EPSRC Centre for innovative manufacturing in ultra precision

CDT-UP Newsletter

Centre for Doctoral Training in Ultra Precision Engineering

June 2015

Ultra Precision Manufacturing Conference 2015

The Ultra Precision Manufacturing Student-Led Conference 2015 took place at the Institute for Manufacturing on the 12th of May, and around 100 people from academia and industry gathered to discuss and explore some of the latest advances in Precision Engineering. The conference comprised of 12 talks given by experts from both academic institutions and industrial partners, in topics of Ultra Precision Engineering. The conference speakers included Martin O'Hara from the EPSRC Centre for Innovative Manufacturing in Ultra Precision, Prof. Richard Leach from the University of Nottingham, Professor Xiangqian (Jane) Jiang from the University of Huddersfield, as well as representatives from well-established companies within the Ultra Precision field. In addition to the talks, a special session was included in the programme where the EPSRC Centre for Innovative Manufacturing & Centre for Doctoral Training in Ultra Precision PhD Students had the opportunity to present their projects to the audience in a 3-minute, one-slide per person format.

Euspen Challenge 2015

On the 16th May, Aaron Rai and Tianqi Dong represented the University of Cambridge in the EUSPEN Challenge. The challenge was to present a solution for detecting early wear and tool damage in precision engineering machining. The solution presented incorporated elements of laser expertise gleaned from the Centre for Industrial Photonics group at the IfM and micro X-ray CT. A challenging and rewarding day, the competition was thoroughly enjoyed by all parties.

PhD Project Request

If you would like to offer a 3 year PhD project, under the Ultra Precision topic, to one of our current MRes students, please contact Sophie Fuller, sg523@cam.ac.uk, with the details of this. The students begin their PhD projects in October after successful completion of the MRes. The CDT in Ultra Precision will fund their student fees, EPSRC minimum maintenance and some travel costs, but we ask that you source funds from industry for an additional top-up for the student, and to cover project consumables.

Science Festival 2015

The MRes in Ultra Precision students each took part in numerous demonstrations on the 21st March at the Institute for Manufacturing, including Rocket Racing, Laser Assisted Oxygen Cutting, Nanoscopic imaging and laser ignition. As always, it was a very busy but successful day with around 1000 families getting an insight into the research taking place.

UNIVERSITY OF CAMBRIDGE

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EPSRC Pioneering research and skills

Project Feature: High power, high speed, large beam laser additive manufacturing of biomedical components

Additive manufacturing technologies are steadily applied in an increasing range of biomedical applications, in particular to make parts with biocompatible surfaces. For implants such as the acetabular cup (part of the hip joint) the demand ~70,000/year in England and Wales exceeds production rates of current systems ~6,000/machine/year). This work will deliver through-put improvements through a dedicated part fabrication process.

An acetabular cup is a single part with two zones: a solid hemispherical shell and outer porous layer to aid bone ingrowth, currently additively manufactured. Solid shell consolidation has been identified as the limiting factor in production. Increasing the scan speed, spot size and laser power are desirable to deliver energy more effectively, requiring new scanning strategies and delivery systems.

High energy delivery rates introduce steep thermal gradients leading to residual stresses and part bending. Keyholes may form in the melt pool when using high power which damage underlying structures. Larger beams and higher scan speeds can be used to minimise these issues when consolidating powder with high power. However, spherical melt defects are observed when using high speeds with high powers. This may be managed by manipulating the aspect ratio of melt pools.

A test rig to investigate up to 1 kW of laser power, beam diameter from 30 µm – 4 mm and scan speeds up to 18 m/s has been developed. Trials have been conducted and the effects of process parameters on spherical melt defect production are being characterised. This project will deliver new beam delivery strategies for producing acetabular cups and the machine to e nable them. An order of magnitude improvement in bulk melting time is being targeted.

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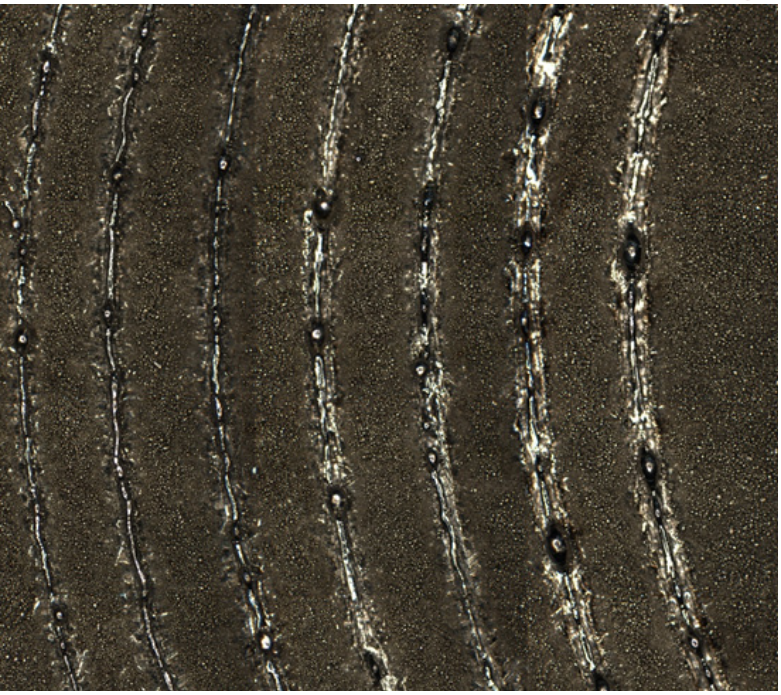
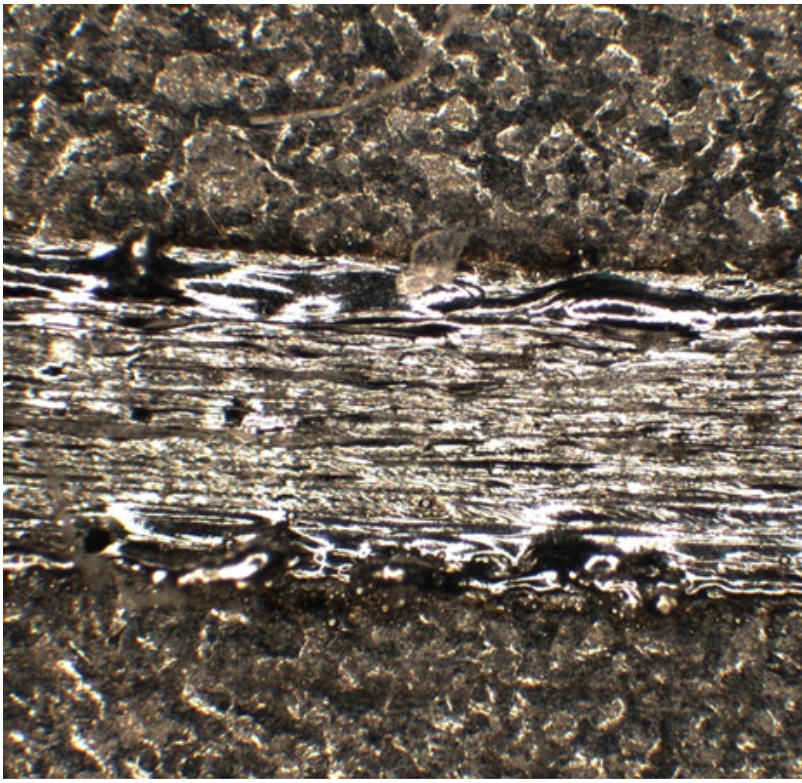
Spot size increasing, maximum speed decreasing



Caption: Top view of stainless steel 316L tracks on a substrate, melted using 1 kW laser power at speeds >3 ms-1 and beam diameters 70 – 300 µm. Spherical defects can be seen in the tracks.



Caption: Top view of melted stainless steel 316L track on substrate. A new scan strategy has been implemented to achieve melting over wider areas than the laser spot size and reduce spherical melt defects in the centre of the consolidated region.

Save the Date:

EPSRC Manufacturing the Future Conference, 17 & 18 September 2015, Cambridge
Laser Processes in Ultra Precision Manufacturing Event, 15 October 2015, Coventry