Bringing laser-based additive manufacturing to the mainstream

The ModuLase project aims to develop and perform a pilot line validation of a modular re-configurable Laser Process Head as part of the Factories of the Future public-private partnership

As industries evolve to produce better, more efficient and increasingly sophisticated products, pressure is mounting on the technologies used to produce them in order to respond to those requirements. Additive manufacturing and laser-based manufacturing illustrate this trend, since they are increasingly relevant as key modern production technologies due to their unrivalled capability for performing a wide range of materials processing applications. One caveat remains for a broader adoption, which is the fact that the flexibility of the laser source is limited by the need to change the processing head for these processes to be performed. By addressing this issue, the ModuLase project will develop a re-configurable highly flexible processing head system, capable of covering welding, cladding and cutting, compatible with existing and future fibre-delivered laser process systems. The project will deliver solutions to the aerospace, power and automotive industries.

ModuLase will encompass all stages of the process chain and provide additional flexibility, cost reduction and execution speed without compromising the overall quality, hence providing a better overall performance. By providing the groundwork for a more thorough utilization of laser-based manufacturing, ModuLase will provide a critical tool for the Factories of the Future public-private partnership which sets a vision and outlines routes on its 2014-2020 roadmap towards high added value manufacturing technologies. As result of this vision, the factories of the future will be clean, highly performing, environmental friendly and socially sustainable.

The ModuLase project will develop a re-configurable highly flexible processing head system, which will be capable of covering welding, cladding and cutting, with a changeover time of less than one minute between processes. The new head system will achieve this through the use of three modular end-effectors and, will include intelligent sensor technologies for in-process monitoring. Lastly, since linked to an intelligent system, the ModuLase system will achieve adaptive process control, quality assurance and semi-automated process parameter configuration.

Technology and knowledge transfer are one paramount issue that will also be part of the project, facilitating the collaboration with EU SMEs and large industries, and enabling the rapid deployment and commercialisation of the new technology.

The ModuLase project partners are TWI (United Kingdom), QSYS (Netherland), ULO (United Kingdom), AIMEN (Spain), EWF (Belgium), CRF (Italy), SODECIA (Germany) and GEL (United Kingdom).

Project specifications and technical deliverables

The technology to be developed and validated in ModuLase consists of the following:

- A Beam Forming Unit (BFU), capable of delivering a wide-range of laser beam energy distributions, suitable for the different processes;

- Modular ‘plug and play’ end-effectors, which can be rapidly attached to the BFU to provide the additional functionality required for the different processes;
- An in-process monitoring and quality assurance system, achieved through co-axial process monitoring and algorithms to support adaptive process control;
- A software system, which allows automated re-configuration of the process head and (semi) automated process optimisation, through a user-friendly human-machine-interface.

Figure 1 shows a schematic overview of the ModuLase system:

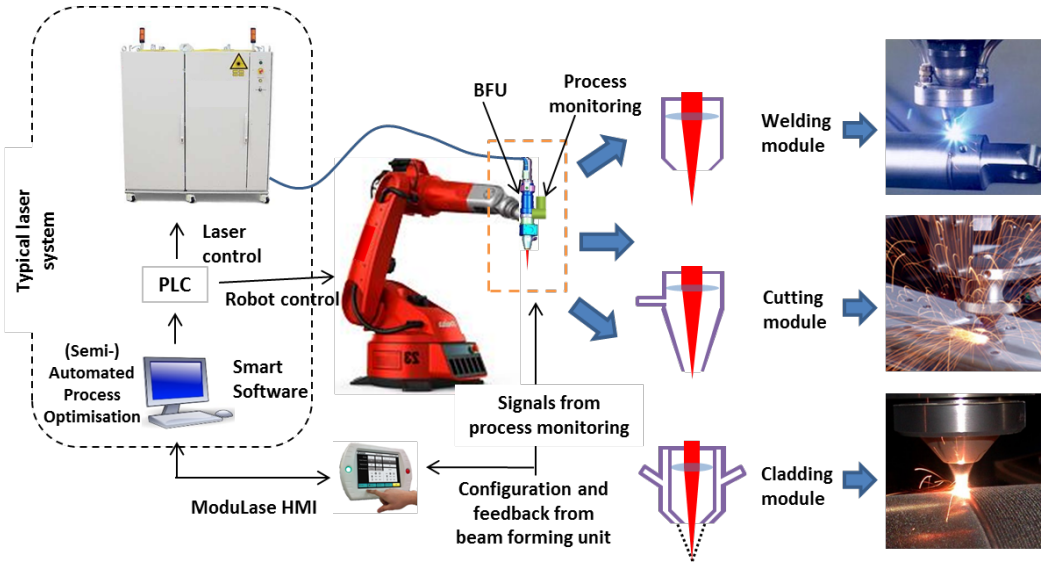

Figure 1 Schematic overview of the ModuLase system, comprosing a re-configurable process head (with BFU and modular end-effectors), process monitoring sensors, and a control system for adaptive process control and (semi) automated process optimisation.

The ModuLase project will also develop welding, cladding and cutting process knowledge for the target markets. Existing laser processing knowledge will be used where possible, to supplement the additional processing knowledge developed within ModuLase. This knowledge will be embedded within a software system, which will:

- Control the positions of the optics within the BFU, allowing automated changing of the laser beam energy distributions;
- Communicate with the other ancillary equipment (laser, robot, powder feed etc.);
- Communicate with the in-process monitoring system and process control algorithms to provide process control;
- Have a human-machine-interface (HMI) to allow (semi) automated process parameter optimisation, by allowing the end user to input process requirements.

The (semi) automated selection of process parameters (including laser beam energy distributions) and adaptive process control, will result in a unique and remarkable product that will maximise the laser sources potential for material processing and facilitates non-expert industrial adoption.

The ModuLase project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. H2020–FoF-2016- 723945-ModuLase. The project is an initiative of the Photonics and Factories of the Future Public Private Partnerships'