Modern Coordinated Control in Laser Systems, The Expanding Dominion of Motion Control Systems

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As it increases in capability and affordability, laser technology continues to proliferate within industrial manufacturing processes. Overall trends in device miniaturization and increased complexity have seen increased application focus on sensitive, high-precision material processing. Success in these applications is beginning to require a greater understanding and control of laser-material interactions than in traditional macro-material processing examples like gross laser cutting. This requirement is forcing a paradigm shift in how laser processing parameters are defined and viewed within the control system of high precision machines. Instead of independently controlling simple parameters like pulse repetition rate, average laser power, and pulse energy through the laser source's control system, future precision laser processing applications will require explicit controller definitions for fluency, power density, and other richer more meaningful process parameters. This shift to rich process parameter definition and control requires coordination of base laser parameters with a system's motion control engine. As a result, we will see a dramatic increase in the level of integration between motion control systems and those of laser sources in industrial machines.

There are tremendous advantages to be gained by tightly integrating the motion control engine to the laser source. Throughput, processing accuracy, yield, and quality can all be improved when laser and motion control are tightly integrated. These advantages all stem from the ability to simultaneously optimize the motion performance of a machine with the material-processing performance of the laser. In current systems, material processing and motion control are optimized serially. Processing quality is achieved through simple laser parameter setting, and then significant optimization barriers are placed on the motion control system in order to maintain quality. In the future, laser and motion parameters will be accounted for within joint control system logic allowing for richer process parameter definitions and deeper levels of optimization.