EXOM engineering

EPIC Online Technology Meeting on
New Developments for Laser Welding

EPIC
EUROPEAN PHOTONICS INDUSTRY CONSORTIUM

Monitoring approaches for wobble laser welding

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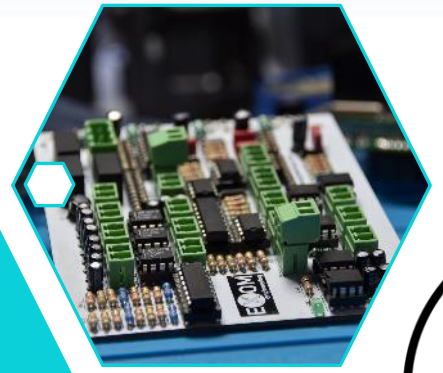
Bilbao

Agenda

- EXOM Engineering
- Wobble Laser Welding
- T-Joint welding with filler wire
- Monitoring approach using visual cameras
- Monitoring approach using IR cameras
- Conclusions

EXOM Engineering at a glance

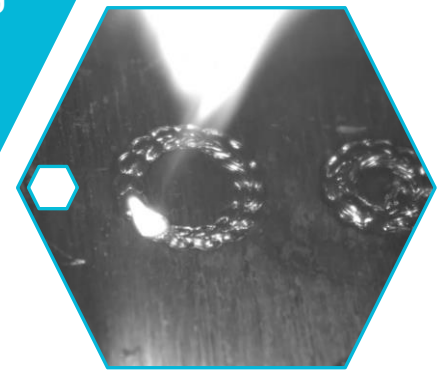
- EXOM Engineering is a specialized provider of industrial solutions for laser welding and surface treatment, integrating in-house developments in artificial vision and real-time process automation.
- Founded in October 2018 as an engineering company, located in the metropolitan area of Bilbao, Spain
- Multidisciplinary engineering team covering opto-mechanics, industrial photonics and machine vision



Electronics

Advanced Manufacturing Engineering

Embedded Software



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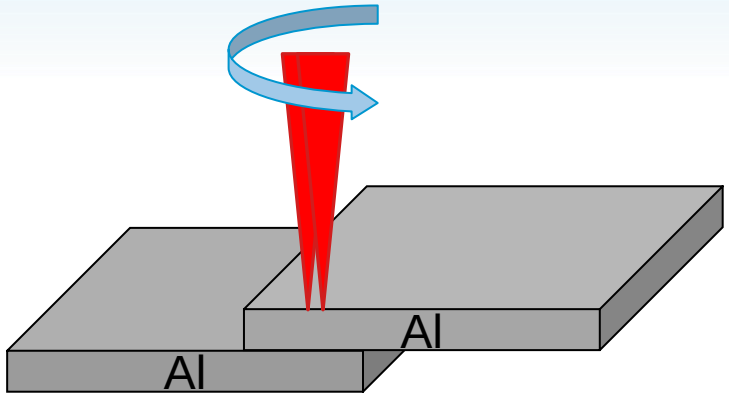
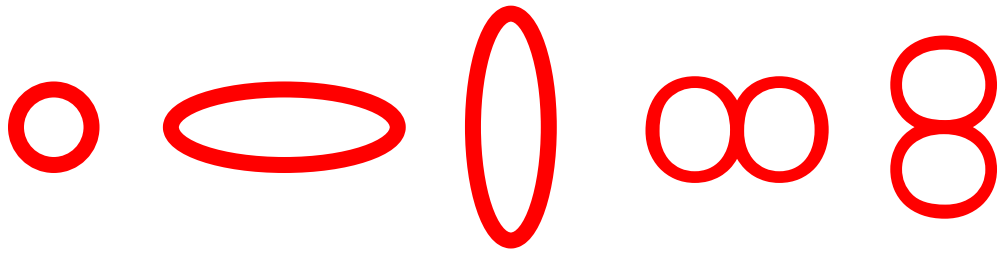
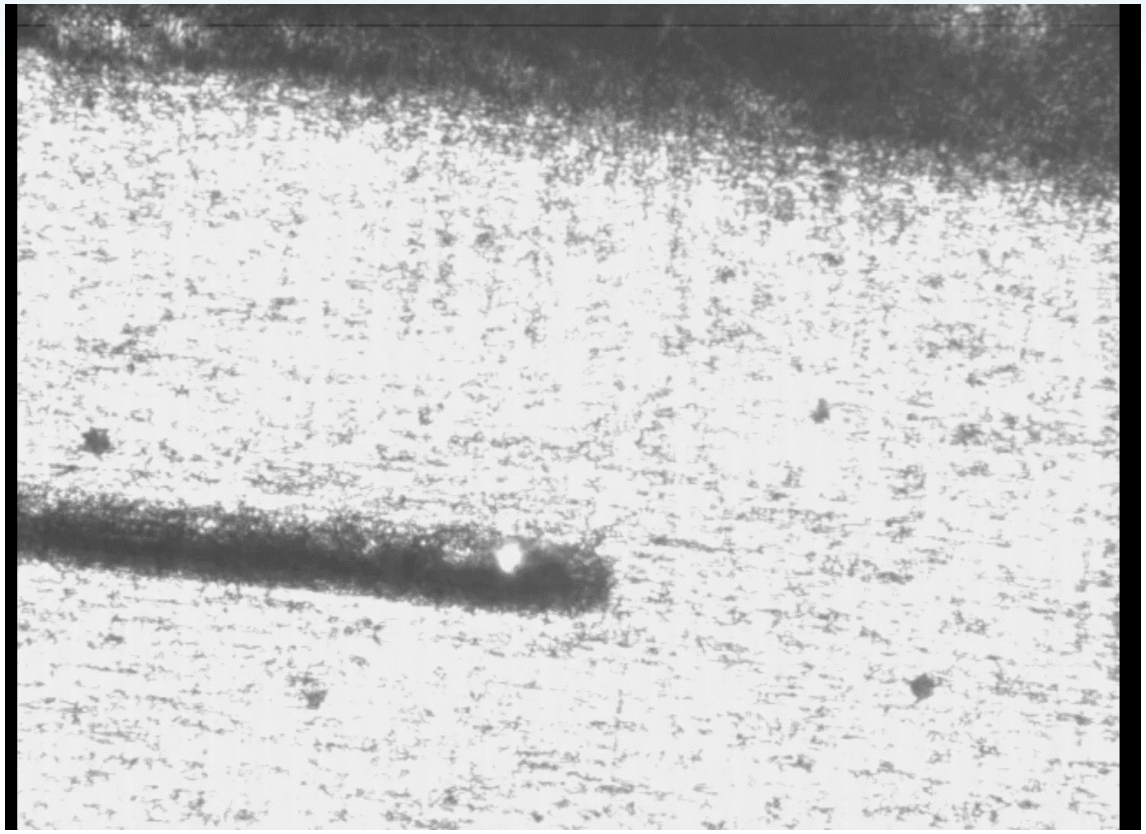
Wobble laser welding





r D1 & D2 Lemniscate

…infinite geometries

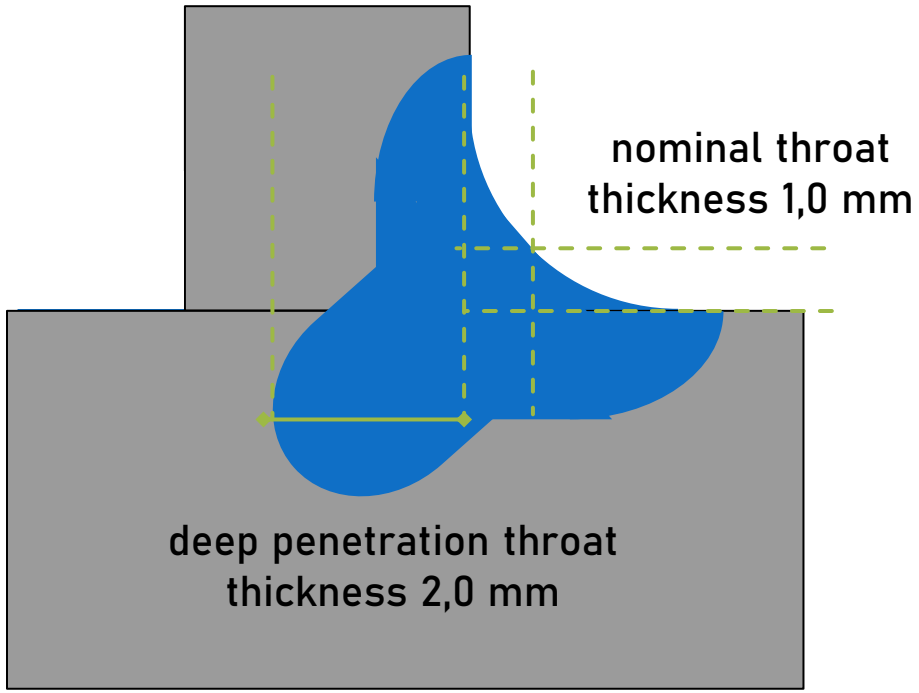


Wobble Type → Frequency → Energy – Power*Time

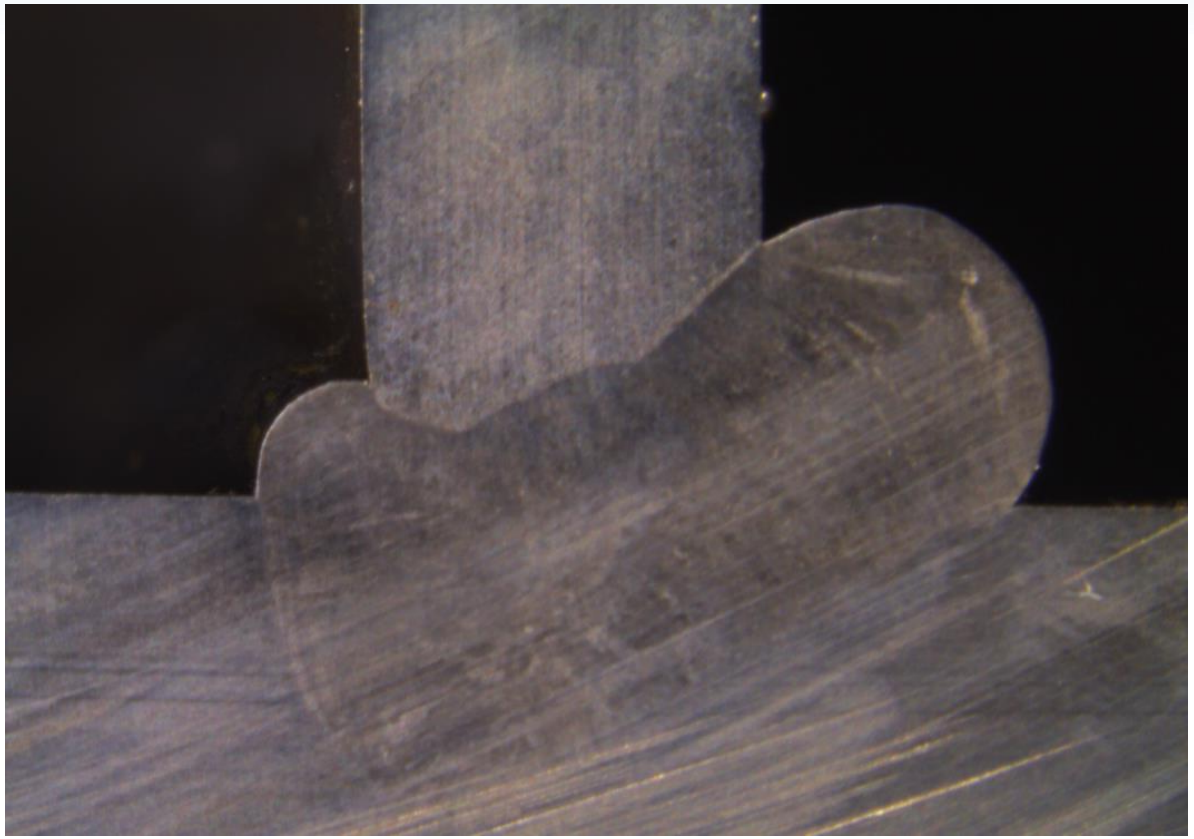
Ellipse (0,2x0,6 mm)
Freq. > 200 Hz
HS Camera: 4434 fps

T-Joint welding with filler wire

Example requirements

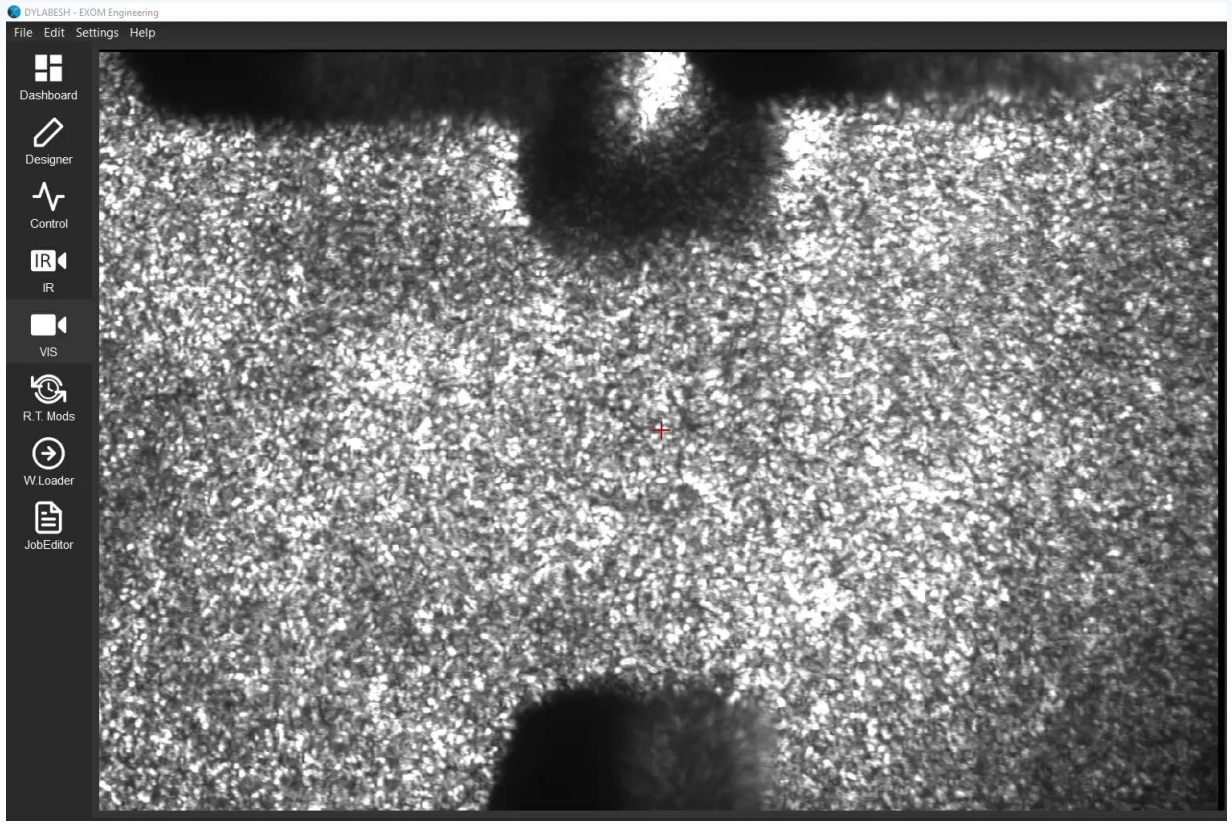


Inox sheet 3 mm

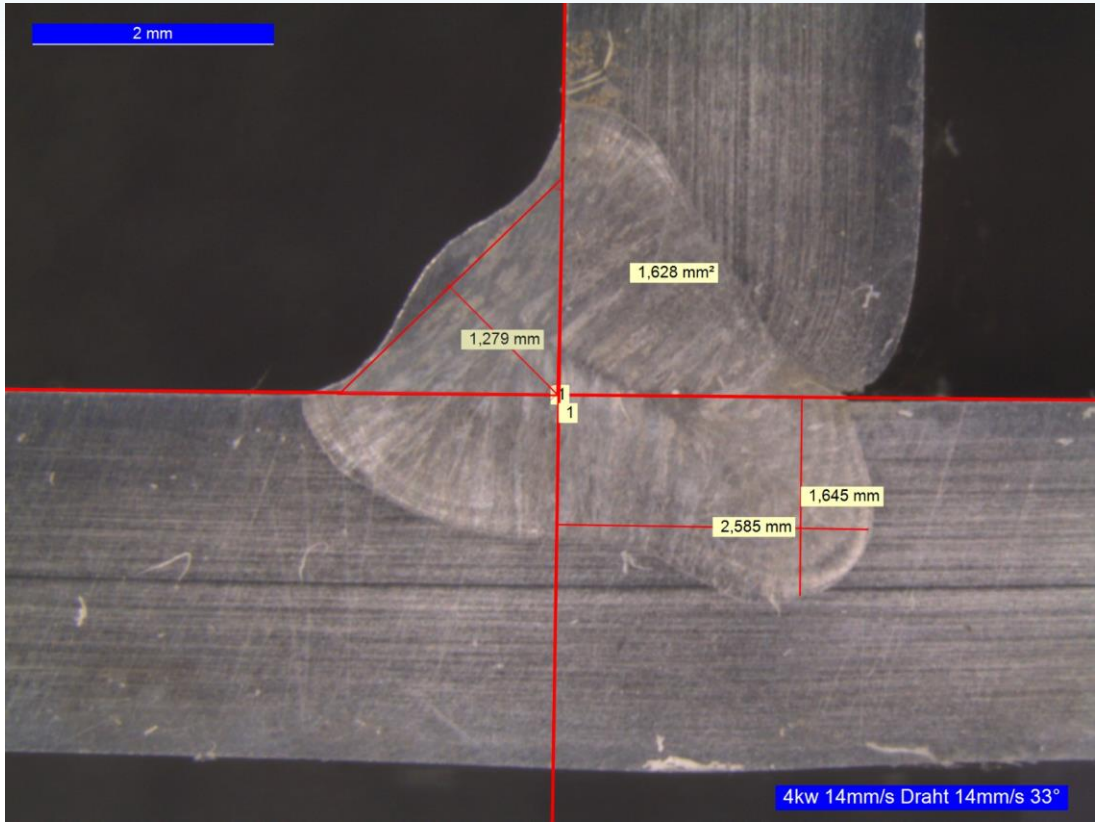


No wobble; 4 kW; EFL 250 mm; 1,6 mm filler wire

T-Joint welding with filler wire - Results

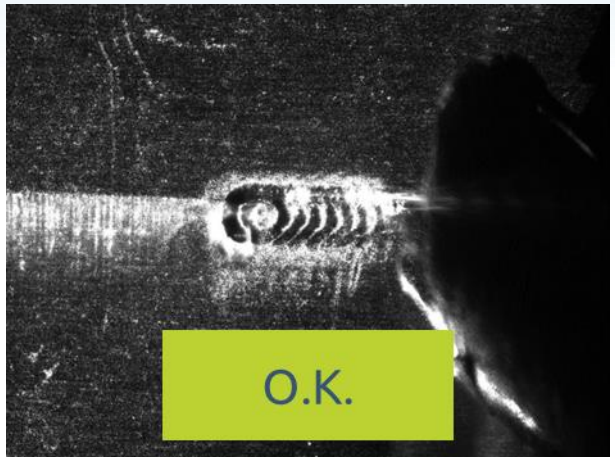


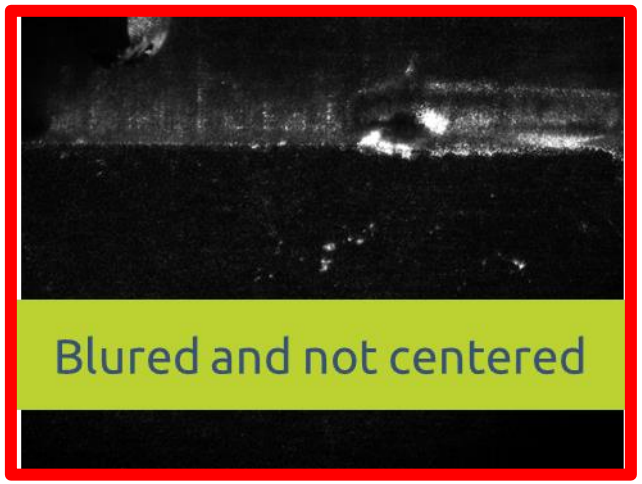
CW; P: 1 kW; EFL: 350 mm; Freq.: < 200 Hz

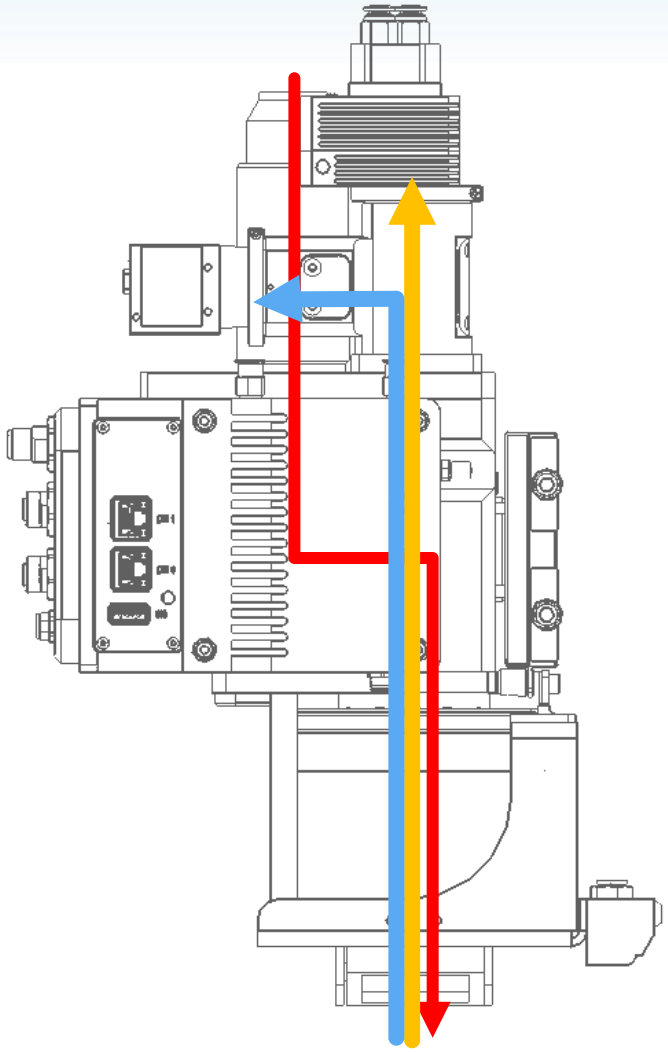


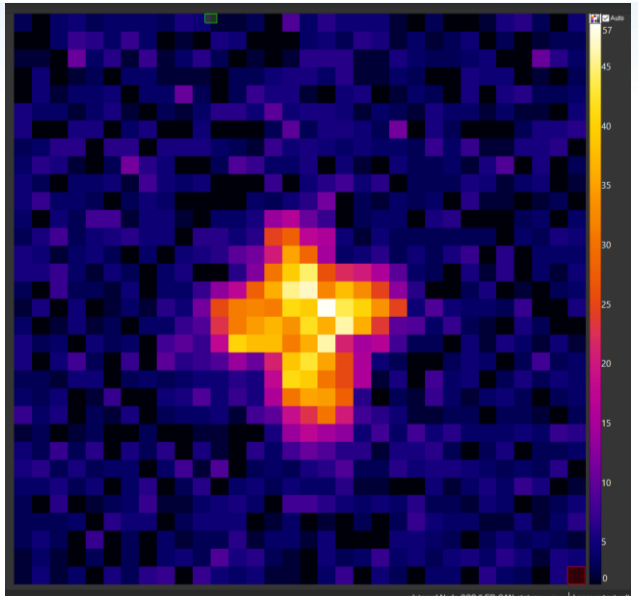
P: 4 kW; EFL: 250 mm; Freq.: < 200 Hz

Laboratory Set-Up; Visual and IR Camera



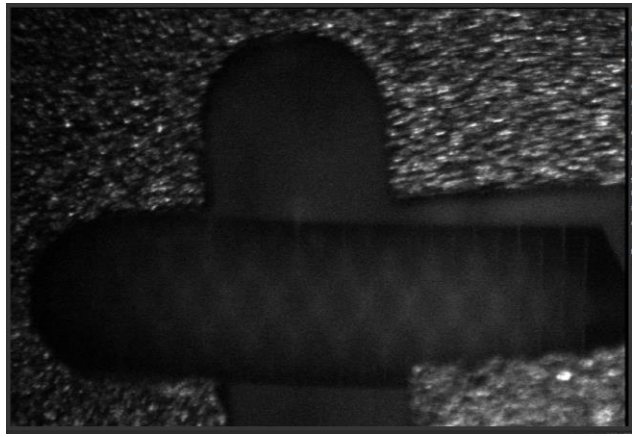






Tachyon 1024 micro-core MWIR 1 - 5 µm; 32x32 pixels; up to 1000 fps;

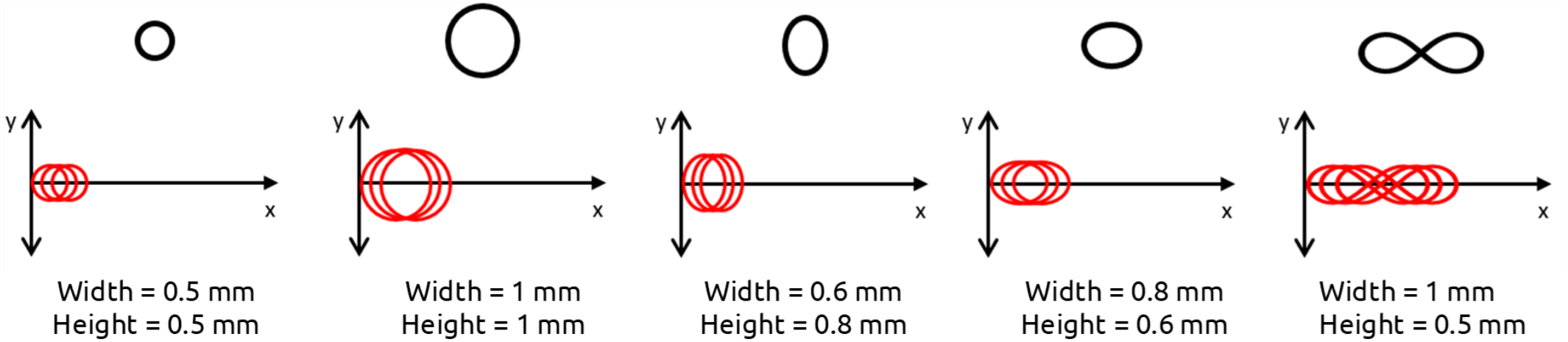
Tachyon 16k plus, MWIR 1 - 5 µm; 128x128 pixels; up to 4000 fps



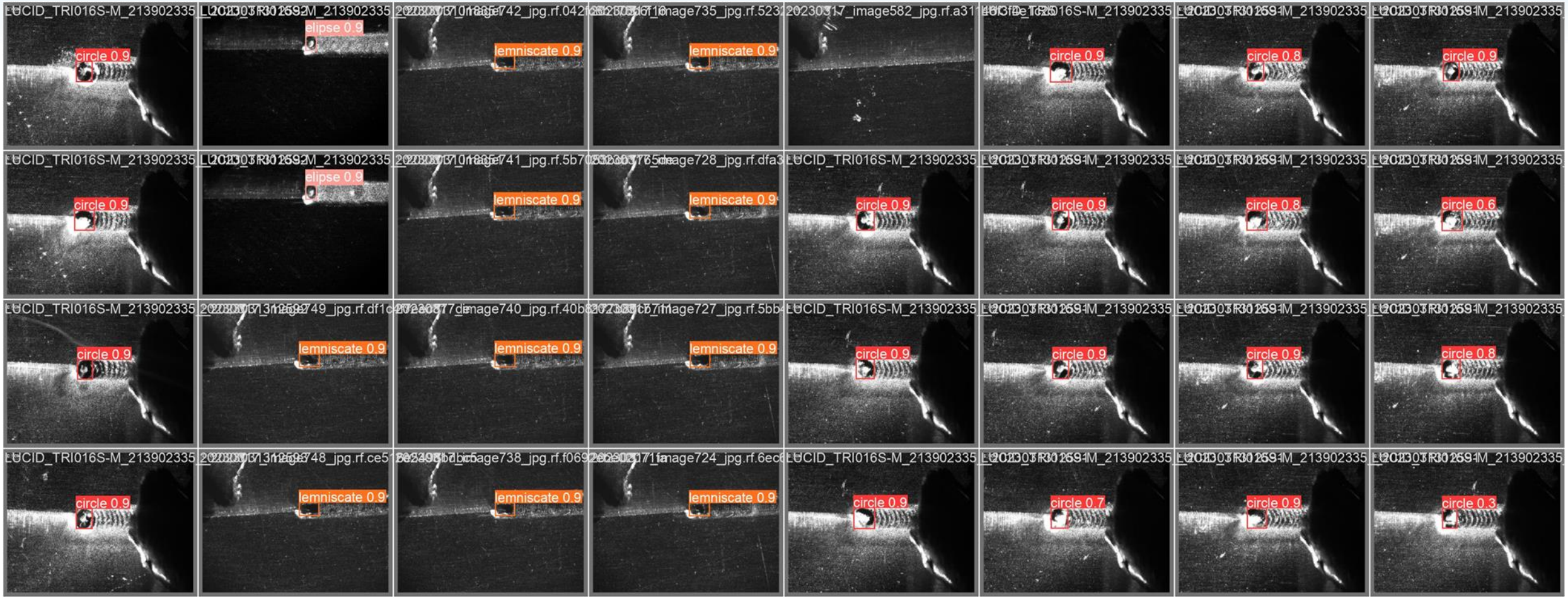
Sony IMX273; Global-Shutter CMOS sensor; resolution of 1440 x 1080 pixels with a pixel size of 3.45 µm; up to 71.0 fps

Data Set parameter – BEAM_IDL Project

Wobble	Width [mm]	Height [mm]	Laser Power [W]	Feed rate [mm/s]
Circle	0,5	0,5	1000	10
Circle	1	1	1000	10
Ellipse	0,6	0,8	950	10
Ellipse	0,8	0,6	950	10
Lemniscate	1	0,5	1000	10



Monitoring approach using visual cameras



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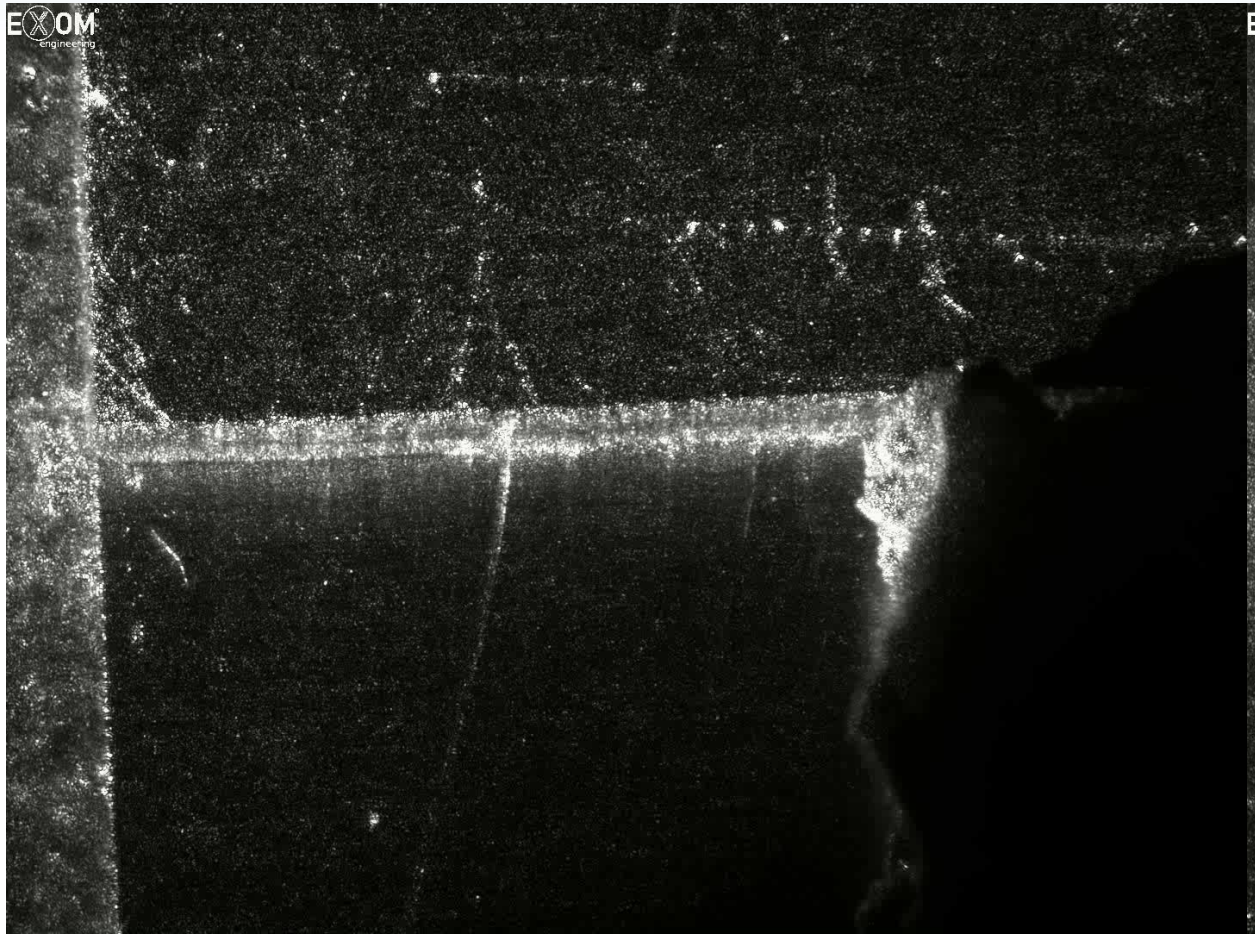
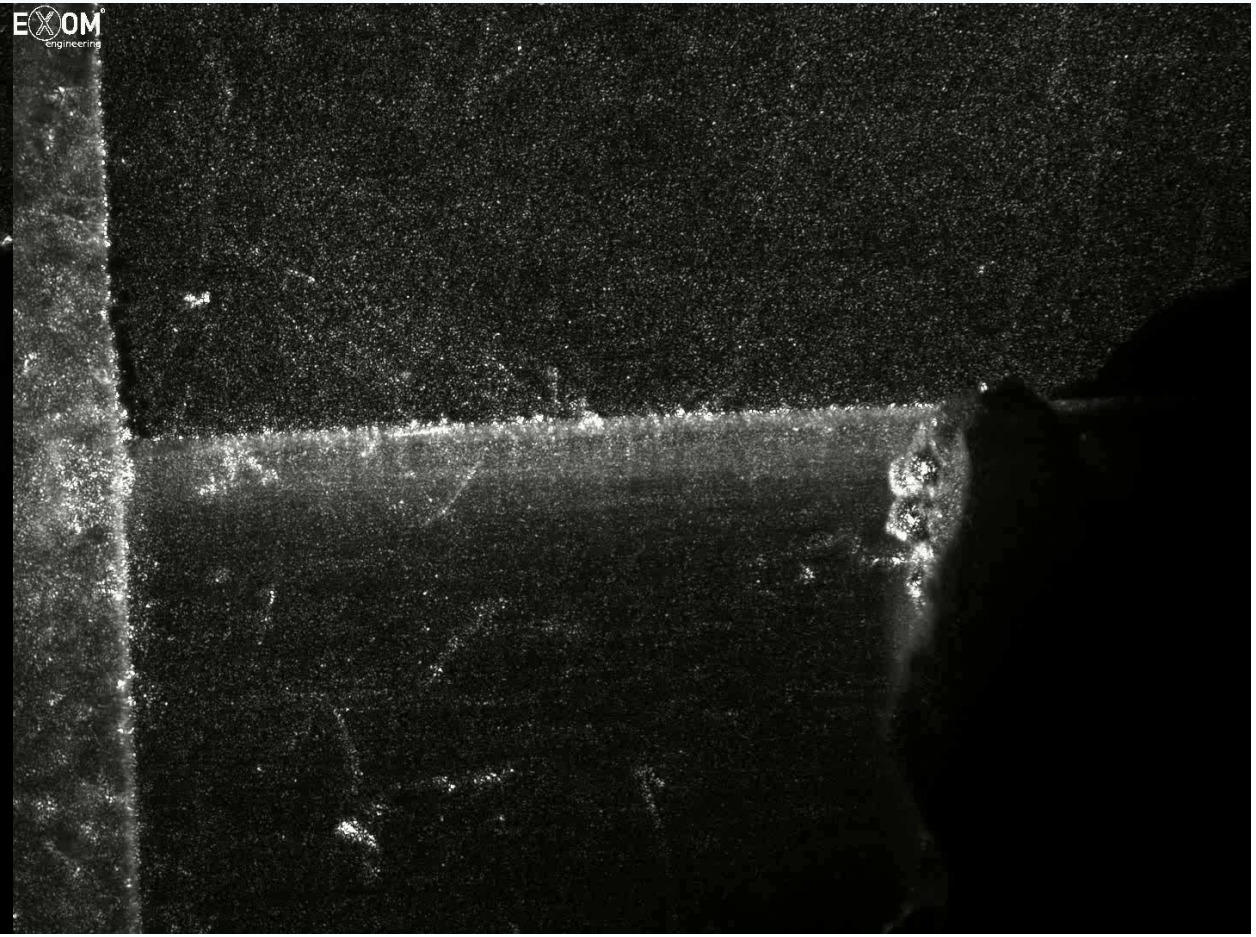
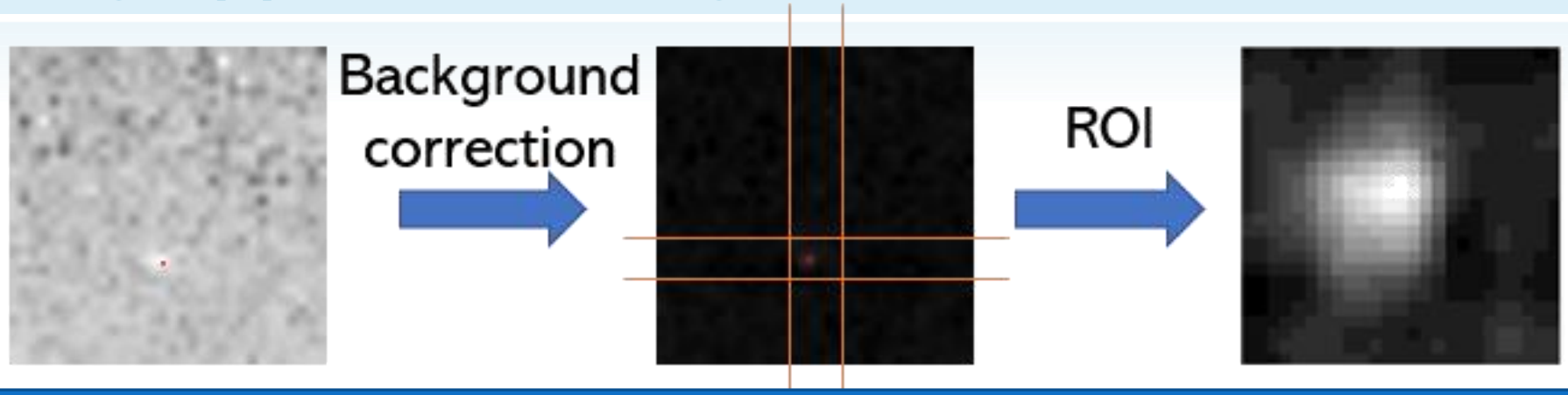
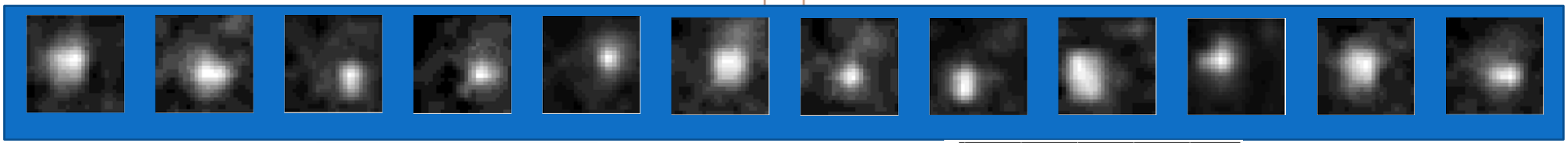
Results using visual cameras

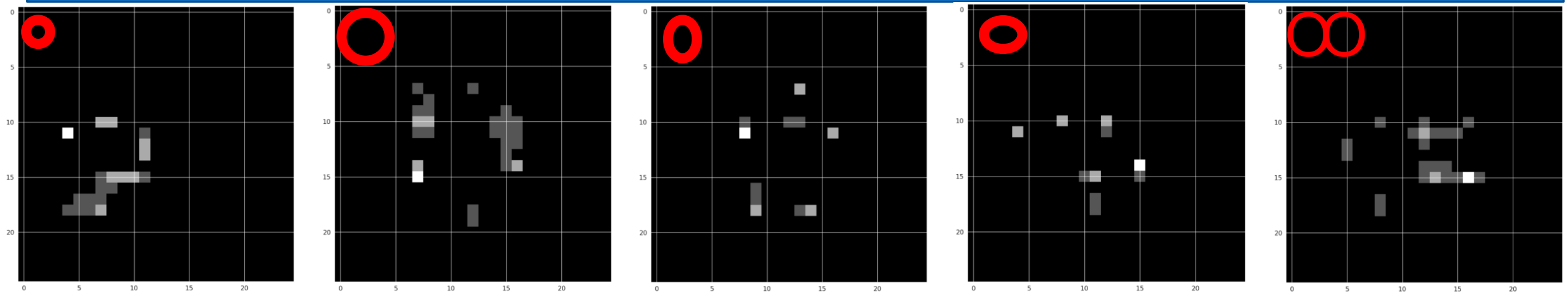




Monitoring approach using IR cameras

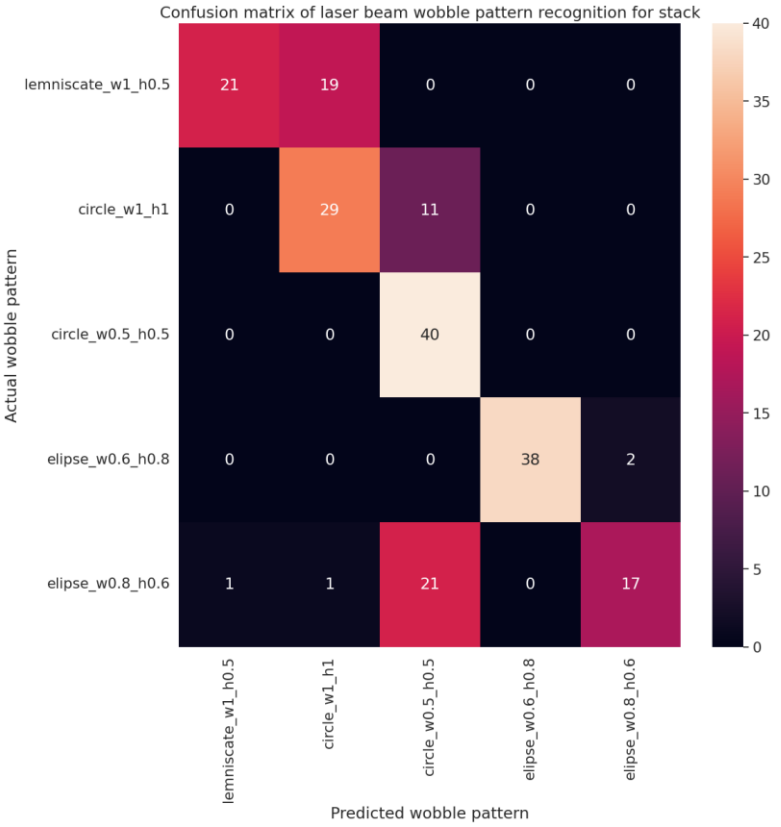




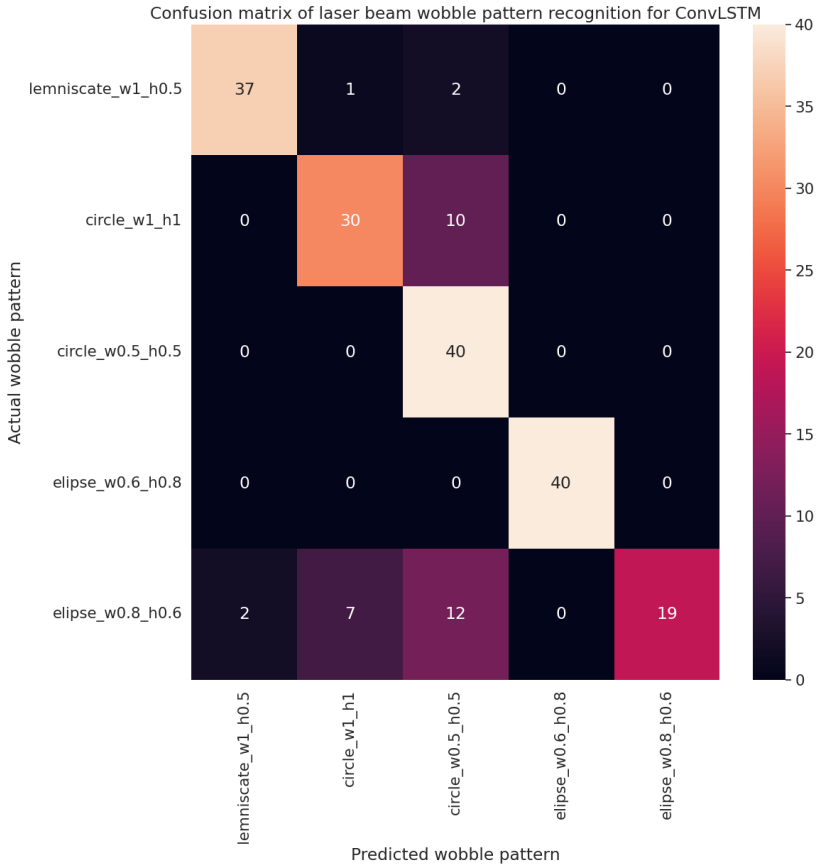


Monitoring results – Model comparison

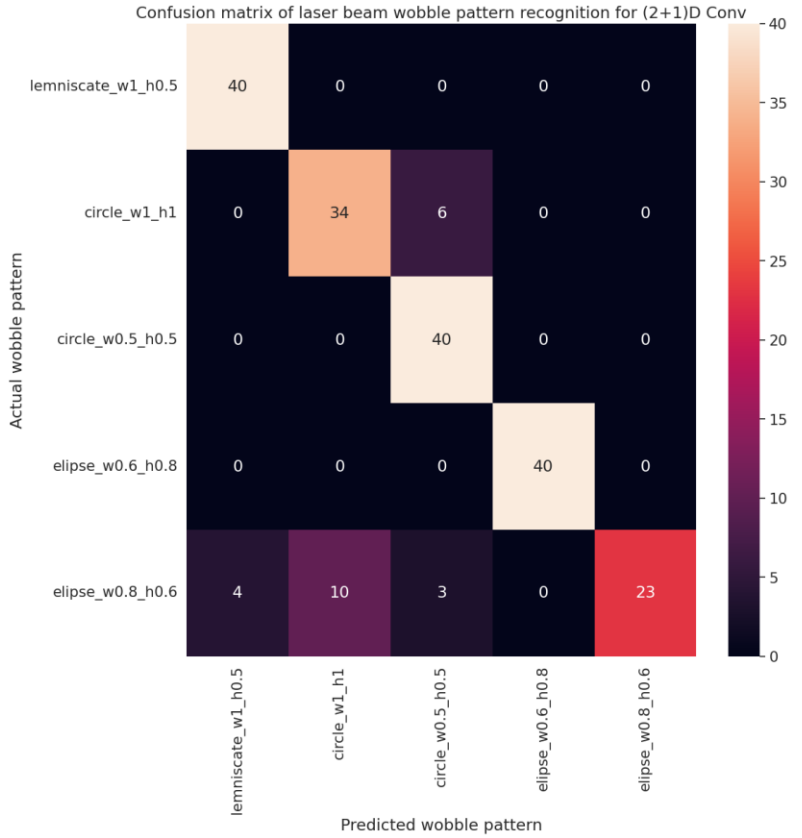
Approach 1: Conv2D



Approach 2: ConvLSTM2D



Approach 3: Conv(2+1)D



Conclusions

- Wobble laser welding serves as a versatile enabler for various applications, both with and without filler material
- Maintaining the constancy of wobbled beam parameters is crucial, extending beyond just laser power control.
- Traditional approaches utilizing visual cameras require additional illumination and filtering, but represent an alternative to more complex sensor integrations
- Employing infrared (IR) cameras offers a higher dynamic range, but introduces additional challenges during the analysis process. While providing higher frames per second (fps), this approach entails a trade-off with reduced image resolution

Contact us

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