Experiment name: New Deli

Experiment "motto":

NEW-DELI assessed a **cutting edge ultra-short pulse (USP) fibre delivery system.**

The experiment gathers together two SMEs, a technology provider, OPI Photonics, and an end-user, IRIS, and a university belonging to the Appolo hub, BUAS, where the cable qualification has been performed.

The Business Sector

The goal of the NEW-DELI's solution is to be the key enabling factor effective and efficient processing technologies for tailoring the surface quality properties of Additive Manufacturing parts by laser ablation and surface-structuring. Because of this, the sectors of applications have been identified in the aerospace, automotive and Medtech ones, and materials to be treated in Aluminium alloys, Titanium alloys and Steel. Moreover, scribing processes on thin film photovoltaic modules have been identified as further possible fields of application of NEW-DELI, showing the application of the delivery system also for those processing cases where there is a need for short-pulse beams for material treatments.

The Company

OPI Photonics is a dynamic Italian SME located in Torino (North-West Italy).

OPI takes advantage of over 20 years of experience in photonics to develop high power multi-emitter laser diode sources and innovative devices for kilowatt laser beam management (combining, coupling, delivery and switching) and laser pulse delivery.

OPI's flexible technological approach allows the seamless coexistence of off-the-shelf and dedicated solutions, up to personalised approaches in which OPI accompanies the customers from the design phase to the realisation of prototypes, and then to volume production.

Figure 1. OPI Photonics

The Challenge and the Solution

So far the delivery of these ultra-short pulses has been through free-space systems, an approach that poses many limitations to machine designers. Very recently, however, innovative fibre based delivery solutions have been reported exploiting a new type of speciality fibre able to route high peak power pulses with minimal distortion and, especially, no fibre damage. OPI has prototyped an industrial grade cable system based on the above-mentioned fibres. BUAS has validated the cable performance, and IRIS owns processes and machines for the cable testing in a real industrial environment focusing on advanced laser based manufacturing processing.

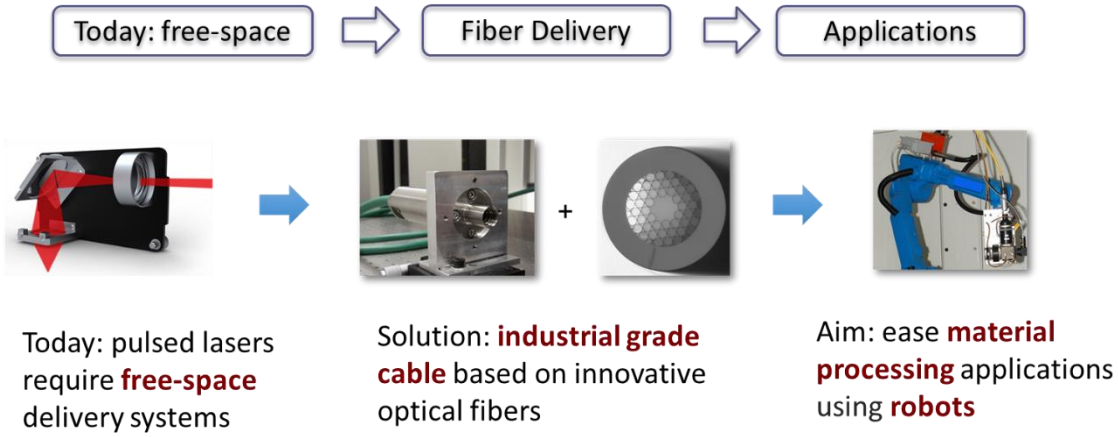

Figure 2: New Deli experiment

The Benefits

The delivery cable for ultra-short pulses enables, first, the possibility to detach the laser source and power supply from the processing area providing much more design flexibility for processing machine builders and integrators. Second, it enables wide working area given the possibility to move the processing head (e.g. on a gantry system). And finally, the developed innovative cable open the possibility to equip a robot with micromachining capability thanks to the fibre based delivery, thus enabling new dynamic processing for the micro-machining field and all the applications where high energy and/or high peak laser power is required.	*Figure 2: Robot material processing through the ultra-short pulse fibre delivery system.*

The Business Advantages of the solution

This USP delivery cable system is targeting as a key application the Additive Manufacturing sector, where the fibre transport of high-energy, ultra-short, pulses (for surface finishing by cold ablation) in parallel with high-power, high-brightness, CW light delivery (for powder sintering) are required to enable new features in next generation of processing machines (see for reference the new concept of AM machines that combine additive and subtractive manufacturing as proposed in the Horizon 2020 funded Borealis and Symbionica projects, in which OPI and IRIS are partners). In such application, the processing head has to move in a wide working area (several meters for the Borealis machine, mainly for aerospace parts) thus the fibre delivery (already existing for continuous beams) is absolutely necessary for the pulsed laser processing. The developed solution is thus the only possible one (unless the pulse width is so long that traditional fibre can be used, but this excludes all the ultra-short pulse processing)

Borealis Project is expected to reach the market with about 14 machines ready for sale in 2020, and this will constitute the main path of exploitation in the machines for advanced manufacturing of the fibre-based device under assessment within the NEW DELI APPOLO project. The developed system will be first integrated into the prototype of Borealis additive manufacturing machine and thereafter in the first 14 new machines to be produced in 2020. For each machine, it is foreseen a minimum number of 5 back up delivery systems, for a total of 70 delivery cables. Symbionica will need an equivalent number of samples in the same timeframe. To be conservative, we can imagine about 100 cables per year with an indicative turnover of 600k€ per year starting from 2020. OPI plans to invest at least 500 k€ in further development and production lines in the period 2017 - 2020.
More optimistic visions based on the relevance that AM technologies are acquiring in industrial fabrication processes allow predicting that the outcome of this project can be safely expected to be further scaled, targeting very large and global markets, with a potentially almost unlimited impact. Then, although focused on AM applications, the successful demonstration of OPI's new delivery system in practical processing cases would provide important benefits also in "traditional" laser machining (such as cutting, and welding), where the possibility to couple short-pulse beams in the same working zone would open a whole set of new applications, as well as other niche applications, such as the medical field (e.g. ophthalmology), and scientific instrumentation (laser scanning microscopy, vibrational and single molecule spectroscopy, etc.).

The Team

OPI PHOTONICS: is a dynamic Italian SME located in Torino. OPI takes advantage of over 20 years of experience in photonics to develop high power multi-emitter laser diode sources and innovative devices for kilowatt laser beam management (combining, coupling, delivery and switching) and laser pulse delivery.

IRIS: is an Italian SME located in Torino. IRIS owns a strong background in industrial laser, Additive Manufacturing and plasma technology applications, adding value in process optimisation/qualification in order to guarantee best affordable product performances

BUAS: is an application-oriented university. It has a strong research orientation towards industrial technology and engineering. The ALPS dept. has a strong background in laser micromachining, applied fiber technology, thin film processing and materials analysis.

The Team Benefits

IRIS is an end user of the project. In the market chain, IRIS is a possible customer of the cable developed by OPI PHOTONICS. This device has been conceived to meet a new market need emerging from the most recent advances in Additive and Subtractive Manufacturing. In fact, the combination of additive and subtractive process in one single machine is the key enabling factor for the new generation of metal processing machines. In this scenario, IRIS is working to develop effective and efficient processing technologies for tailoring the surface quality properties of AM parts by laser ablation and surface-structuring in order to assess the capability and flexibility of the delivery system.

BUAS has tested the cable in a real application by comparing the scribing quality of thin film photovoltaic modules with and without the cable. The results show no changes in the performance introduced by the delivery cable. Confirmed the potentiality of the developed cable also in industrial fields, BUAS has now available several NEW-DELI's cables mounted on their machines to test them and further investigating the potentialities offered by this new type of large core size air-guiding photonic crystal fibre for both academic and industrial purposes

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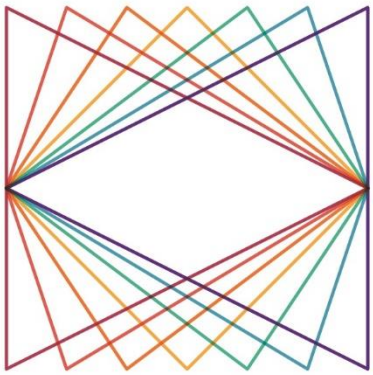

OPIPHOTONICS

Bern University of Applied Sciences

Name and LOGO OF THE PROJECT

NEW-DELI

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KEYWORDS:

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