A Hybrid Approach to Multi-physics Laser-processing for Low-volume Manufacturing

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Since its inception, a wide variety of processing physics have been developed to make use of laser energy in manufacturing applications. Typically switching between different sizes and configurations of laser processing heads is capital intensive, time consuming, or both. For example, frequently a beam switch or manual changing and re-alignment of the fibre into a separate processing head are needed to switch processing scales, configuration, or physics. These practicalities have favoured the moving of parts between separate machines, where each machine is optimized for a particular type of laser processing (cutting, adding, etc.). While this approach is efficient, it requires enough throughput to justify the capital investment for multiple laser-based machines. For that reason, it often remains out of reach for lower-volume manufacturing operations.

In the last seven years, innovations in beam delivery have enabled applications combining laser-based additive manufacturing with conventional CNC machining. Using laser processing inside of CNC machines has prompted the development of beam delivery techniques and equipment that can handle the mechanical demands and dirty use environment of a CNC machine. The ethos of CNC machining has increased operational flexibility by pushing these systems to incorporate automatically interchangeable nozzles and optics. These developments now return new opportunities for optimization to the laser-processing market.

This presentation reviews innovations in beam delivery and laser processing head design enabling multiple modes of laser processing never before used in a single setup. This novel approach enables unique focusing optics and nozzle designs to be used for manufacturing varied parts, where different heads can be deployed automatically on a feature-by-feature basis. Examples will be discussed, including internal and external cladding on the same part, and the technical and commercial advantages of the added flexibility highlighted. Progress so far provides compelling evidence of future development trends for automating hybrid manufacturing processes.