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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

INTERNATIONAL CENTRE FOR SCIENCE AND HIGH TECHNOLOGY

CURSO DE ESPECIALIZACIÓN Y TALLER APLICACIONES INDUSTRIALES DE LOS LÁSERES
22 DE JUNIO AL 4 DE JULIO DE 1998 - BUENOS AIRES, ARGENTINA

ICS TRAINING COURSE AND WORKSHOP
LASER SOURCES AND INDUSTRIAL APPLICATIONS
Buenos Aires, Argentina, 22 to 27 of June
Gonnet (La Plata), Argentina, 29 of June to 4 of July
by

Final Report

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Synopsis

A training course and Workshop on Lasers Sources and Industrial Applications, under the sponsorship and coordination of ICS / UNIDO, was organized in Buenos Aires and Gonnet (La Plata) with twenty participants from Latin America and Caribbean region as well as participants from Argentina. The course was designed to allocate 40 participants, but due to the interest shown by entrepreneurs, professionals, universitary professors and students make an active audience of 81 persons, adding all people in the several activities covered in the training Course. The following institutions: Agencia Nacional de Promoción Científica y Tecnológica (ANPCYT), Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Comisión de Investigación Científicas de la Provincia de Buenos Aires (CIC), Universidad Nacional de La Plata (UNLP) and the host institution Centro de Investigaciones Ópticas (CIOp) – (CONICET-CIC) gave support as counterpart to ICS-UNIDO subcontract. Local organizations that congregate micro, small and medium scale industries and other contributers provided facilities and suport to get local founds to the allocation of 27 full fellowships for argentinians (among them 17 entrepreneurs) and help to another 16 persons (7 of them entrepreneus) to participate in the sessions of Lasers in Biomedicine (mostly Odontology and Photodynamic Therapy). Several lecturers and invited speakers from various countries gave their contributions to this activity that added 115 hours of classes. Several laser industries from United States, Canada and Switzerland, made presentation on actual laser applications of high productivity. The first week in Buenos Aires was mostly theoretical with restringed experiments made to support concepts and understanding of basic principles of optics and lasers as well the optical properties of materials to be processed by lasers. Cuting, piercing, marking, engraving, heat treatment and fast prototyping were covered in the lectures. On the second week the laboratories of CIOp were open to 57 participants to attend classes, lab demostrations, video tape sessions, technical visits and exercises on Laser CAD / CAM / CAE. The training course could be regarded as highly successful according with the ratings obtained by the evaluation made at the end of first and second week by the participants.

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ICS Training Course
LASER SOURCES AND INDUSTRIAL APPLICATIONS
Buenos Aires and Gonnet (La Plata), ARGENTINA, June 22 to July 4, 1998
FINAL REPORT

1. Introduction

The Latin American region, although developed in same high-tech niches, lack the appropriate university-industry interaction. The industrial development of such countries processed apart to the investment in higher education. Brazil and Argentina, for instance, have a good critical mass of scientists and engineers but most of the big companies' projects come from abroad. There are basically no development or application in the local universities or research institutions and multinational companies import equipment and processes directly from their mother organisations. Regarding the automotive industry, for example, high-tech applications in their assembly lines, with robots and lasers, are imported in a turn-key policy directly from developed countries through their local representatives. Consequently the question of technology transfer and University-Industry interaction are, today, of the most discussed items in the agendas of the Ministries charged of Science and Technology and in the Economy Courses.

Of particular interest is the industrial use of lasers in small industries since this tool may provide to the small entrepreneur with a new way of making old things or also manufacturing new things that were impossible to do before to the development of lasers. Today some of many industrial applications give high productivity in comparison with other technologies with the addition of not requirements for a second operation or finishing. Thus, this new age entrepreneur, with the help of lasers, will now aggregate technology to his product or service. Therefore, the opportunity created by a training course aimed to this particular sector of the economy is vital to start up a culture of technology transfer and thus help the economical development of the region.

2. Objectives

The philosophy behind this training course was to provide the small industrialist-technologist from Latin America and Caribbean countries with some training on advances areas of laser applications and their business. It was also an opportunity to put them in contact with one another and with their colleagues from different countries, in order to promote exchange of experiences and technical information. Moreover, this course was an opportunity to strengthen the links among ICS/UNIDO, scientific institutions, small industries and business organisations in the region with the final objective of creating a network of high level scientific institutions, small scale industries organisations and technicians from industries in Latin America.

Since the vendors of services of metal-mechanic are the ones that may incorporate lasers to they everyday jobs, this training course gave special presentations of the most applications that provide high productivity. Special interests by requests of micro and small industry were cutting mild steel and other materials, Piercing of different materials, marking and engraving and welding metals with lasers. This request made possible to introduce the background of laser welding and the technology of Taylor Blank Welding (TBW).

3. Location of Training Course and Choice of Institution

The training course had two locations aiming to obtain a better efficiency on the two main blocks that integrated. Buenos Aires, the capital of the country that has the biggest industrial belt of Argentina and the city itself has several areas devoted to industry. Buenos Aires is the second economic pole of Mercosur and for all these reasons is the big centre for finances and business of Argentina. Hosting this activity in Argentina, Latin American and Caribbean countries received intensive assistance by local organisers. The course was held under the scientific responsibility of the Centro de Investigaciones Ópticas (CIOp) [Optical Research Centre of Argentina] {main building} with the administrative responsibility by the Laser Processing Laboratory (LPL) of the CIOp {with a special building refurbished to host industrial lasers.} The training course was split in two weeks.

First week was made in Buenos Aires city and sessions took place at the "Museo y Archivo Histórico del Banco de la Provincia de Buenos Aires". Its amphitheatre has 130 places and full equipment for audio-visual presentations with a couple of technicians with expertise to support the needs and all requirements for the programmed schedule. This was devoted to background lectures by invited professors from other countries and local professors. This city was choose for the first week of the training course because it was of better convenience to micro and small entrepreneurs that do not were able left completely the business while attending the lectures and commercial presentations of lasers and lasers systems manufacturers. At the same time the region has the biggest concentration of micro entrepreneurs of the country.

The second week was held in Gonnet (La Plata) at the CIOp and LPL buildings in the Campus Tecnológico de Gonnet of the Comisión de Investigaciones Científicas de la Provincia de Buenos Aires (CIC) and was fully devoted to Laser CAD / CAM / CAE. The routines of work were two, lectures on the mornings and practices in the afternoons. The host institution, CIOp, provided all facilities for the Training Course (auditorium, laboratories, demonstration equipment, audio, video, computers with multimedia equipment and CO_2 Industrial Laser for practice cutting of stainless steels, carbon steels, acrylic, laminated wood, aluminium and other materials.

The Gonnet Campus of 145.000 m2 was wide open to visit all facilities its seven centres for Research and Development. These are devoted to Acoustics, Lighting Technology and Mechanical Vibrations (LAL), Clay minerals and Ceramics (CETMIC), Leather Technology and Leather Products (CITEC), Spectroscopic Analysis for Industries (LASEISIC), Fine Chemistry (mostly Flavours and Colorants for Food Technology), fuels and additives for fuels (PLAPIMU), Centre for Research of Urbanism and Environment (LINTA) and the Optical Research Centre (CIOp) with two buildings as already described above.

A visit to the laser jobshop in the city of Avellaneda was made from 9:00AM to 5:00PM The visit was very important by several reasons. First because the company is operating industrial lasers since 1980 (Oxicorte bought a system from Messer Grinnesein from Germany that was the very first industrial system for laser cutting). The experience of this company is colossal. Second, they manage several technologies and are very able to distinguish what

technology must be used for an specific blank required according to precision and quantity as well the estimate how the design will restrain the figures of productivity. Technologies available in the company are: flame-cuting, plasma, high precision plasma, chemical milling and four industrial cutting lasers.

The INNOVATEC Foundation as the administrator of the Laser Processing Laboratory was the host for all persons that collaborate the most of the actions necessary to drive the Training Course to be operative and efficient.

4. Partnership and Join Ventures that Provided Additional Support to the Training Course

After to mail the announcement of Training Course addressed to local companies, institutions and organisations related to chambers of metallurgy, fabricators, job shops, etc., a promptly replay was obtained. Some companies an one institution send to the local committee the welcome and congratulations by the initiative, endorsing the training course and the program. This backup was important to apply for a grant to the Agencia Nacional de Promoción Científica y Tecnológica (ANPCyT), since the institution has a requirement asking endorsing from companies stating that are interested in the training course. The President of the Local Organising Committee made the applications for a grant of US$ 18,500.00 to cover the local counterpart to ICS-UNIDO subcontract in order to full cover the expenses of 27 fellowships for participants from Argentina. The CIOp contributed with US$ 11,000 to cover extra expenses for the second week of the course. Local contribution was US$ 29,500.00 representing (39 %) of the total budget of the course. The local financial provided funds to promote the course in local papers and special magazine devoted to CAD / CAM with the biggest circulation in Latin America, with 30,000 subscriptions in Argentina, 50,000 in Brazil and 42,000 in Mexico. The same local partnership made possible to publish in the two most relevant newspapers on last Saturday and Sunday before the starting the Training Course. The newspapers were "La Nación" and "Clarín", both of them of the City of Buenos Aires with more than 700.000 copies per day distributed in all the country. Both newspapers rise close to a million of copies on Saturdays and Sundays.

5. Programmatic Structure of the Course

This Training Course was conceived with a full week devoted to background on optics, optical properties of different materials of industrial interest, lasers concepts and deep descriptions of the different processes that are made in "jobshops" as well in manufacturing companies. The topics covered description of different resonators and efficiencies with their modes. It was explained how the modes are substantive for the quality of the different processes.

Excitation of active media of the lasers and also the very differentiation of Carbon Dioxide (CO_2) laser and the Neodymium: Yttrium Aluminium Garnet (Nd:YAG) laser on their

utilisation. The CO_2 laser is the big cutter of many materials and the Nd:YAG as the best piercing tool for marking, scribing and engraving and also to cut very small pieces. Cutting was explained in deep due to the fact of being the most important process to be made with lasers.

Laser heat treatment of metals was presented and it was pointed out that the result protection obtained reduces the rusting in applications where moisture, humidity or saline ambient are present. Laser heat treatments were explained in detail and with diagrams of Temperature, Time & Transformation (TTT). The influence of the previous history of the material being conditioning the expected results. Metallography of metals to be hardening after and later of treatment being crucial for good results and repeatability of processing.

TTT were also described by simulation done by Finite Differences Method made with "Mathematica" computer soft. With an specific program for this demonstration it was shown several cases of the heat being absorbed by different materials and the dissipation, conduction and radiation of the cases.

Laser welding was taken as special topic to be cover with more detail due the increasing use in the industry. Old technique from the very early days of lasers, today has grown dramatically in technology, accuracy, repeatability and on line quality control through optical spectroscopy of the weld on process. The decision was very important to update to audience and professors, considering that the technology called Taylor Blank Welding that is being used by the automobile industry and vendors of welding services for same industry. This technique is the only one that allows the welding of different metals without the addition of any other components (including metals, alloys or fluxes). Even in the case of different metals with different thickness. In addition to that, the welds support the deep shaping by conforming by matrices to produce the different parts of the body car. This laser technology is unique on quality control on line. Since the welds are made by CO_2 or Nd:YAG lasers without touching physically the metals, the gap between the metal and proximal emission of the laser from the optical fibre or output lens allows to make axially in the same direction of the welding an analysis by optical spectroscopy that shows the state of the plasma produced by the processing. From the point of view of the ecology this technique was presented as the one that reduces to a half the scrap in comparison with the current old technology in use.

The body car is made with less pieces and set-up is fast and accurate. Probably the more impact of all innovation of this technology is the fact that a body car by this technique is more safe and less costly (~ U$ 1,000). In the case of cars the base of the body are made with blanks manufactured with micro alloy mild steels. Some blanks have thickness of 0.9 mm and others 1.5 mm.

This technique, was envisioned to be used for manufacturing appliances and some other welding application that may support the investing necessary to put an operative system of this technology (investing near two million US$ dollars is necessary for automatic systems to get very high productivity). In the talks related to TBW were showed several aspects in addition to the functionality of the technology, among them: The global business of TBW, economic aspects

related to major providers of systems of the technology, comparisons to show the differences of the systems with advantages and disadvantages for different applications.

Lasers for Fast Prototyping was a topic that rose a big expectancy. FP is today very important for micro entrepreneurs in order to obtain rapidly prototypes of a product. This technologies (there are several physical modalities that can be used with the same three-dimensional drawing) allows to get models of products overnight. That is, this technology consists of a fully automated fabrication of objects from an specific drawing from a 3D CAD (Three-dimensional Computer Aided Design). It was explained several additive and subtractive methods and systems. The additive systems using specific Araldits that cure by radiation of a laser was covered with many details showing some cases as examples of products with several degree of complexity.

On Saturday 27 of June was devoted to an special session in Hotel Buenos Aires (place where all professors and participants were hosted during first week). The management of changes was the point of view from technology and economy and how the new behaviour of the variables make different times for development and marketing. It was a master lecture for entrepreneurs. Specially with the several examples that were presented to stress the need of imagination, and co-operation of micro and small industries.

On the workshop (second week) The aim of this second week was that every one of the participants have the chance of making drawings and process by CAD / CAM some of the ideas willing to develop. This exercise was very important due to the fact that the laboratory (LPL) is complement integrated in its parts to make the job very fast. 1) Drawings are received by E-mail from entrepreneurs. 2) Requests of services from E-mail are printed together with a printing of AutoCAD drawing of the design. 3) The drawing to be processed is passed to the special application that is used to make quotations of the services requirements (Cutting, marking, heat treatment). 4) After quotation has been approved by the entrepreneur the drawing is imported to the CAM, where every entrepreneur has an special folder to keep the orders.

First of all an industrial laser was showed. Specially all parts that were described on the theoretical lectures. It was shown the functionality of the machine by using the Computer Numerical Control (CNC) and using the keys to move the working table.

Regarding specific applications of laser systems it was given instructions and examples to get the ability of make quotations, based on the parameters of processing (i.e. piercing time, speed of cut, speed for marking, etc. for every material and thickness). Instructions and examples to evaluate dead times and processing of drawings, processing by CAM and the set-up of the area of material to be used and size. Very important were the examples to get the best performance to process by lasers based on get a weak condition of processing and approach by touching the main parameter to obtain a faster conditions for processing. To this aim was explained the role of every parameter and their sensibility (recalling the physical and chemical implications of increase and decrease the different variables.) Power of laser, frequency and

duty cycle of pulses, pressure of adequate gas to help in the process, speed of process, etc. It was explained the conditions for pearcing conditions and times required to avoid the sputtering and ablation of material that may impact the Zinc Selenide (ZnSe) output lens. Exercises to get the point to set a good condition for a specific material and thickness.

It was given concepts to make the designs for high productivity according to get higher speeds of processing independent of materials and thickness.

Several professors on lectures covered more than one the topics that have been described above. Sometimes with redundancy and with the intervention of other professors present on the lecture. We encouraged this interventions to show different visions and ways to realise the processing and other subjects. These interactions were made with sense of true contribution to the matter being place and with very good manners that every one of participants and professors

6. Course evaluation

The course was design to allocate 40 participants and 10 professors, but due to the interest shown by entrepreneurs, professionals, university professors and students an audience of 81 persons, adding all people in the several activities covered in the training course. Professors rose to 20 from Brazil (6), Denmark (1), United Kingdom (1), Italy(1), United States (1), Canada (2) and Argentina (7). Local founds made possible to grant 27 full fellowships for Argentineans (among them 17 entrepreneurs) and help to another 16 persons (7 of them entrepreneurs) to participate in the sessions of Lasers in Biomedicine (mostly Odontology and Photodynamic Therapy). The professors gave lectures adding 115 hours. Several laser industries from United States, Canada and Switzerland made presentations on actual laser applications of high productivity.

This staff showed to be very professional, precise and gentle with the audience and on duty out of hours to give generously extra time to the requirements from participants and other professors. Professors itself were very co-operative and made a comments on classes and out of classes to each other ones. From our local committee we liked very much the high level of the lectures and the simplicity and appropriate slides to fix the more complex concepts.

From the side of the participants:

At the end of the first week of the course two questionnaires were distributed. The evaluation of the training course was made by asking the participants to answer the questions to qualify the lectures, presentations and organisation. The questions were to be qualified by excellent, very good, good and fear in relation to: Organisation, Scientific Program, Duration of program, Training Facilities. A global evaluation of the course was uptake the answers to the question: Would you Recommend this activity?

At the end of the second week, the evaluation was concerning the quality of Workshop and Lectures as well as the Organisation of the Workshop.

From the side of the organisers:

The evaluation of the scientific knowledge of every participant was made by the examination of their studies, degrees and curriculum vitae from their application to the fellowship (either from UNIDO and local resources) and by the questions and answers on the every day of the training course.

The training course could be regarded as highly successful according with the ratings obtained by the evaluation made by at the end of first and second week by the participants. On the annex VII, the reader may appreciate by the graphic representation with bars the qualification of different maters of the questionnaires.

7. Conclusions and Recommendations

From the analysis of the evaluation questionnaires (annex VII) is obvious that the course has been was highly successful. The bars selected by the participants speak by itself. The fact that ICS/UNIDO has been a pioneer in South America to promote this activity of high technology has made a great impact in South America and Caribbean. The audience was very interested on the topics that were presented on the lectures and professors that actively participated in the course really showed to be experts.

The accumulated experience by the staff of CIOp and the lecturers and professors (local and Foreign) hired for the course gave a solid concepts without doubts. The CIOp personnel had given by twenty years a training course called "Lasers and Optics in Engineering" that shows many aspects of lasers and optics to solve engineering problems. It was very important that this training course included CAD / CAM / CAE, having the chance to put the hands on to make a very sophisticated manufacturing that takes a few minutes from the design to the metal piece. The capacity of appreciate "in-vivo" the manufacturing showed again that an experience is by far better that many lectures.

Devoted time by Professors and Lectures as well the time given to all requirement by audience was a key factor of the enthusiasm and work shown.

From this very first experience of CAD / CAM / CAE, we have to make some very important suggestion . This training course was projected for 12 persons for the second week. Fortunately we had 41 persons interested on this experience. We gave preference to all people be present in order to every person uptake a vision of the capabilities of the lasers by the restriction and the working groups were integrated by six persons. This fact make that some persons were not happy with the elapsed time to make the experiments on import the drawings and further processing. Hint: If some person or institution wants to learn from this experience

+a good thing will be to pay attention first to the foreign people and later weeks make the experience with local participants.

People or institutions willing to organise this activity it should have different forms to invite professors and lecturers. We suggest to make lectures from Monday to Friday and invite some professor of with special interest to the organisers days before the week of course and some days after the course to other professor to be invited. This will help to be able to have interaction and have the chance to learn from other expertise.

To close this report the organisers have to say that this activity with practice is the real one to push further to have the major capacity for demonstrate the great abilities of the industrial lasers in manufacturing. As a final suggestion for the ICS this kind of activity it should be more frequently in this region.

Eliseo Gallego Lluesma

8. Annexes

I Poster
II Folder
III Programme
IV List of Lectures and their affiliations
V List of participants and their countries
VI Applications Forms of the participants
VII Evaluation questionnaires

VIII Material from lectures distributed during the course
Material provided in three binders.

8.I Annex Poster

ICS-UNIDO

Curso-Taller

Industriales de los Láseres Aplicaciones

Workshop on Laser Sources and Applications in Industry Training Courses and

1998

Cursos
22 al 27 de junio

Taller
29 de junio al 4 de julio

Profesores
Spero Penha Morato
Mario Garavaglia

Eliseo Gallego Lluesma

David Belforte

Willam Steen

Jay Baron

Norman Ferguson

Fabrizio Grassi

Guillermo A. M. Alvarez
Flemming Olsen
Mariano Creus
Niklaus Ursus Wetter
Wagner de Rossi
Nilson Vieira Jr.
Oscar Blake
Mario Gallardo
Denise M. Zezell

Carlos E. de Paula
Ricardo Lepore
Roberto de Antueno

Argentina

Salón de Conferencias del Museo y Archivo Histórico
del Banco de la Provincia de Buenos Aires
Sarmiento 362, Buenos Aires

Laboratorio de Procesamiento Láser/
Centro de Investigaciones Ópticas (CIOP)
Camino Centenario y 506 ,Gonnet, La Plata

Temas
ICS-UNIDO y la tecnología láser
Óptica y láseres
Interacción radiación láser-materiales
Nociones de seguridad láser
Visión actual de la tecnología láser industrial
Bases metodológicas de la tecnología TBW*
Corte láser de materiales
Introducción a la tecnología de láseres industriales
Una perspectiva de los láseres industriales del mañana
Tratamientos superficiales por láser
Prototipos rápidos
Areas de crecimiento futuro de procesamientos por láser
Metalurgia de la soldadura convencional
Metalurgia de la soldadura láser TBW
Soldadura de metales por láseres
TBW
Sistemas láser de 3 y de 6 ejes
Algunos aspectos de TBW
Láser CAD-CAM
Nuevas tendencias en tecnología láser industrial
Modelado de tratamientos superficiales por láser
Láseres de estado sólido bombeados por diodos
Eficiencia de los láseres de estado sólido
I+D en optoelectrónica para láseres de estado sólido
Management de los cambios
Macrometrología láser en puentes carreteros y ferroviarios
Láseres en odontología
Terapia fotodinámica
Clínica y cirugía odontológica por láser
Modelado de la interacción de la radiación láser en tejidos
Nuevas tendencias en la terapia fotodinámica

*Tailor Blank Welding es la soldadura de partes planas de diferentes aceros y espesores para su posterior embutido.

Coordinación internacional
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CONICET INNOVATEC UNLP

diseño gráfico Julieta Cazzaniga

ICS Training Course
LASER SOURCES AND INDUSTRIAL APPLICATIONS
Buenos Aires and Gonnet (La Plata), ARGENTINA, June 22 to July 4, 1998
FINAL REPORT

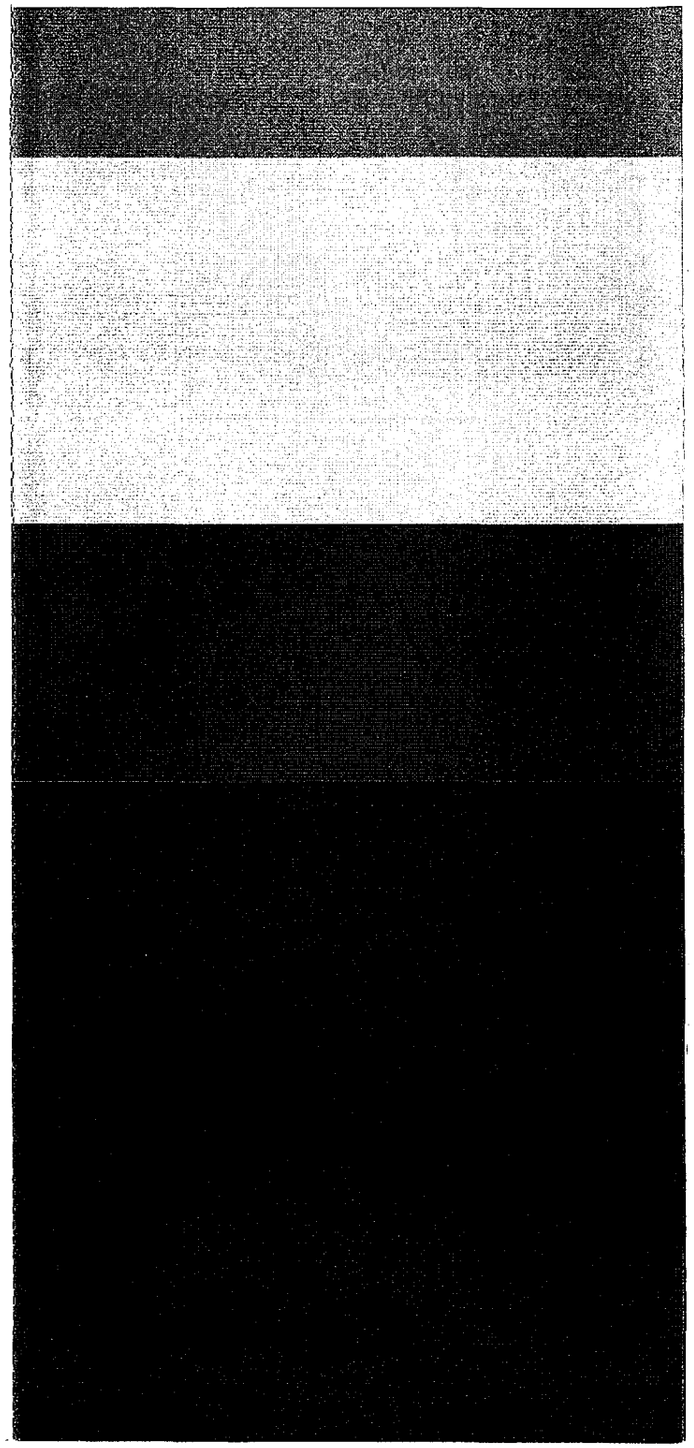
8.II Annex Folder

Casilla de Correo 4
1897 Gonnet, Provincia de Buenos Aires
Argentina

ICS-UNIDO

Curso-Taller Aplicaciones Industriales de los Láseres

del 22 de junio al 4 de julio de 1998 Salón de Conferencias del Museo y Archivo Histórico del Banco de la Provincia de Buenos Aires Sarmiento 362, Buenos Aires, Argentina



El International Centre for Science and High Technology (ICS)/UNIDO, Trieste, Italia, con el apoyo del Centro de Investigaciones Ópticas Investigaciones Ópticas (CIOP) (CONICET-CIC), La Plata, Argentina, organizará el *Curso-Taller* sobre *Aplicaciones Industriales de los Láseres*. El mismo tendrá dos sedes, una en Buenos Aires y otra en La Plata. El *Curso-Taller* fue especialmente diseñado para los empresarios y los profesionales de las micro, pequeñas y medianas empresas de Latinoamérica y el Caribe. El principal objetivo es ofrecerles un contacto próximo con los láseres industriales que les permita apreciar y valorar, en forma directa, sus posibilidades y ponderar las aplicaciones de esta tecnología de punta en nuevos emprendimientos.

Contenido del Curso-Taller Se abordarán los principios del láser y sus aplicaciones industriales. La mayor parte del *Curso-Taller* estará dedicada a explicaciones, demostraciones, experimentos y visitas a centros de investigación y desarrollo, y empresas. El cronograma de tareas incluye cuatro cursos y un taller dirigidos al entrenamiento para CAD-CAM con láseres, los que podrán ser atendidos por todos los participantes. Ellos son:

1 Curso regular de introducción al láser y a sus aplicaciones en las industrias metalmecánicas. En lenguaje simple pero preciso, se describirán las aplicaciones de corte, perforado, marcado, tratamientos superficiales y soldadura. Se cubrirán los materiales más frecuentes, como los aceros al carbono SAE 1010 a 1090, aceros inoxidables 300 y 400, aluminio, latón, etcétera.

2 Curso especial para empresarios. Está diseñado para aquellos micro, pequeños y medianos empresarios cuyas actividades no les permiten asistir a los otros cursos. Este curso está dedicado a los procesos productivos por láser y al análisis de los costos-beneficios de las aplicaciones industriales de los láseres.

3 Curso sobre CAD para que los participantes diseñen una pieza metálica plana, la que luego será procesada por láser. Así apreciarán el ciclo de trabajo y las tareas involucradas entre el requerimiento y la entrega del producto.

4 Curso de atención personalizada de consultas sobre temas de los Cursos 1, 2, y 3.

5 Taller de trabajo CAD-CAM en el Laboratorio de Procesamiento Láser del CIOP, La Plata. Los participantes tendrán durante cuatro días la oportunidad de elaborar el producto que diseñaron en el curso 3, o bien, replicar alguno de los productos de una extensa diversidad, fruto de la experiencia recogida por el personal del Laboratorio de Procesamiento Láser en los últimos años.

Objetivos Se espera que después de su participación en el *Curso-Taller*, los empresarios y profesionales estén más y mejor capacitados para tomar decisiones sobre el perfeccionamiento de su línea de producción, considerando la posibilidad de incorporar la tecnología láser a sus productos o servicios. Además, cumpliendo con el propósito de ilustración general, el *Curso-Taller* ofrecerá seminarios y exposiciones informales sobre asuntos relacionados con las aplicaciones de los láseres en otras áreas, como metrología, control de calidad, medio ambiente, medicina, odontología, etcétera.

Profesores según órden alfabético de nombres

Carlos E. de Paula USP, San Pablo, Brasil
David Belfore Editor, Industrial Laser Review, USA
Denisse M. Zezell IPEN, San Pablo, Brasil
Eliseo Gallego Lluesma CIOP, La Plata, Argentina
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Mariano F. Creus CIOP, LaPlata, Argentina
Mario Gallardo Director del CIOP, La Plata, Argentina
Mario Garavaglia UNLP y CIOP, La Plata, Argentina
Nilson Vieira Jr. IPEN, San Pablo, Brasil
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Norman Ferguson Ryerson, Polytechnic University, Toronto, Canadá
Spero Penha Morato Representante ICS, Brasil
Wagner de Rossi IPEN, San Pablo, Brasil
William Steen University of Liverpool, United Kingdom

No todos los profesores invitados confirmaron su presencia.

ICS-UNIDO

Curso-Taller Aplicaciones Industriales de los Láseres

del 22 de junio al 4 de julio de 1998

Salón de Conferencias del Museo y Archivo Histórico del Banco de la Provincia de Buenos Aires Sarmiento 362, Buenos Aires, Argentina

Inscripciones, becas y cronograma

El *Curso-Taller* está dedicado a empresarios y profesionales de micro, pequeñas y medianas empresas metalmetálicas de Latinoamérica y el Caribe. La inscripción al *Curso-Taller* permite la asistencia a todas las actividades programadas.

Podrán participar estudiantes del último año de carreras universitarias científicas y tecnológicas.

La inscripción general cierra el 13 de junio de 1998.

Las becas se otorgarán a empresarios y profesionales de micro y pequeñas empresas metalmecánicas de Latinoamérica – excepto Argentina – y el Caribe. Éstas serán cubiertas por la United Nations for Industrial Developments Organization (UNIDO). Es requisito de inscripción el conocimiento del idioma inglés. La beca incluye viaje vía aérea, parcialmente hotel con desayuno y 'per-diem'. Las solicitudes de beca deben ser enviadas antes del 15 de mayo de 1998. Las comunicaciones de aceptación serán anunciadas antes del 29 de mayo de 1998.

PARTICIPANTES	PAÍS	CUPO	COSTO
Empresarios y profesionales	Latinoamérica y el Caribe	30 plazas	$ 200,–
	Latinoamérica, excepto Argentina, y el Caribe	20 becas	—
	Argentina	40 plazas	$ 200,–
Estudiantes	Latinoamérica y el Caribe	40 plazas	$ 100,–

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diseño gráfico Juliana Gorenstein

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Comité local
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Mario Garavaglia, UNLP y CIOP
Mariano F. Creus, CIOP
Guillermo A. M. Alvarez, CIOP

Patrocinan el Curso-Taller
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Comisión de Investigaciones Científicas de la Provincia de Buenos Aires (CIC), Argentina
Fundación INNOVATEC, Argentina
Foro Nacional de Ciencia y Tecnología, Argentina

En asociación con las instituciones
Universidad Nacional de La Plata (UNLP), Argentina
Instituto de Desarrollo Empresario Bonaerense (IDEB), Argentina
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Empresas participantes
Algunas empresas argentinas usuarias de la tecnología láser serán invitadas a exponer sus puntos de vista sobre los productos que elaboran. Asimismo, algunas empresas extranjeras productoras de sistemas láser para diferentes aplicaciones industriales expondrán sobre ellas.

Solicitud para mayor información

institución

nombre

dirección

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e-mail

☐ temas específicos a desarrollarse en el *Curso-Tal*
☐ costos y facilidades
☐ formularios de inscripción
☐ formularios para solicitud de beca
☐ alojamiento
☐ turismo y transporte

información para un colega, estudiante, becario,

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☐ formularios de inscripción
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☐ alojamiento
☐ turismo y transporte

8.III Annex Programme

TRAINING COURSE ON LASER SOURCES AND APPLICATIONS IN INDUSTRY, BAIRES ' 98
CURSO - TALLER SOBRE APLICACIONES INDUSTRIALES DE LOS LÁSERES, BAIRES ' 98

SCHEDULE
FIRST WEEK JUNE 22 TO JUNE 27, 1998

MONDAY JUNE 22

08:00	Check in	
09:00	Aperture	
10:30	Dr. Spero Morato	*Industrial Lasers Program at ICS-UNIDO*
11:15	Coffe Break	
11:30	Dr. Eliseo G.Lluesma	*A bird eye vision of lasers in industry*
12:30	Lunch	
13:30	Prof. Mario Garavaglia	*Optical properties of materials*
14:45	Break	
15:00	Prof. Mario Garavaglia	*What is the laser ?*
16:45	Coffe Break	
17:00	Commercial Presentation, SEIBO, CAD/CAM/CAE by Proengineer.	

18:00 CAD / CAM /CAE
and Questions and Answers
at Hotel Buenos Aires

TUESDAY 23

08:00	Prof. David Belforte	*Laser Metal Cutting*
09:00	Prof. David Belforte	*Industrial Lasers – Tomorrow's Technology, A perspective*
10:15	Coffe Break	
10:30	Prof. William Steen	*Laser Welding, Laser Heat Treatment*
12:30	Lunch	
13:30	Dr. Fabrizio Grassi	*Architectures of 2D and 3D Laser systems*
15:00	Break	
15:15	Dr. Fabrizio Grassi	*Industrial Applications of Power Lasers on Metal Fabrication*
16:45	Coffe Break	
17:00	Commercial Presentation VIL Tailor Blank Welding, Mr. Bob Lewinski	

18:00 CAD / CAM / CAE and Q&A at Hotel BA

19:00 Teatro Cervantes TANGO

WEDNESDAY 24

08:00	Prof. William Steen	*Rapid Prototyping*
09:00	Break	
09:15	Prof. Jay Baron	*Tailor Blank Welding (TBW)*
10:15	Coffe Break	
10:30	Prof. Jay Baron	*TBW Economic aspects*
12:30	Luch	
13:30	Prof. Niklauss Wetter	*Diode Pump Solid State Lasers*
14:15	Break	
14:30	Prof. Wagner de Rossi	*Efficiency of Solid State Lasers*
16:45	Coffe Break	
17:00	Commercial Presentation, Soudronics, Mr. Rudolf Corrodi	

18:00 CAD / CAM / CAE and Q&A at Hotel BA

TRAINING COURSE ON LASER SOURCES AND APPLICATIONS IN INDUSTRY, BAIRES ' 98
CURSO - TALLER SOBRE APLICACIONES INDUSTRIALES DE LOS LÁSERES, BAIRES ' 98

SECOND WEEK: JUNE 29 - 30 AND JULY 1 TO 4, 1998

TIME	MONDAY JUNE 29	TUESDAY JUNE 30	WEDNESDAY JULY 1	THURSDAY JULY 2	FRIDAY JULY 3	SATURDAY JULY 4	FRIDAY JULY 3
9:00 AM	Visit to OXICORTE Plasma and Flame Cutting Job Shop	Trainning on lasers CAD/ CAM for manufacture **Prof. F.Olsen**	Trainning on lasers CAD/ CAM for manufacture **Dr. E.G.Lluesma**	Trainning on lasers CAD/ CAM for manufacture **Dr. E.G.Lluesma**	Trainning on lasers CAD/ CAM for manufacture **Dr. E.G.Lluesma**	Trainning on lasers CAD/ CAM for manufacture	Photo Dynamic Therapy (PDT) Faculty of Odontology **Dr.A.Kitilakis** **Dr.M.Garavaglia**
12:00 AM 1:00 PM	**LUNCH TIME** Laser Job Shop	**LUNCH TIME**	**LUNCH TIME**	**LUNCH TIME**	**LUNCH TIME**	Inquiry - Opinion Poll Diplomas	**Dr.E.G.Lluesma** **Dr.de Antueno** **Dr. Eduardo** **Dr.D.Zezell** **Lic.R.Lepore**
5:00 PM		Trainning on lasers CAD/ CAM for manufacture **Eng.G.Alvarez** **Lic. M. Creus**	Trainning on lasers CAD/ CAM for manufacture **Eng.G.Alvarez** **Lic. M. Creus**	Trainning on lasers CAD/ CAM for manufacture **Eng.G.Alvarez** **Lic. M. Creus**	Trainning on lasers CAD/ CAM for manufacture **Eng.G.Alvarez** **Lic. M. Creus**		
7:00 PM		**TANGO (Bs.As)**		Café Tortoni **DINNER AND JAZZ**			
CITIES >	Avellaneda, Prov. of Buenos Aires	Gonnet, Provincia de Buenos Aires, Campus Tecnológico CIC Camino Centenario entre 505 y 508					

8.IV Annex List of Lectures and their affiliations

Datos personales de los profesores del "Curso-Taller Aplicaciones Industriales de los Láseres"

22 de Junio al 4 de Julio de 1998. Bs. As. - La Plata, ARGENTINA

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Visit to Laser Jobshop
Jorge Fazio Vice President, **OXICORTE S.A.**
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1870 Avellaneda, ARGENTINA
Tel: ++ 54 1 208 2988 Rotative lines
Fax: ++ 54 1 209 4447 Hosted & Lunch to 43 persons member of Training Course
Visited Flame, Plasma, Micro Plasma and Lasers cuting of metals.

8.V Annex List of participants and their countries

Participants with fellowships

ADDRESSES OF PARTICIPANTS TO THE "ICS-UNIDO TRAINING COURSE ON LASERS AND INDUSTRIAL APPLICATIONS", ARGENTINA , June 22 – July 4, 1998

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8.VI Annex Applications Forms of the participants