Group of Laser Technology
Department of Coherent Optics

Institute of Scientific Instruments AS CR, v.v.i.

THEMATIC RESEARCH FOCUS

Research area
– Laser welding
– Laser 2D/3D cutting
– Laser surface hardening
– Process diagnostic
– High power beam shaping

Excellence
– Diagnostics of laser welding process

Mission
– Theoretical and experimental study of the laser welding process
– Control of the laser welding process
– Application of the laser welding technology for the manufacturing of heat exchangers and solar absorbers
– Thin optical coatings for high-power laser optics

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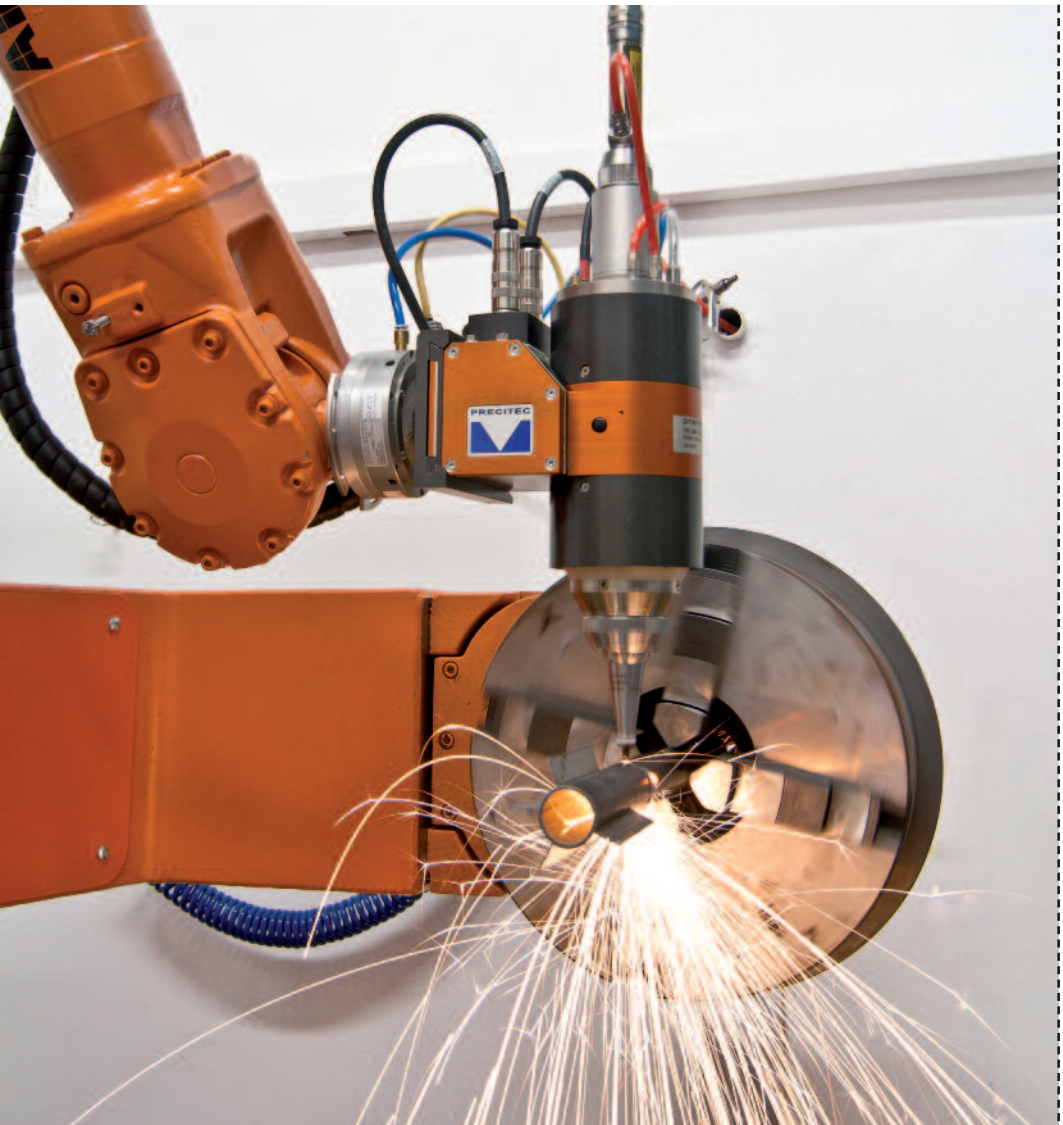


Laser cutting in action

Laser processing facility: six-axis robot with absolute accuracy precision

Content of research

– Correlation of the penetration depth and the frequency characteristics of the light emissions produced during the welding process
– Numeric modeling of the laser welding process
– Analysis of the welding process dynamics by means of image processing
– Analysis of the laser weld microstructure by means of electron microscopy
– Development of optical components adjusting the intensity distribution and the focal geometry of the laser beam
– Theoretical and experimental study of laser induced damage threshold of thin film optical coatings

Main capabilities

Basic research

– Study of the welding process using a method based on frequency analysis of the light oscillations produced during the process
– Numeric modeling of the welding process depending on the welding parameters and the focal geometry of the laser beam

Applied research

– New type of a sensor monitoring the quality of the laser welding process
– System for continuous control and optimization of the laser beam geometry during the welding process
– Heat exchangers and solar absorbers with controlled circulation
– Laser induced damage threshold test station

Fields of research results application

– Engineering industry related to modern methods of material processing
– Renewable energy
– Materials science
– Optics for high-power lasers

Laser welded solar collectors

KEY RESEARCH EQUIPMENT

– Laser YLS2000 (IPG photonics), welding head YW30 (Precitec), cutting head YRC100 (Precitec), robotic arm IRB2400 and 2-axis rotary positioner IRBP250 (ABB)
– PIAD Electron beam evaporation coating system SYRUSpro 710 by Leybold Optics
– Electron beam evaporation coating system Balzers BAK550
– Spectrophotometer Varian CARY 5E

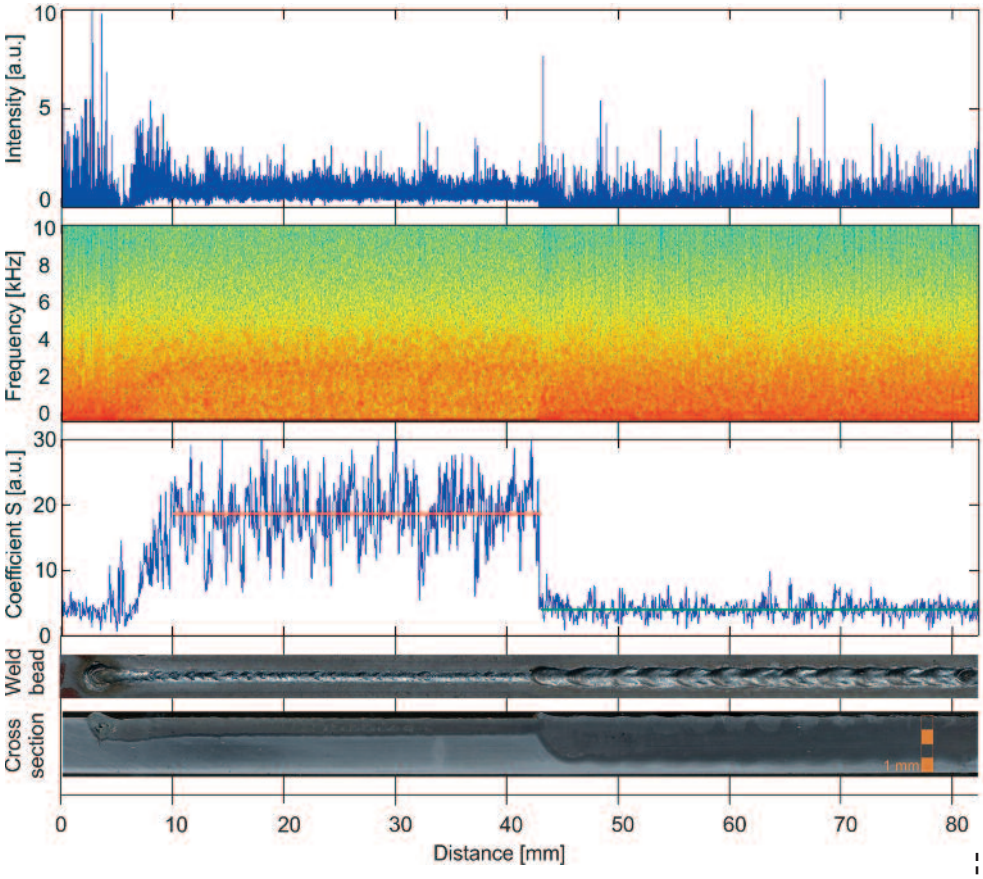
ACHIEVEMENTS

– Feedback control of laser welding based on the frequency analysis of light emissions, adaptive beam shaping
– Correlation Between Keyhole Depth and the Frequency Characteristics of Light Emissions in Laser Welding

MAIN COLLABORATING PARTNERS

Collaboration with academic partners

Brno University of Technology (Brno, Czech republic)
Technical Unversity of Liberec (Liberec, Czech Republic)



Sample output of the laser welding diagnostics

Collaboration with companies

Aquadem (Brno, CZ)
Fermat CZ (Brno, CZ)
AB KOMPONENTY (Brno,CZ)
LAO - Lasers and Optics (Praha,CZ)
TMT (Chrudim,CZ)
Matex PM (Plzeň, CZ)

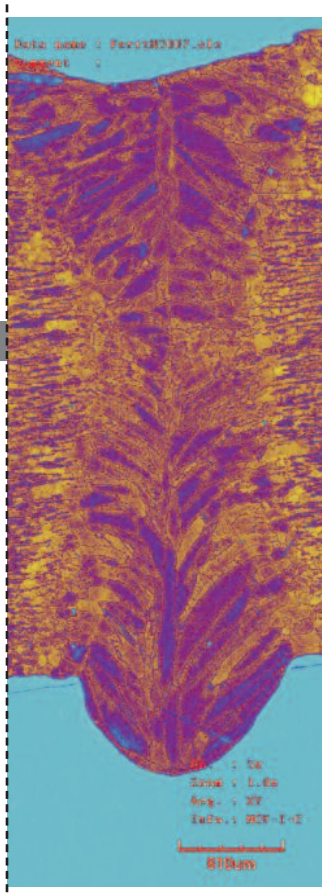
EXPECTATIONS

Offers

– Licensing of the patent for automatic optimization of the laser beam geometry in laser welding
– Partnership in international projects
– Long term collaboration with industry partners (contract research)
– Contractual research in laser welding, cutting, surface hardening etc.
– Consulting in the field of laser welding, cutting, surface hardening etc.
– Cooperation in the development of solar absorbers and heat exchangers
– Design and production of custom thin film optical coatings
– Consulting in the field of optical coating deposition

Requirements

– Real interest in applied research and innovation
– Knowledge of grant projects
– Collaboration with industrial partners in common projects dedicated to applied science
– New complementary technologies



laser weld microstructure shown on a cross-section