

The background of the entire page is an abstract, expressive drawing. It features a large, bright yellow circular shape in the upper center, surrounded by swirling blue and grey lines. A thick, dark yellow stroke runs diagonally from the top left towards the center. In the bottom right corner, there are several dark, parallel, diagonal strokes. The overall style is painterly and dynamic.

WPI²

WPI² **Weld Pool Intelligent Imaging**

**ONLINE WELD POOL CONTROL
FOR SERIAL PRODUCTION**

ZM

Messtechnik & Consulting

WPI²

Weld Pool Intelligent Imaging

Innovative measurement tool for Laser-Cladding-Processes to detect:

- process- stability / constancy
- deviation of power input
- heat input / output of the component
- variation of powder type / flow
- variation of process temperature

Characteristics of WPI²- system:

- optical weld pool control
- application field: serial production (24/7)
- setup for Laser-Cladding-Processes up to 25kW! (also EHLA)

Characteristics of WPI²- camera:

- CCD camera system in a robust industrial case with cooling and lens air flushing
- camera mounting position on the laser head
- system layout design for very dusty atmospheres
- IR- radiation protection by a snap-on cover cap with quick change spare glass unit
- lens setting for near field monitoring, focus distance 200mm for direct control of the weld pool

Characteristics of WPI²- software:

- designed for integration into existing coating plants (PLC compatible)
- clear and easy to use
- two operating levels: User / Administrator
- result and data backup (component logging)

A weld pool diagnostic system can be realised with different methods. Mainly the method “temperature profile monitoring” is used. The corresponding camera technique is often not convincing the requirements of serial production use.

The WPI² measuring system therefore follows a different way. In principal there are three essential facts that differs to conventional measuring systems:

- 1.) measuring strategy
- 2.) image acquisition
- 3.) image analysis

Measuring strategy WPI²:

The characteristic of the algorithm is „measure and compare”. Therefore, a reference image of the optimal condition is generated in advance. This image is the basis (reference) for all further measurements (target state). During the current coating process images are generated continuously (current state) and compared with the reference image (target state). Thus differences between target state and current state can be detected quickly.

Since all essential process information is available within the images comparable with a „process fingerprint“ a comprehensive and fast process control can be realised.

Image acquisition WPI²:

For the optimal implementation of the WPI² measuring strategy stable comparison images are the crucial factor. For this reason the image acquisition occurs in a period of 1 - 3 seconds.

The wavelength of the images is the visible spectrum between 400 - 800 nm. The irrelevant, short-term but process typical fluctuations are filtered out of the resulting image due to the long exposure time. The result is an image corresponding to the actual coating condition - the process fingerprint - averaged over time.

Image analysis of WPI²:

The analysis of the obtained images is carried out by means of geometric „image approximation“. This enables the detection of the process fingerprint by the process-describing ellipses. Thereby a fast and certain mathematical comparison of the images is viable - so called „comparative measuring strategy“.

Measurement results WPI²:

In addition to the error analysis (OK / NOK) the calculated ellipse parameters and their variation to the reference ellipse parameters (target state) make it possible to get conclusions to the further described, process relevant disturbance variables:

- process- stability / constancy
- deviation of power input
- heat input / output of the component
- variation of powder type / flow
- variation of process temperature

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