



iQonic

IQONIC

Innovative strategies, sensing and process chains for increased
Quality, re-configurability, and recyclability of Manufacturing
Optoelectronics

Press Release

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Deliverable Lead: SACMI



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Toward the end of the iQonic project

On February 11th, 2022, partners met online for the 5th General Assembly of the iQonic project. The event aimed at assessing what has been done so far and the results achieved and discussing the next steps for the last months of the project to give the best conclusion to the iQonic project that will see its end in September 2022. Since we are approaching the end of this journey, it seems only fitting to reckon the main results achieved by partners in the context of three use cases in the project.

ALPES LASERS's use case relates to the manufacturing of semiconductor lasers through a highly complex and customized production process, involving different optical, physical, and chemical parameters. ALPES LASERS expects to gain a better overview of the production process thanks to a “single window platform”, to improve the overall production yield, the quality of the process, the lead-times and to minimize waste thanks to a monitoring, zero-defect system.

Through the iQonic project ALPES LASERS, together with partners from **ATLANTIS**, **CORE Innovation**, **BRUNEL University London**, and **SENSAP**, developed a wafer scanning and image processing technique. More specifically, this work includes the image collection with image pre-processing, the labelled data creation (annotation of images) via COCO Annotator (Figure 2) and the development of deep learning algorithms for image defect segmentation. This allows for an early and detailed components qualification and detection of defects at the wafer level. It prevents opto-semiconductor components, such as quantum-cascade laser chips, that are below a quality threshold, from entering cost-intensive assembly processes. In terms of potential benefits and application of the result, component qualification and defect detection at the wafer level are common tasks in the early stage of optics device manufacturing. Highly automated technologies that also incorporate machine learning and artificial intelligence approaches to combine actual and historic data enabling high yield and close to zero-defect manufacturing in photonics.

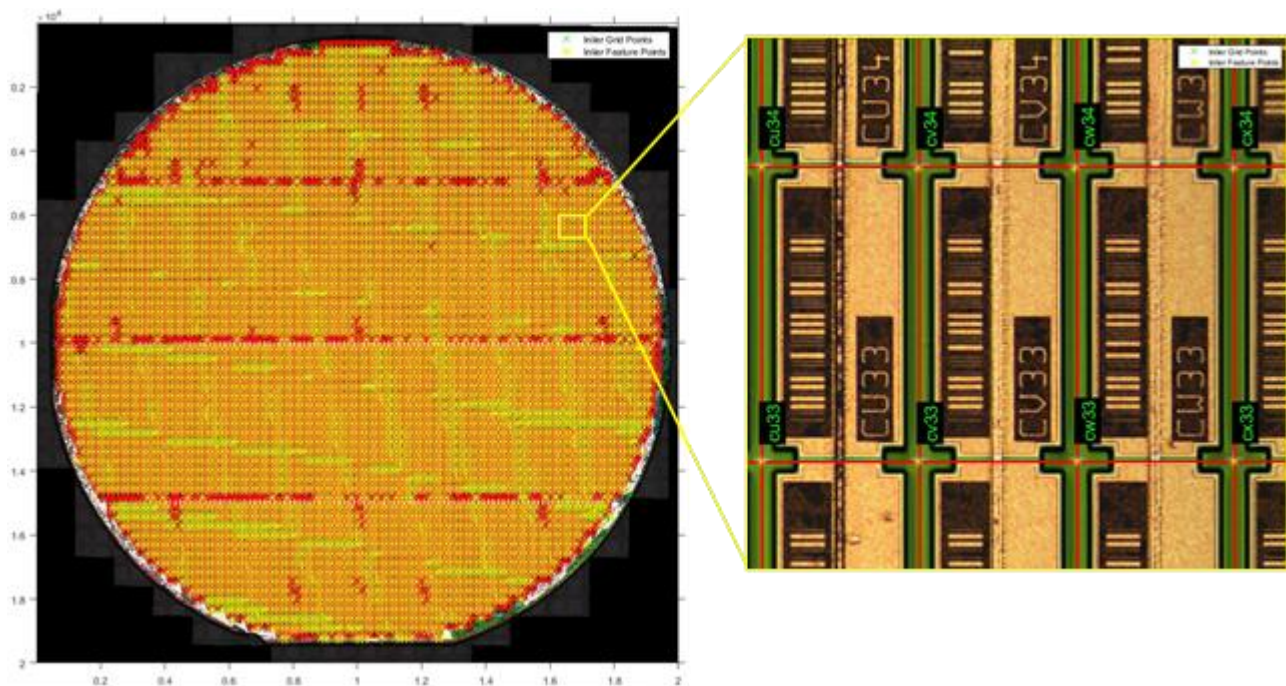


Figure 1: Image-based automatic detection of semiconductor laser devices on the wafer.





Figure 2: Sample of a wafer-level inspected semiconductor laser device.



Figure 3: LabVIEW program and GUI that assess the waveguide quality of semiconductor laser devices and display the results

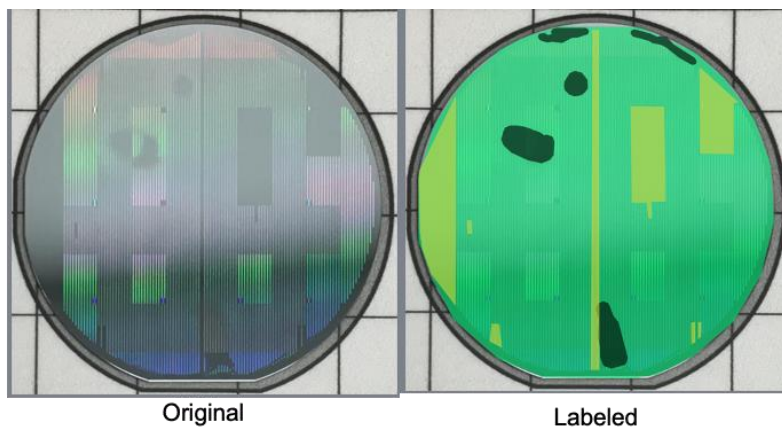


Figure 4: Example of image annotation (COCO Annotator) by CORE Innovation



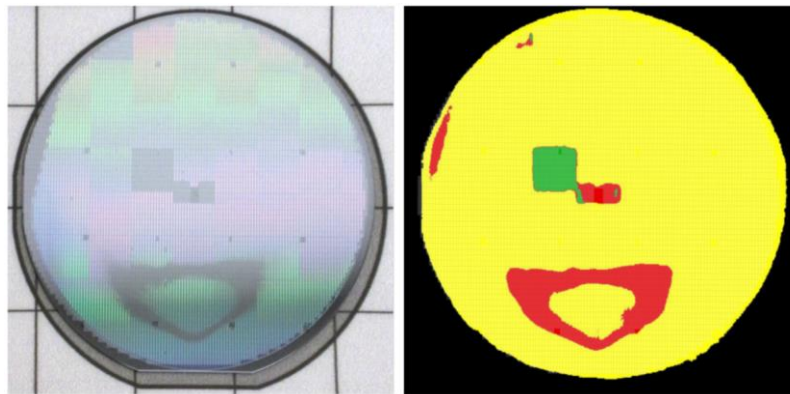


Figure 5: Image of a wafer revealing the top grating and the corresponding defect detection result

The **Prima Electro** use case relates to the demonstration of a laser production process for the multi-stage zero-defect manufacturing of laser sources with increased quality. Via the iQonic project, Prima Electro aimed at reducing production time and scrap rate of the diode to eliminate defects during the production process, to monitor quality and production stages, and to automate production for extra customization.

The result of the work done, together with partner **Politecnico Milano**, is defined by Cyber-Physical System (CPS) representations of complex and tolerance sensitive optical systems. Examples are fiber-coupled and multi-emitter high-power laser diodes that enable deep manufacturing process understanding and early detect costly defects, allowing for fast and reliable decisions on the shop-floor level about using/ re-qualifying/ reusing high-value photonic components. In terms of potential benefits and application of the result establishing various CPS along the full value chain of photonics, the production allows for the control of cost-intensive manufacturing and assembly processes towards zero-defect production and circular economy approaches to be adopted by the photonics industry.

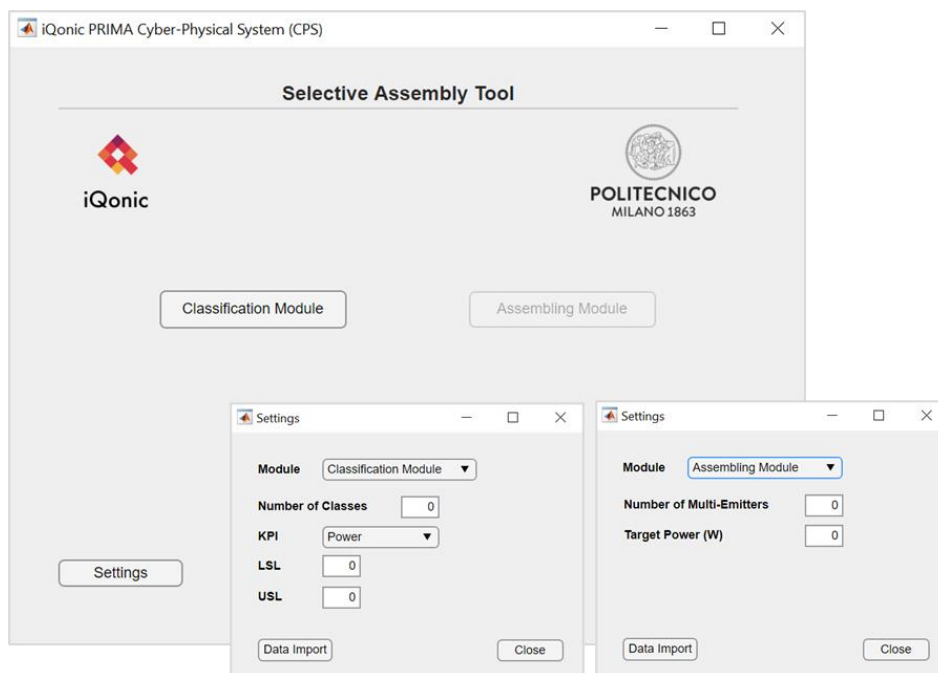


Figure 6: CPS main Screen



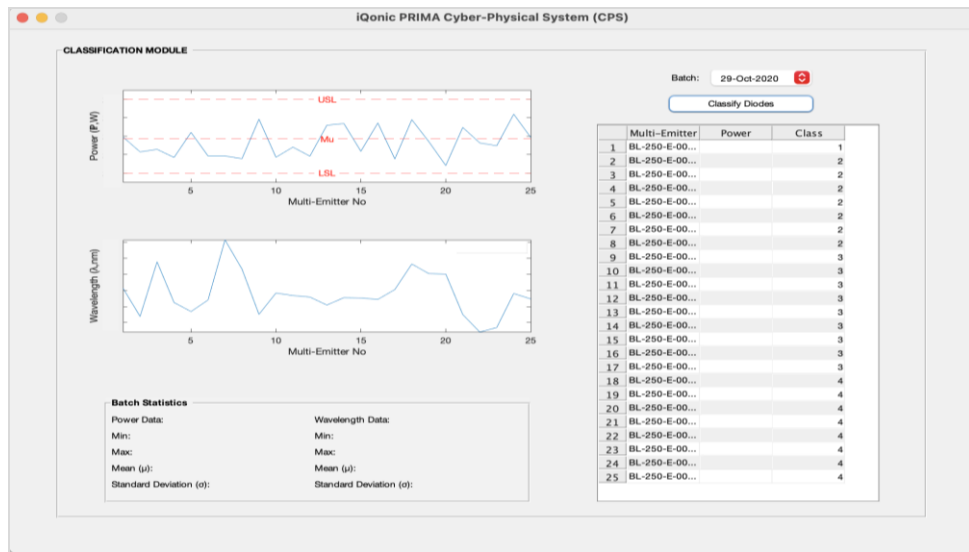


Figure 7: CPS classification Module

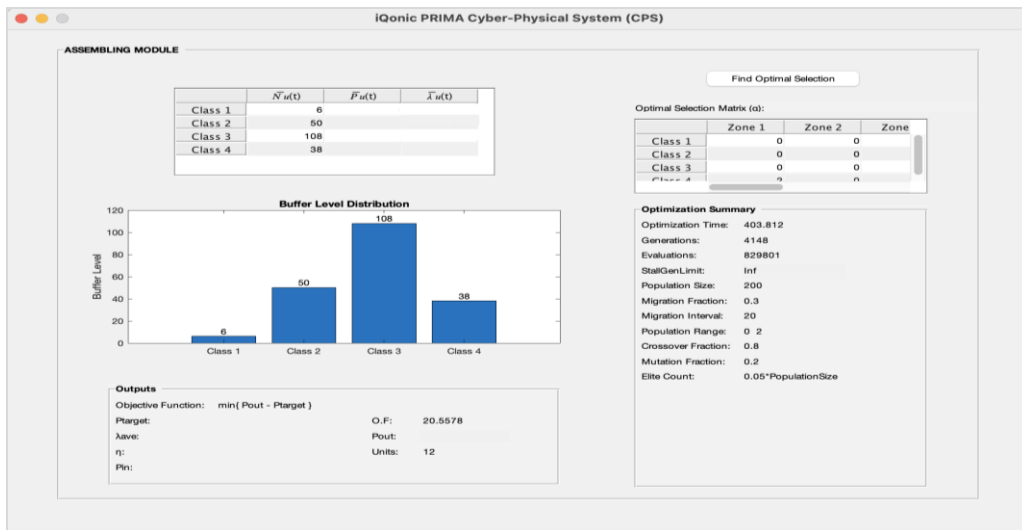


Figure 8: CPS assembling Module

Finally, the **Filar-Optomaterials** use case involved the manufacturing of synthetic crystals (laser, optical, and scintillation) in an industrial chain starting from raw material sintering until the supply of the final product to the end-user. Through the iQonic project, FILAR with partner **Sensap Swiss** expected to benefit by adding value to both online and off-line monitoring of the process chains by seeking more accurate feedback to deeper understanding and analysis to reach optimum conditions for crystal seeding, pulling, extraction and to gain to reduce production cycle time and driving the material waste to a minimum.

Thanks to the project, collecting data from raw crystal optics manufacturing processes such as ultrasonic grinding allowed for process monitoring and optimization with respect to e.g., tool wear and component quality – not only in the closed-loop process during the actual manufacturing but also based on historic data from previous manufacturing batches. In terms of potential benefits and application of the result sensorics in dirty raw optics manufacturing process environments enable deeper process understanding and are a basis for analytical as well as statistics-based process optimization, and consequently also





automation, in an up to now still highly manual production.



Figure 9: FILAR shop floor with ultrasonic drilling station into optomechanical area



Figure 10: FILAR shop floor with laser marking station into optomechanical area



Figure 11: FILAR shop floor with lapping and polishing stations into optomechanical area





Figure 12: Daedalus Box with Installed sensors

To see what the end of the projects will bring to these already advanced use cases keep following out project websites and social media pages.

Want to know more about iQonic?

Discover our website: www.iqonic-h2020.eu

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