until recently, there hasn't been a good solution.



Fillet Welding of Groove in Nuclear Vessel

The Dilemma

Operators directly monitoring a weld don't have good visibility of both the super-bright region around the arc and the dark background surrounding the arc, where important detail about the weld process is contained. The weld helmets they wear to protect their eyes from the arc may provide good definition of the arc, but filter out critical information in the background. Also, putting operators in close-enough proximity to the weld to see it through a weld helmet or protective screen exposes them to the disagreeable and dangerous conditions of the weld

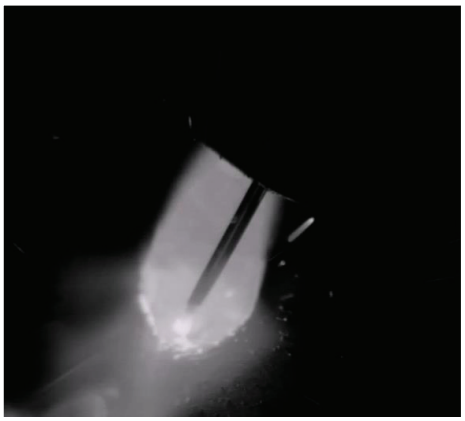
environment, resulting in higher safety and health costs while making it harder to recruit and retain good operators.

So, using operators to monitor automated welding processes presents a dilemma—how to keep operators safe while also giving them good visibility into the weld process?

The way to get around the weld-proximity problem has been to video the process using cameras that can instantaneously send the video to a monitor in a remote location, allowing operators to view the real-time weld process in relative safety and comfort away from the weld head. However, this approach has been hampered in past by the inability of the camera to simultaneously view detail in the arc region of the weld and its darker background. The dynamic range of standard cameras, even those retrofitted for weld monitoring, is too low to provide enough detail.

As a result, when using traditional cameras, operators have to stop the welding process and adjust the camera's optics each time they need to shift the visibility between the arc region and the background in order to get the full picture of what is happening with the weld.

Weld Background Detail



Weld Foreground Detail

The Solution

Fortunately for manufacturers, a new technological solution—High Dynamic Range imaging—has emerged. High Dynamic Range imaging overcomes the traditional limitations of weld monitoring by simultaneously providing high-quality images of both brightness extremes.

Whereas a standard camera can image a range a brightness of only about 1,000:1 signal-to-noise ratio (50-60 dB), Weld Cameras with High Dynamic Range capability can image a signal-to-noise ratio greater than 1,000,000:1 (120 dB)—sufficient for clear images of the entire weld scene.

When High Dynamic Range imaging is integrated into an industrially hardened, state-of-the-art camera with built-in auxiliary lighting, the visibility/proximity problem of remote weld monitoring is overcome—and production goes up! With such a Weld Cameras system, operators will have excellent visibility of the entire weld scene, from a remote distance, without ever having to stop the process.

MIG Bead on Plate

The Productivity Impact

Investing in any remote monitoring solution should involve a well-researched projection of return on investment. But it's not hard to justify a Weld Camera with High Dynamic Imaging and the right features. Productivity gains that could not otherwise be achieved are made possible with this solution, including:

1. Lower safety and health costs

Using a Weld Camera frees operators from dangerous proximity to the weld without compromising process control. The result is a reduction in the many costs related to the riskiness of a workplace, such as:

- Higher workers compensation insurance premiums
- More-expensive group medical coverage
- Lost work time
- The hiring and training of replacements
- Decreased output due to the lower skill levels of replacements
- Litigation exposure

2. More-efficient operators

When forced to directly monitor a weld, operators are subject to numerous risks, such as weld fume inhalation, electrical shock, contact with weld splatter, "welding eye" (direct exposure of the weld arc to the human eye), and injuries from moving or falling objects. To protect themselves from these hazards, operators must always be on guard, operating slower than if they weren't at risk and they have to take the time to put on and remove protective clothing and weld helmets as they work.

There's also a mental factor. Directly monitoring welds is hot, noisy, uncomfortable work that can easily cause an "emotional" exhaustion that cuts into productivity just as much as physical fatigue. And many operators working in that unpleasant environment understandably have relatively low morale, which usually lowers productivity.

Using Weld Cameras with High Dynamic Range imaging, manufacturers can free operators from this productivity-inhibiting environment, while actually increasing visibility of the weld process.

3. Less set-up time

The combination of High Dynamic Range imaging and built-in auxiliary lighting reduces the time required to set up the weld because adjustments to the weld process can be done while viewing the actual result on a screen. In addition, there's no need to change the lighting each time the arc is off during the initial positioning of the arc tip to the weld seam.

4. Increased run-time productivity

Arc-on time increases with High Dynamic Range cameras because operators can see both brightness extremes of the weld scene without having to stop the process to adjust lighting when they need to make adjustments.

Because operators can view every part of the process, they can know exactly when it's necessary to make productivity-enhancing adjustments such as:

- Aligning the weld head to the seam or the filler material
- Modifying wire length or shielding gas flow rates
- Detecting impurities or porosity in the weld pool
- Optimizing the weld process by keeping the shape of the molten metal as ideal as possible

5. Reduced costs due to bad welds

Because cameras using High Dynamic Range imaging enable operators to monitor the full weld scene in real time, operators can use their skilled judgment to catch problems with the torch tip, material flow, melt pool, edge presentation, keyhole, seam alignment, shielding gas barrier, or weld undercut—before they result in large batches of defective product being made.

This high level of process control reduces the cost of rework, such as grinding off spatter, chipping off slag, grinding welds down, or even having to re-do the weld. It also lowers the cost of scrap volume, which is particularly important in high-volume production environments where direct material costs are a major variable cost.

Operator visibility into the entire welding process also allows some defects—such as: impurities or porosity in the weld pool—to be detected that would otherwise escape detection by post-weld inspection equipment (e.g., eddy current, ultrasonic). This reduces the costs of returned product, which can be incurred through reworking to improve quality to the customer's level of expectation, extra shipping and handling, or other costs of placating the customer.

6. Faster troubleshooting

When operators detect defects, they can use the time-logged video record provided by a Weld Camera to quickly pinpoint and correct the causes of a defect. With High Dynamic Range imaging, the operators can easily see the entire process—in both brightness extremes at the same time—to determine what's going wrong.

7. Fewer final inspections

Because Weld Cameras allow operators to use their expertise to limit defects, the number of defects seen in the final product will drop significantly, reducing the need for final inspection.

Most defects will already have been caught by the time the welding is complete, and any type of final inspection that is required need only be done on those segments of the weld where the weld parameters went out of control—which can easily be determined with the video record provided by the Weld Camera.

8. Continuous improvement and training

By auditing the Weld Camera's video record, manufacturers can identify opportunities to improve quality and efficiency in their processes. The video record can help reduce or even eliminate recurring quality defects such as porosity or contamination that are otherwise difficult to detect on an ongoing basis.

Trainees, as well as experienced operators, can learn from videos of both successful and problematic welds—increasing their productivity capability.

Conclusion

In monitoring automated welding processes, the challenge is being able to see the full range of the weld scene, including the definition of the weld tip and its darker background, despite its extreme brightness variation.

Even operators stationed close enough to the weld to directly monitor it cannot make out the full range of detail present in a weld scene. Because of the harsh conditions proximate to the weld head, direct monitoring of the weld process is less productive than remote monitoring and introduces a variety of health and safety issues. Traditional Weld Cameras haven't conquered the challenge, either. While they do get operators away from the weld, they aren't capable of imaging both the extremely bright arc and the dark surrounding background.

Weld Cameras with High Dynamic Range imaging capability, such as the Xiris XVC-O, can image both extremes of the weld head —with high image quality. In so doing, they present an opportunity for fabricators to improve weld processes, increase productivity and gain a competitive advantage over competitors still struggling with the question of how to effectively monitor their automated welding process.

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