



Hub of Application Laboratories for Equipment
Assessment in Laser Based Manufacturing



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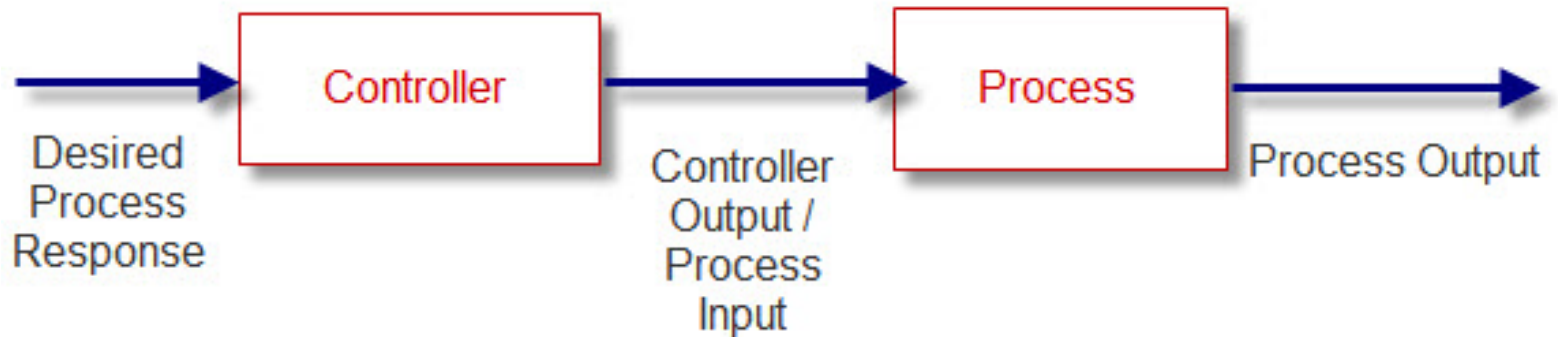


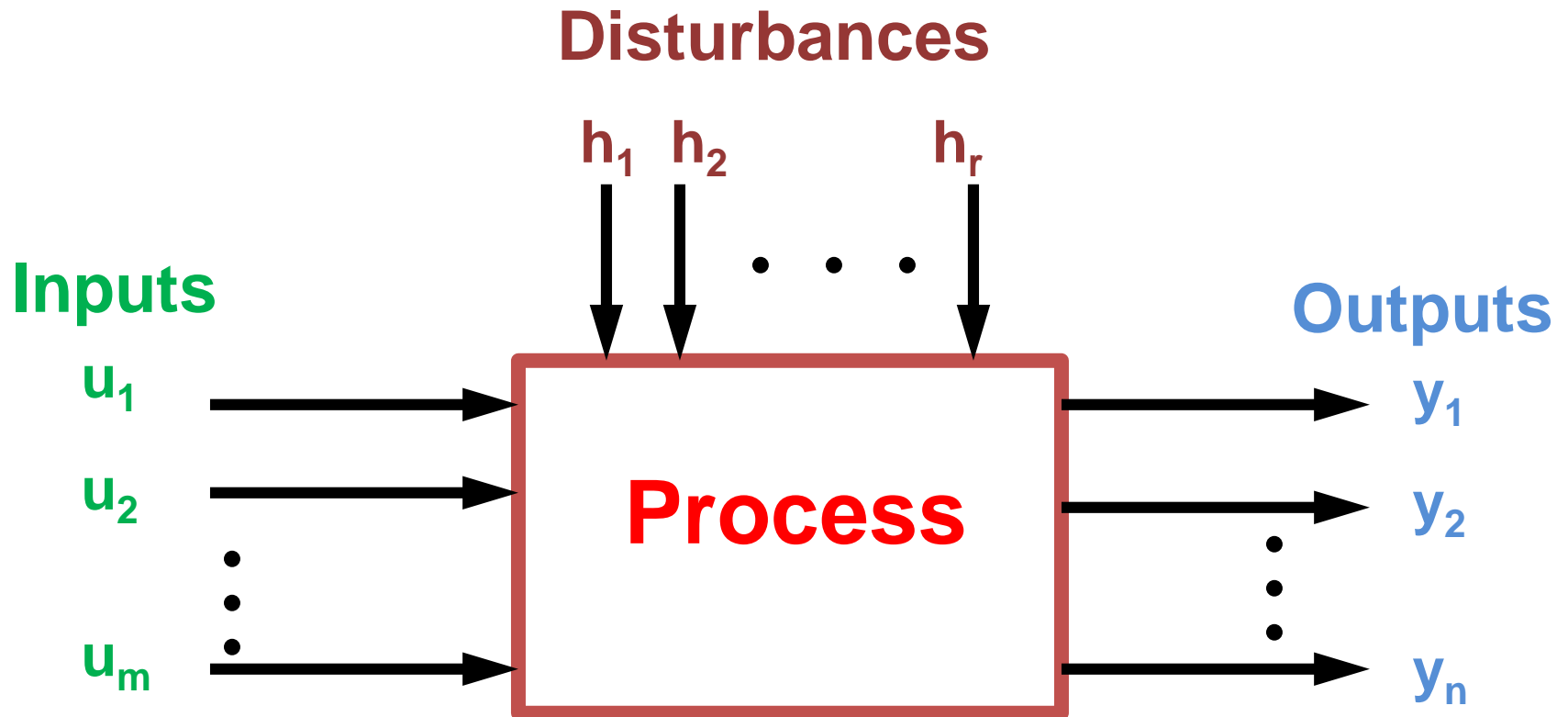
On-line monitoring

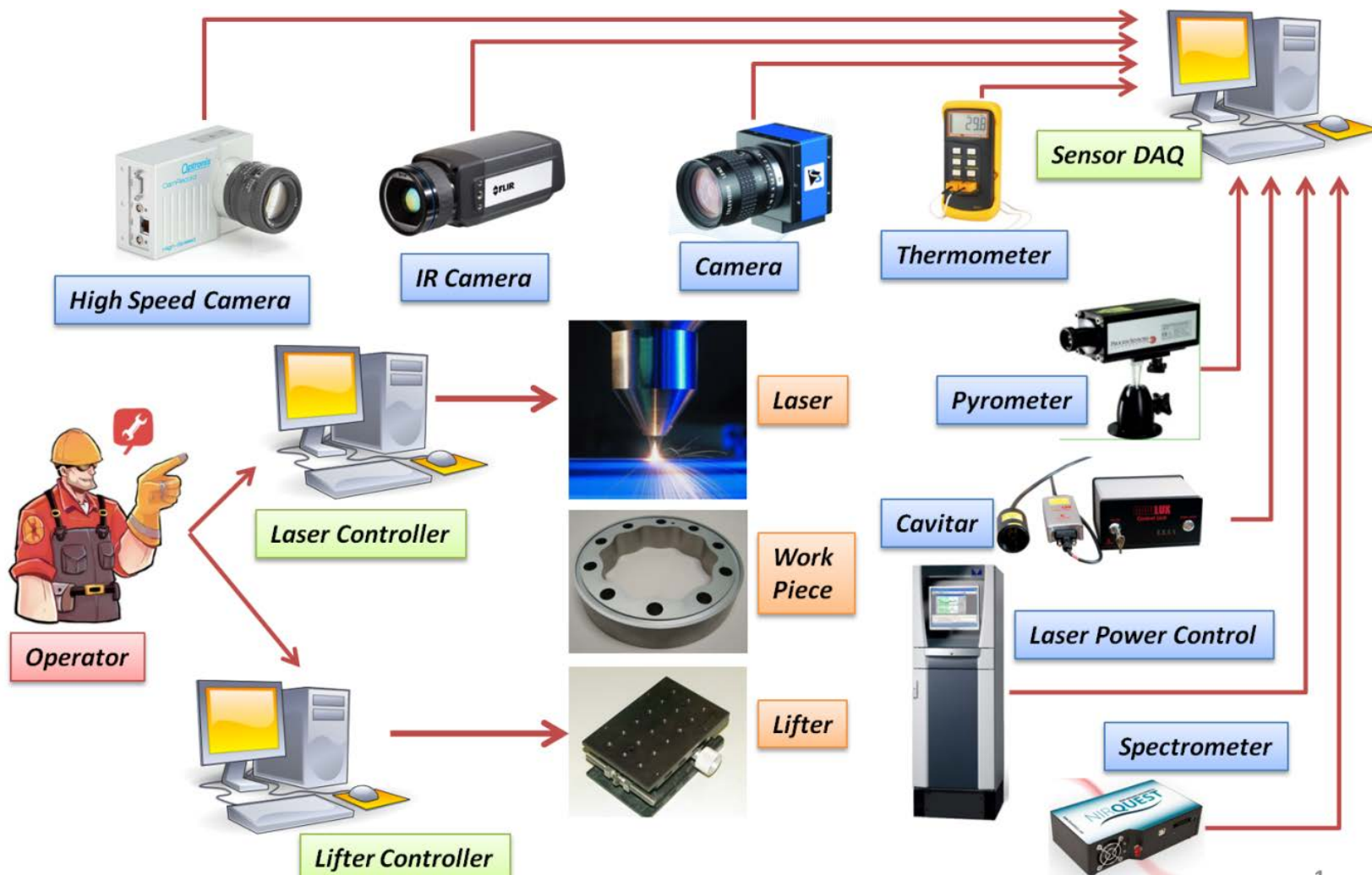
Work Package 8: On-line monitoring tools for laser-based technology assessment

Objectives

- Development and assessment of **on-line monitoring and control systems**, necessary in other WPs for selected material processing trial applications;



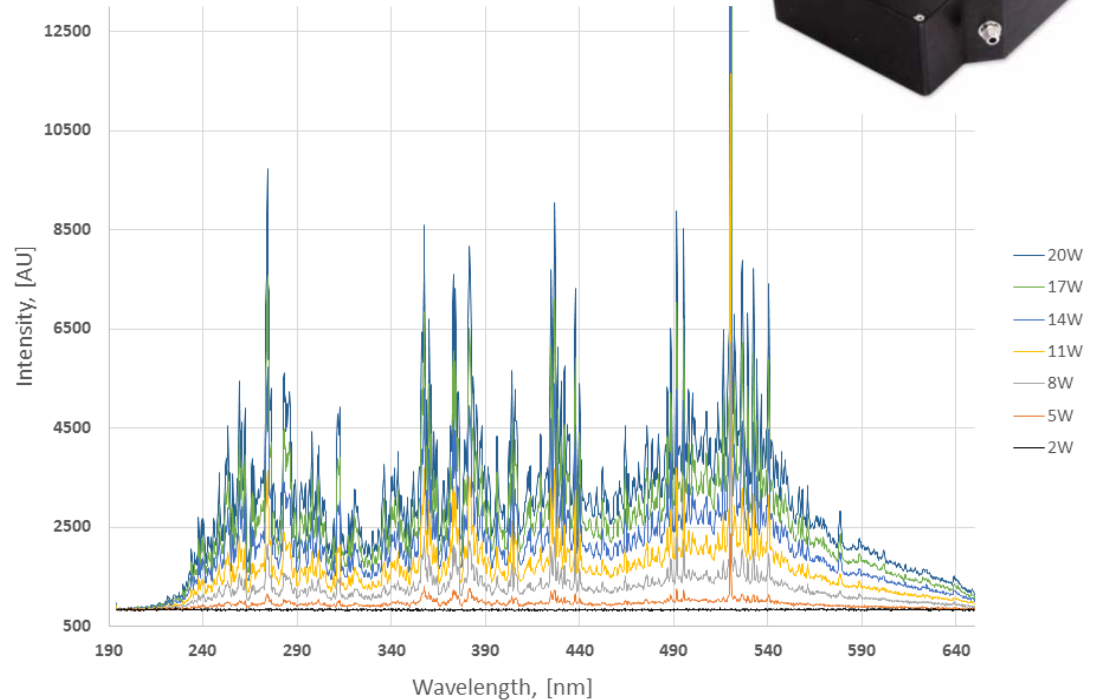
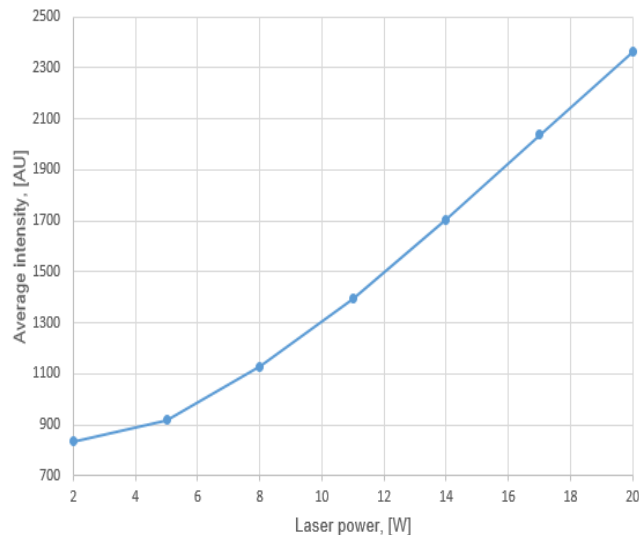




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■ Spectrometer sensitivity to laser microprocessing

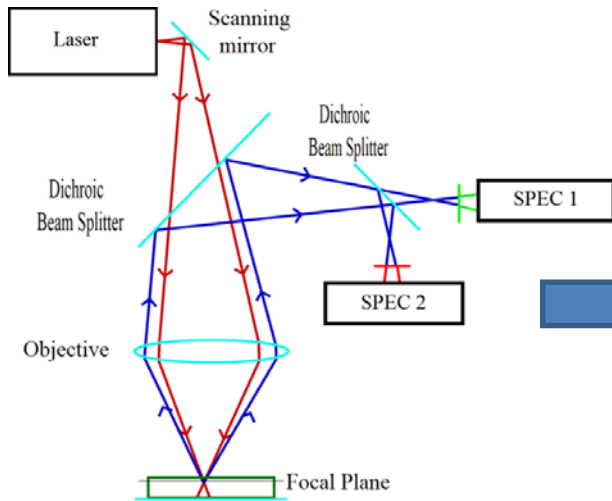
1. Repeatability
2. Effect of laser power
3. Effect of pulse length
4. Effect of focal position



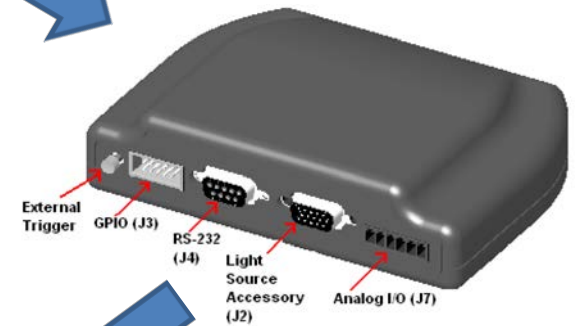
Spectral graphs of radiation intensity in laser scribing process – effect of laser power.

Average radiation intensity levels between 200-650 nm for different laser power settings.

- Spectrometer



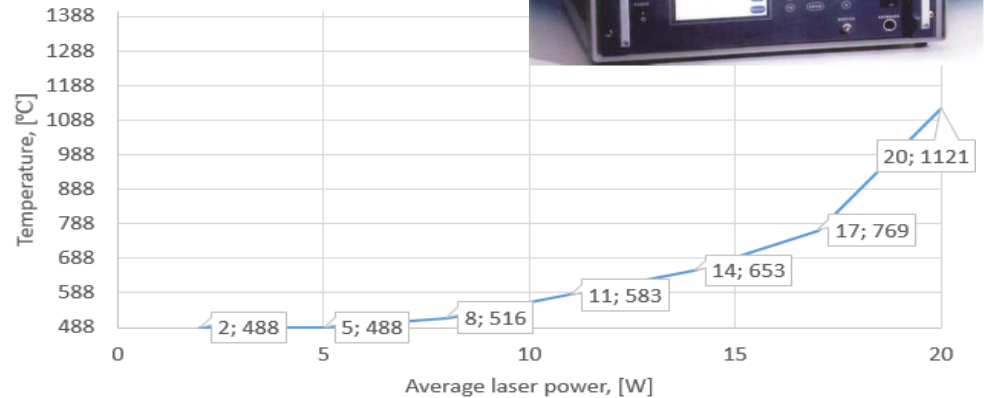
30-Pin Connector



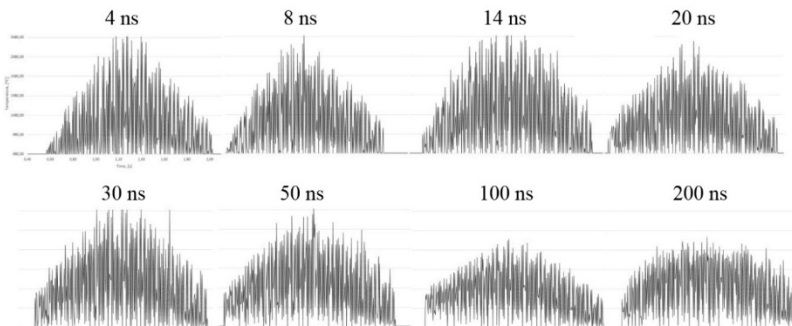


Pyrometer sensitivity to laser scribing

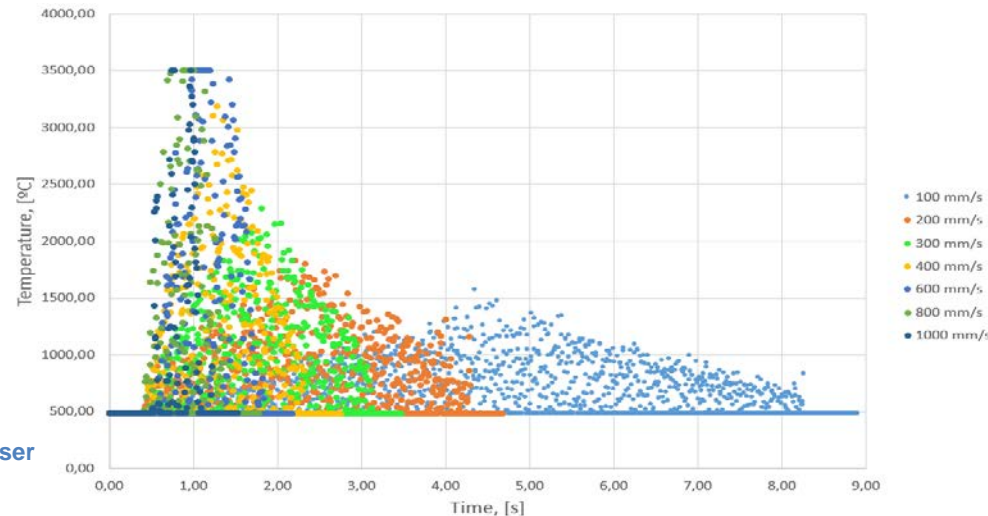
1. Repeatability
2. Effect of focal position
3. Effect of laser power
4. Effect of pulse length
5. Effect of laser beam scanning speed



Average temperatures in laser scribing with different power levels, measured by the pyrometer



8 images showing pyrometer temperature measurements between different laser pulse lengths in laser scribing. Y-axis is the temperature, ranging from 480 to 3800 °C. X-axis is the time, ranging from 0.4 to 2.1 seconds.

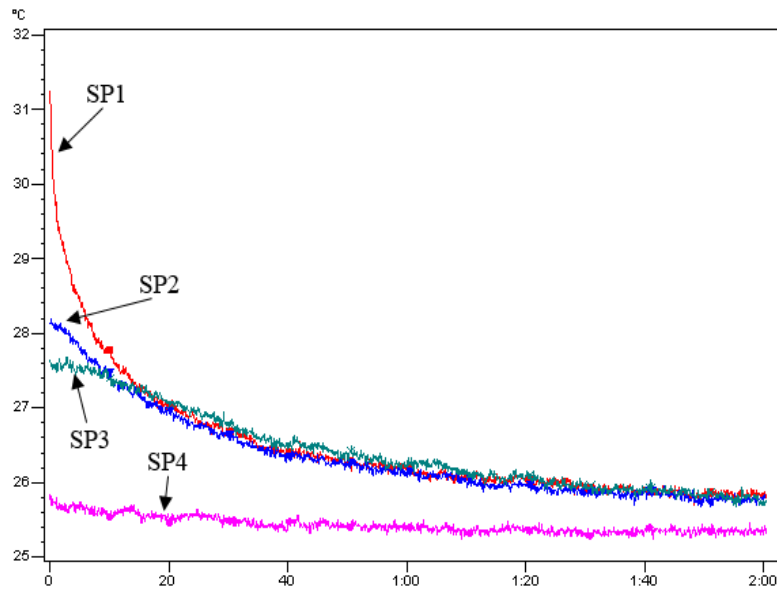


Pyrometer temperature measurements using different laser beam speeds.

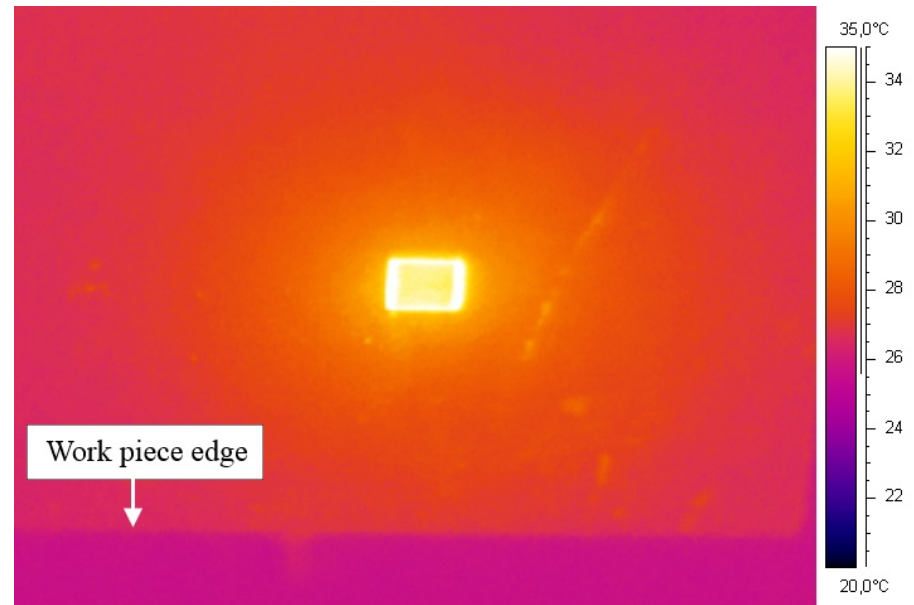
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■ Use of infrared camera in laser scribing

1. Thermal imaging of the work piece during laser scribing
2. Thermal imaging of the work piece after laser scribing



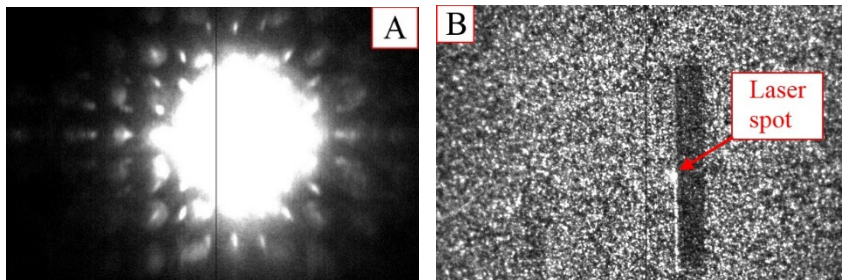
Temperature measurements for the bottom side of the laser processed area.



Thermal image of laser scribing right after laser processing for 98.3 seconds.

■ High-speed camera monitoring of laser scribing with an active illumination system

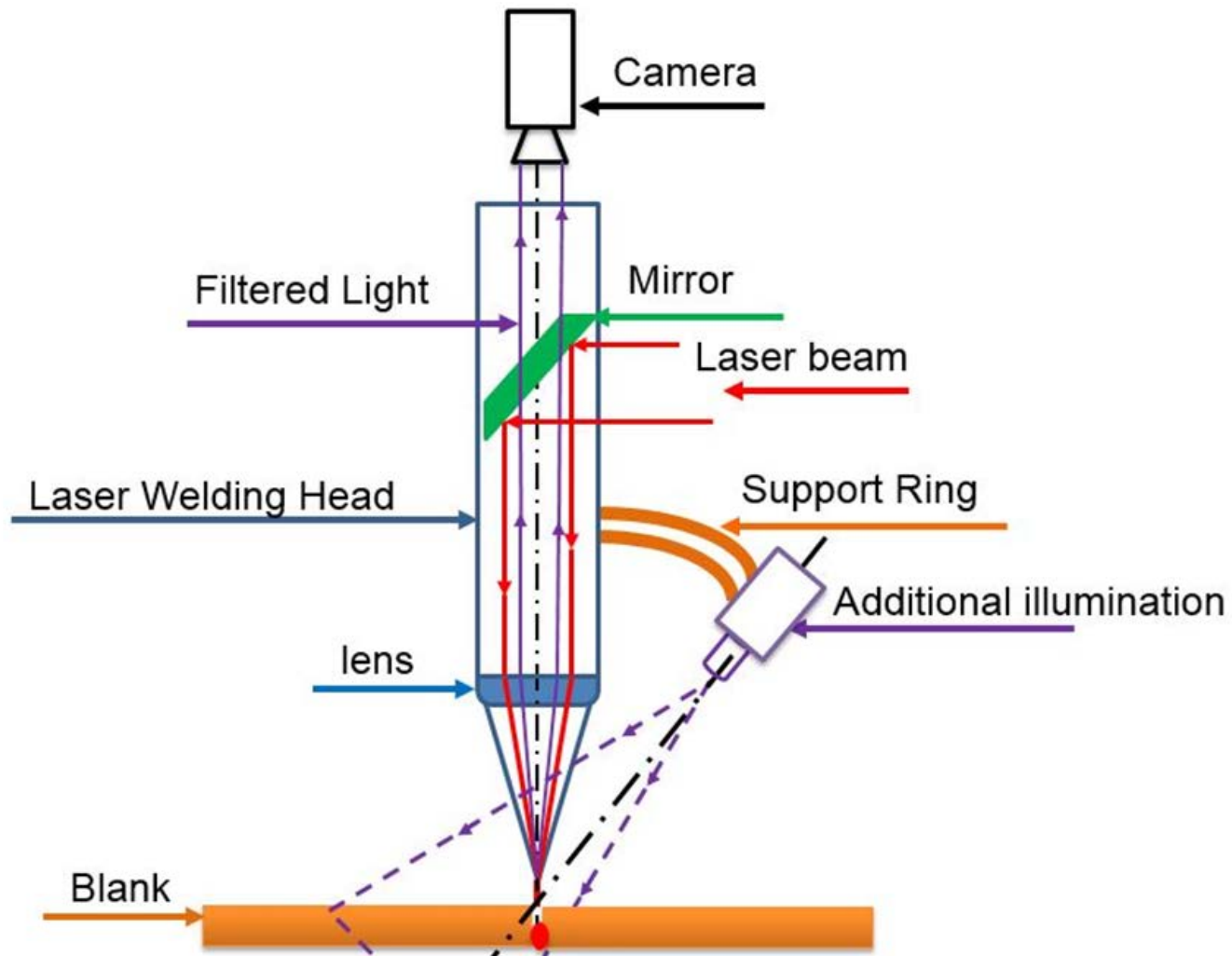
1. Resolution experiments
2. Effect of pulse length

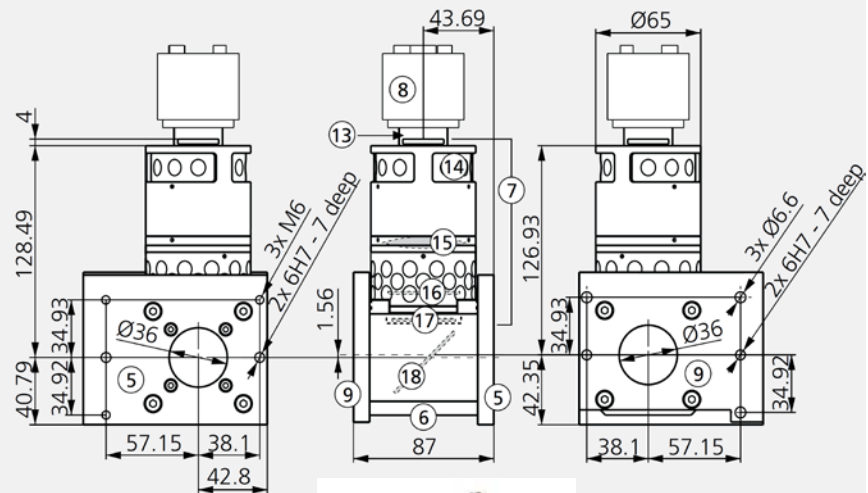
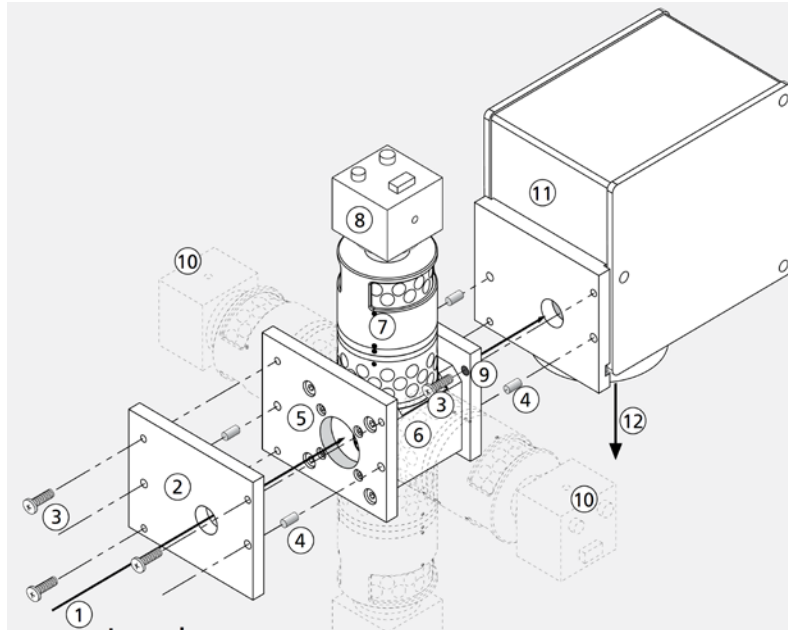


14 ns	50 ns	100 ns	200 ns

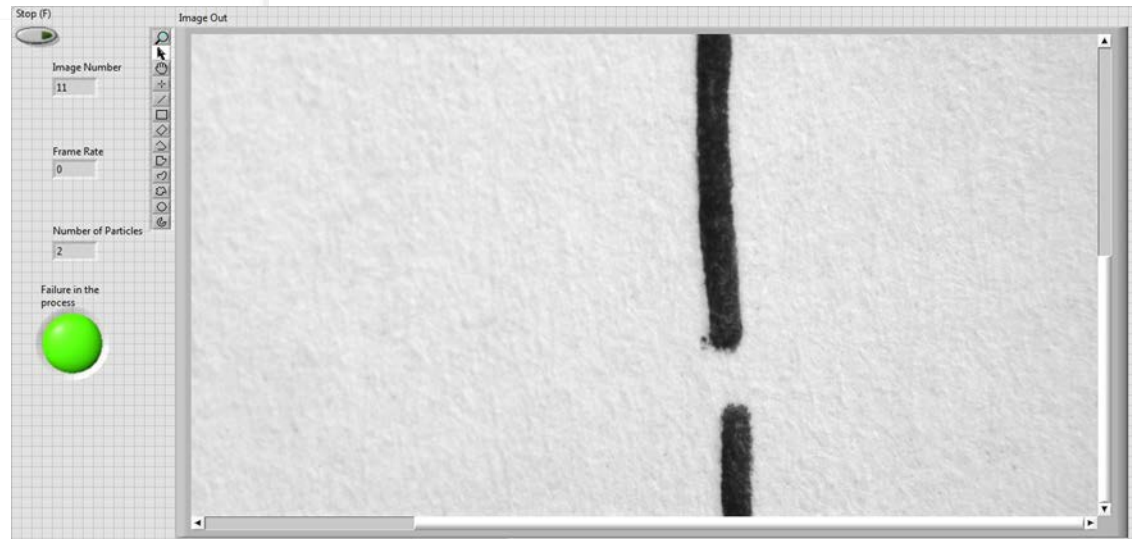
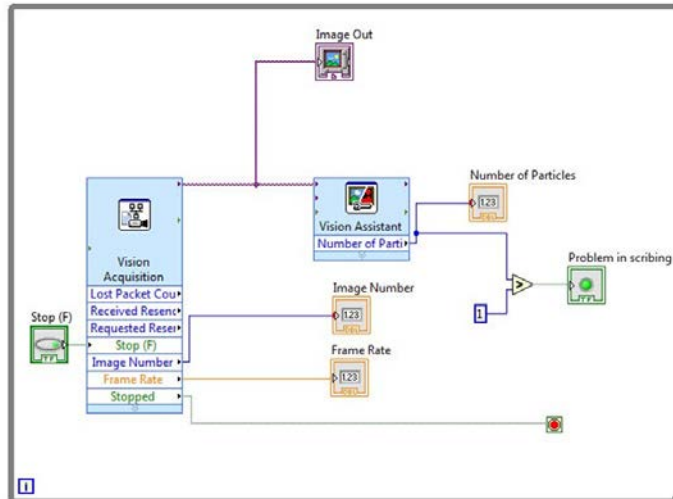
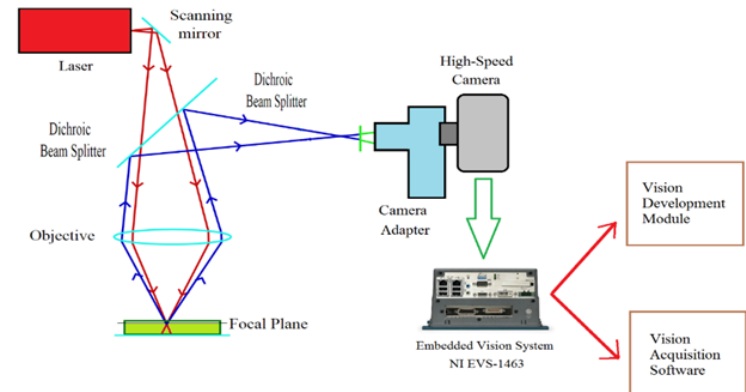
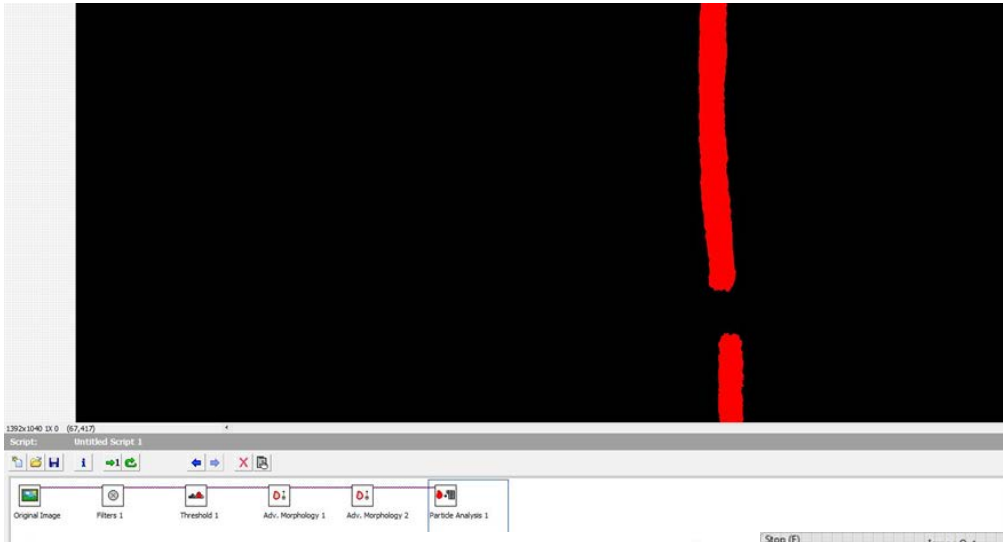
Figure 46: Still images of a high-speed video of laser scribing. A) Without the active illumination, and B) with the active illumination.

Table 3. Side-by-side comparison of the effect of pulse length on the high-speed video images of laser scribing.





High-speed camera

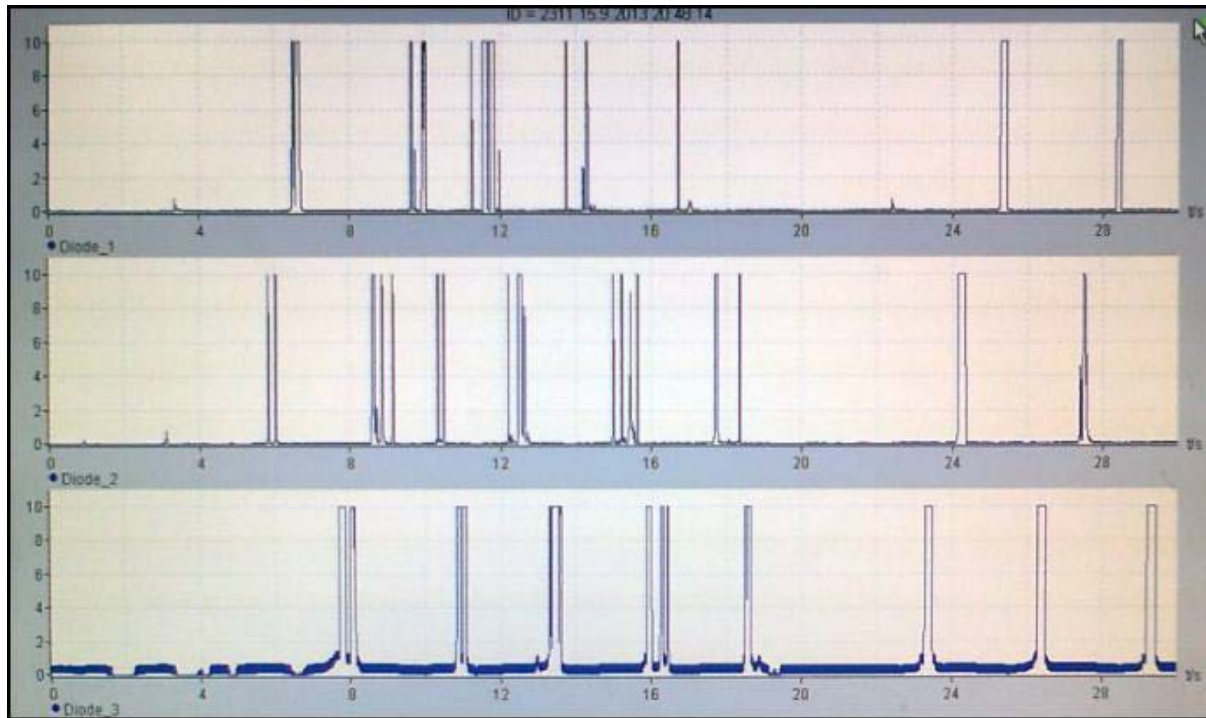




- Back reflected plasma fume
- Metal fume
- Temperature
- Laser beam

Changes are identified and determined in:

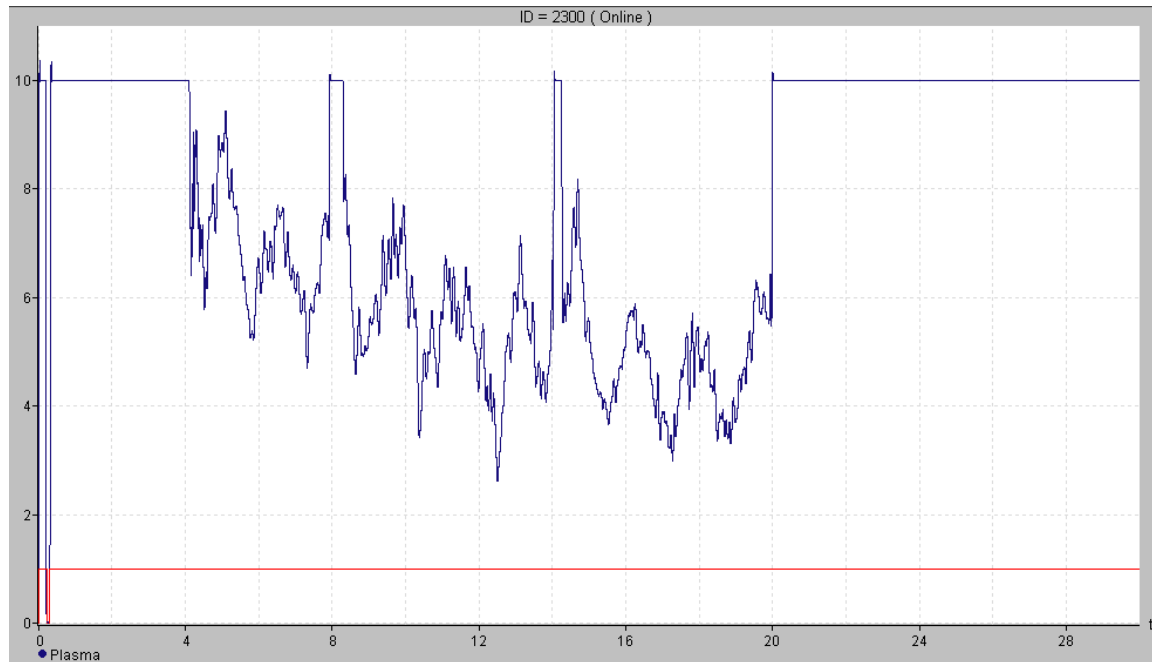
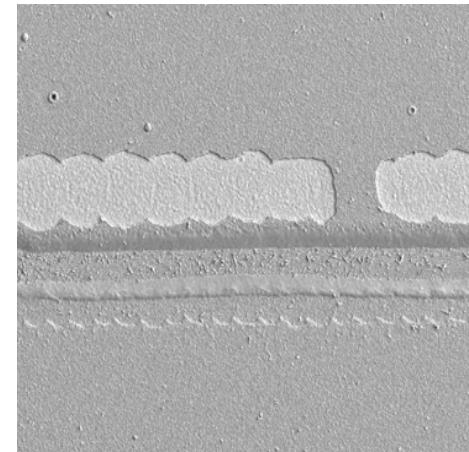
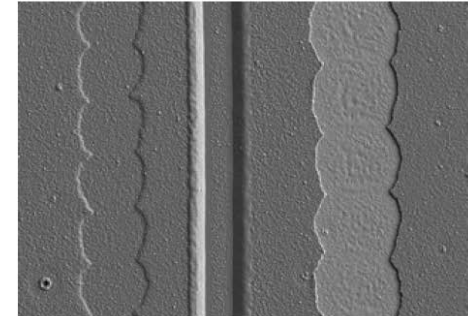
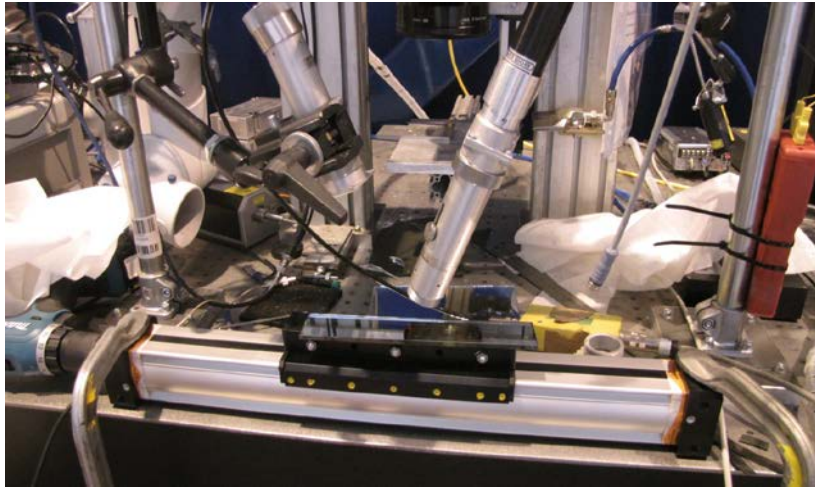
- Laser power
- Focal position

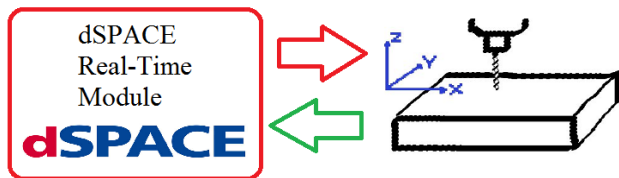


Errors so-called:

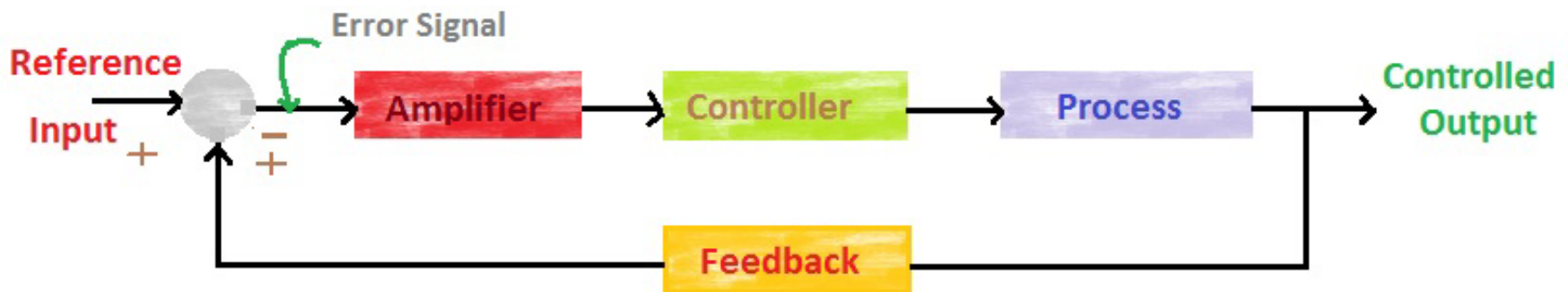
- Lack of Fusion
- Component deviations

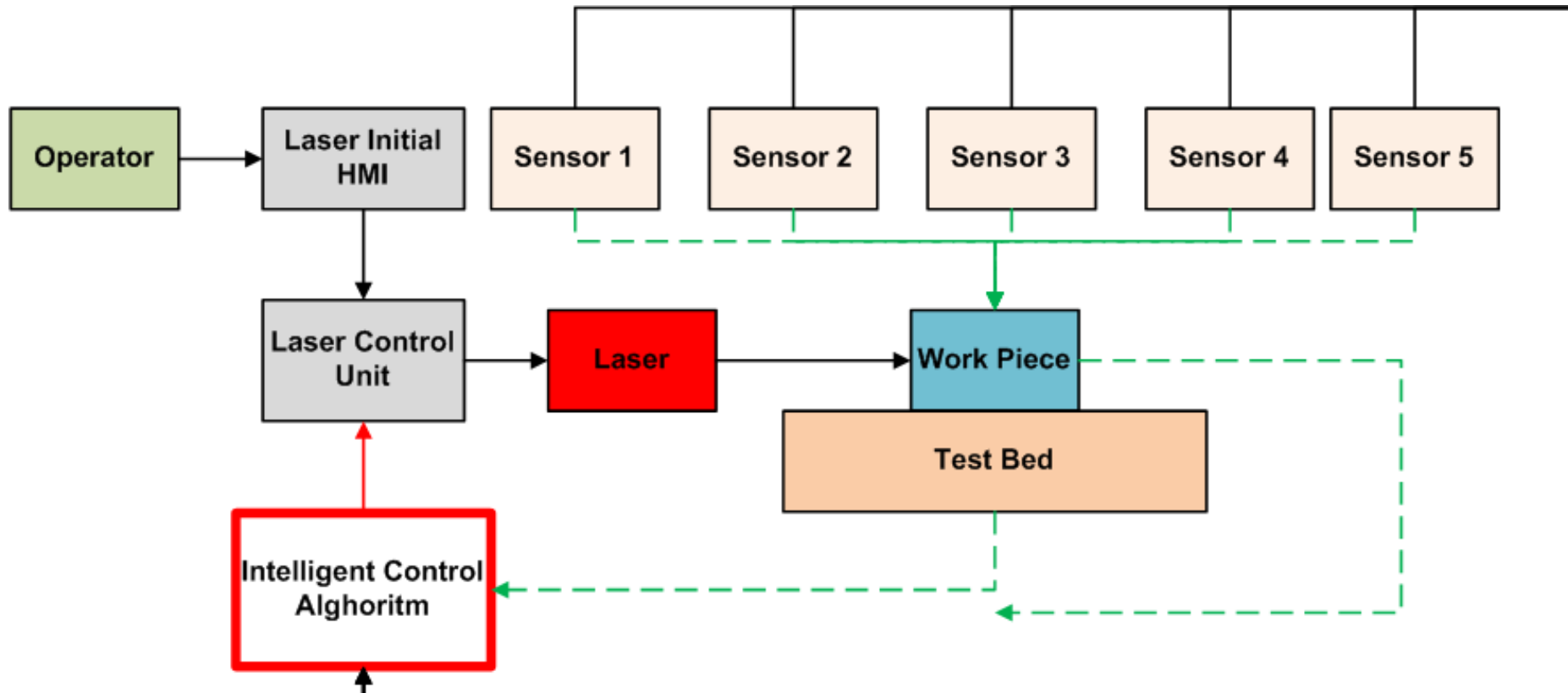
Novel real-time monitoring solution for scribing deflection on solar panels





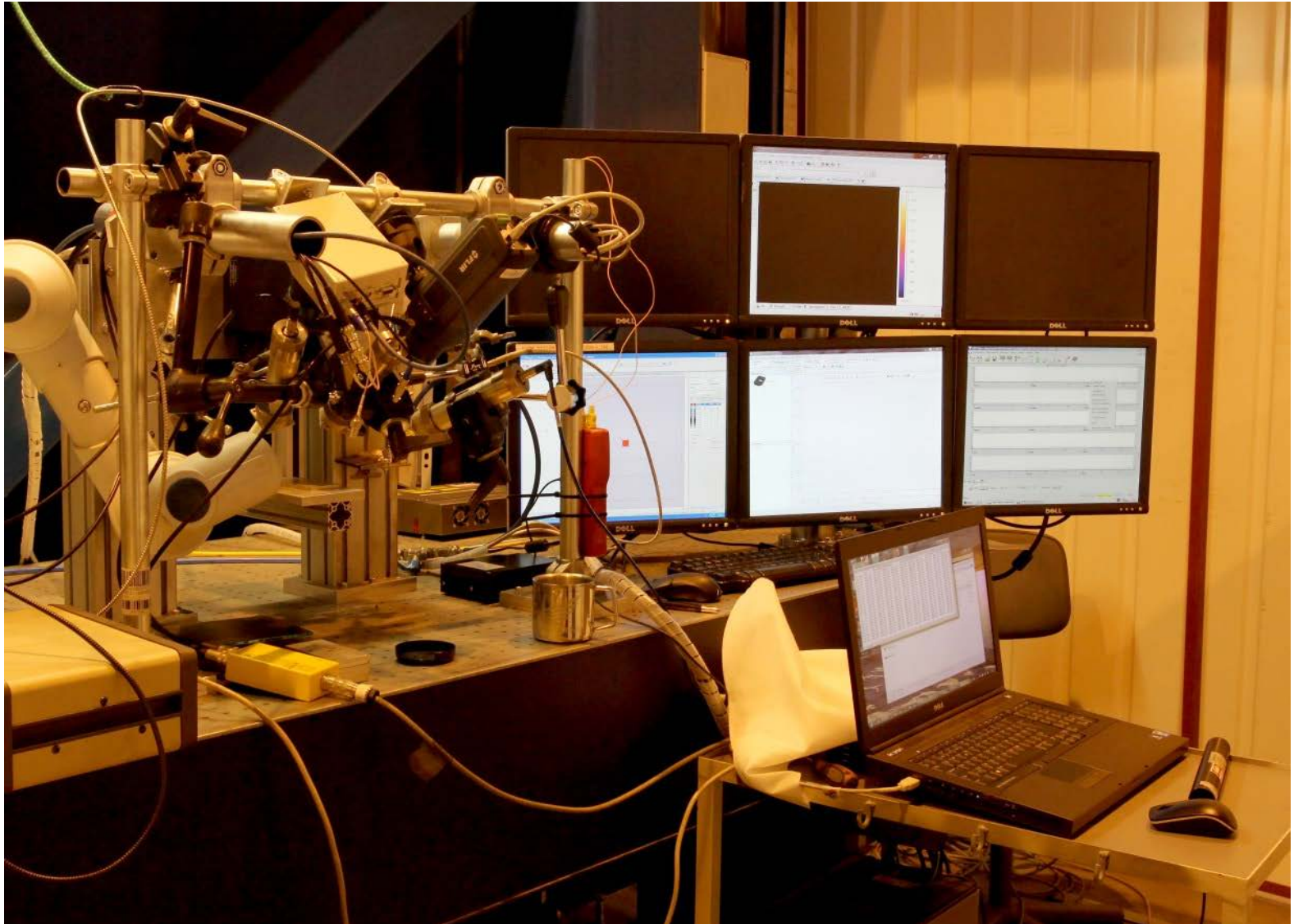
Real-time Control System (RCS) is an architecture and methodology to develop an intelligent system out of several online sub systems.

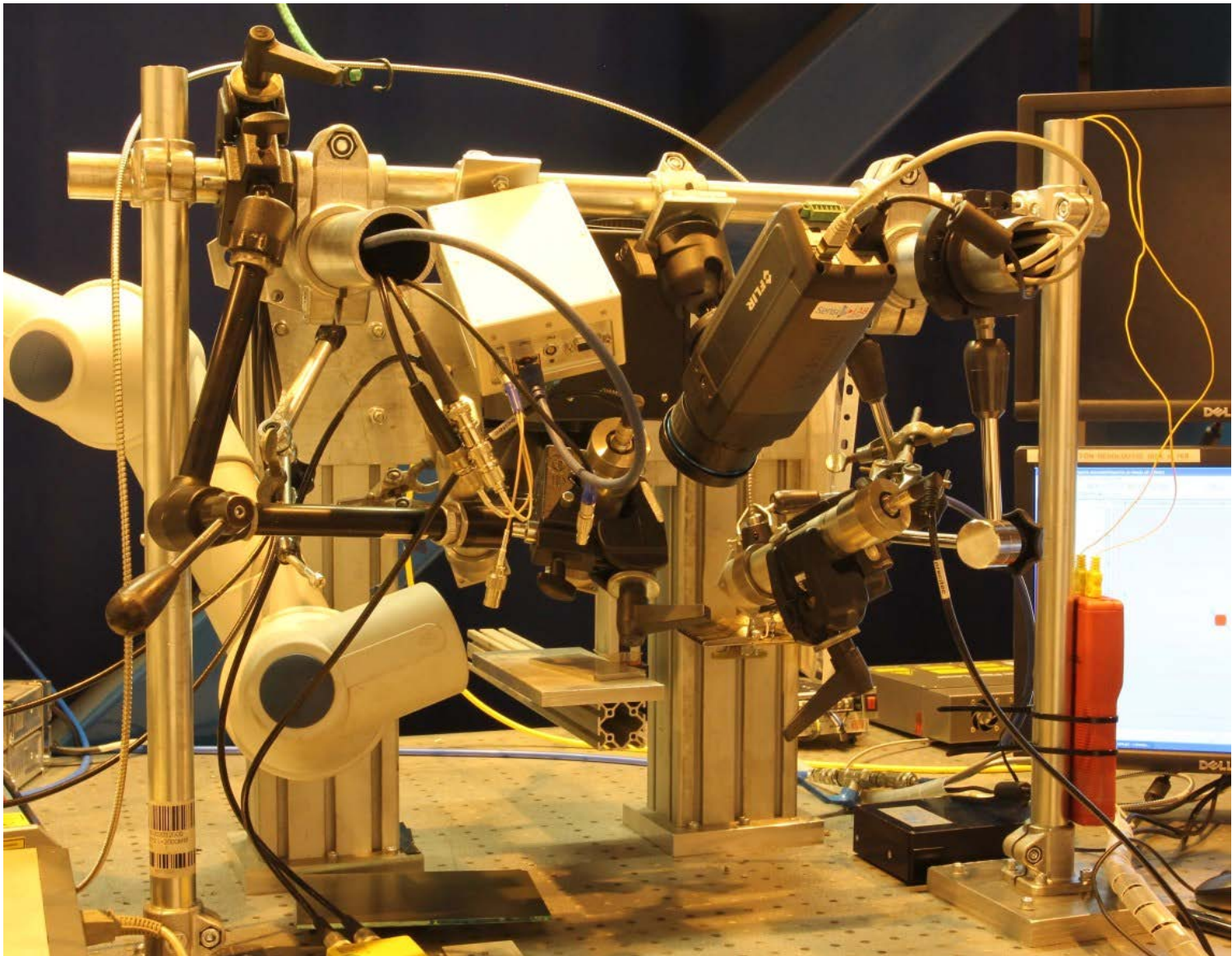




Future plan: Intelligent Data Acquisition System







- Applying online monitoring into micromachining and thin layer scribing processes is possible and useful to increase the process efficiency and decrease the process deflections.
- Voltage based sensors such as photodiodes, spectrometers and pyrometers, due to their high speed outputs, low size of output data and data simplicity are useful in real-time online monitoring.
- It is impossible to provide an integrated high speed real-time monitoring system by using any kind of sensor with its built-in DAQ system. Using a central high speed DAQ is a necessity.
- Image based sensors such as high speed cameras and IR cameras because of high size of output data and difficulty of data processing in very short time period are just useful in off-line monitoring and after process data analyze.

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