Shining a light on factories of the future

13 July 2016

Credit: Shutterstock

The EU HALO project has extended existing laser technology for material processing to create more adaptable options, increasing operational quality and speed, whilst reducing overall cost.

Over the last few years, the industrial use of high powered lasers, especially in the automation of production lines, has become increasingly commonplace. They are used with metals, ceramics, glasses, semiconductors and plastics for cutting, marking, joining and patterning. As such lasers are now integral to the production of many of the things that make up our daily lives, such as the components for the electronic devices powering the information age.

However, one size does not fit all; with varying processes and materials necessitating different lasers. For European industry to be more globally competitive it needs a more adaptable generation of laser tools. The HALO project set out to create such a breakthrough.

Getting into shape

Laser use in materials science involves balancing many complex variables, such as power, pulse, wavelength, shape, duration and beam profile. Through experimentation the HALO project team established the current state-of-the-art, with results stored in a database. Additionally, the laser cutting process was meticulously analysed with high speed video. Using known data points, meta-models then helped to ascertain the best parameters for laser use in various scenarios. These models pointed to fruitful paths for increased adaptability, including varying beam shape.

The spot of light that a laser generates when it shines onto a surface is brightest at its centre. Light intensity reduces further from the centre, creating the classic bell-curved shape (Gaussian distribution). However, this arrangement is not ideal for all laser applications. Other shapes might be better suited for precision cutting, such as those having a halo effect, with a brighter ring around a darker centre. Utilising an altered shape such has been shown to increase the efficiency of some processes by up to 30 %.

HALO principally looked at exploiting the adaptability of laser cutting for three industrial application areas. Firstly, by examining the usage of fibre guided continuous wave (CW) systems for cutting sheet metal (1mm - 25mm thickness), which constitutes the largest market share for industrial laser usage. HALO techniques improved edge quality with shorter dross length. Secondly, by looking at pulsed lasers emitting at new wavelengths for glass and thin metal sheet cutting (under a mm thick), which represents the consumer market for items such as mobile phones and computer components. Here techniques reduced roughness and improved bend strength. Lastly, by analyzing sapphire cutting using lasers guided by water-jet for the first time, with HALO techniques reducing heat damage with less contamination.

The shape of things to come

As the laser designs and processes used in HALO were novel, the project developed many components, some previously not available, that included; capillary tapers, isolators, acousto-optic modulators, an in-cavity acousto-optic Q-switch, and segmented waveplates for tailored polarisation.

As regards sheet metal cutting, the optimal laser beam polarisation was established along with advances in the use of high-speed videography in the process. Addition-ally, the project developed a 2 micron (µm) laser which could cut transparent poly-mers. In terms of glass cutting, ultra short pulsed lasers using customised beam shapes and multi-spot patterns were further developed. These delivered enhanced cutting quality and speed as well as minimised problems such as micro-cracking.

Project learning was captured in the interactive HALO IT-tool for planning and evaluation, which enables operators working through an interface to interrogate modules, ascertaining optimum laser optics and processes for their needs.

Perhaps the major implication of HALO's work is that it offers the opportunity to use one adaptable laser for factory processes, such as robots cutting rubber and metal parts in car production, where currently multiple lasers are in operation.

More information: Project website: halo-project.eu/

Provided by CORDIS