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Manufacturing Parts and Mechatronics Systems by Laser Welding on CNC System

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ABSTRACT

In this document are presented the manufacturing capabilities of laser welding of different assemblies with complex outlines on CNC systems with examples for different configurations for mechatronics systems.

General considerations

Due to the advantages of laser radiation (temperature field and heating time precisely controlled, minimum heat-affected zone adjacent to welding track, high speed of the welding without surplus metal, full automation of the welding process) using laser for manufacturing welded assemblies is an opportunity especially for materials that are difficult or impossible to weld by classical means.

To manufacture an assembly by proper laser welding is necessary to choose the most suitable laser generator for the type of binding and the characteristics of welded materials, with emitted power and wave length that leads to a large absorption of laser radiation by the welded material.

Experiments were made using an installation with a solid state laser Nd:YAG, (maximum impulse power selectable from 4.5kW to 10.5kW), made by ROFIN company, model SWP 6002 which allowed easy manufacturing of welded assemblies of good quality for various combinations of metals both in manual mode and also using CNC facility. In this picture (fig 1) there is shown the installation on which the experiments were made.



Figure 1. Installation laser model SWP 6002

This installation allows manufacturing a wide range of welded assemblies (in CNC mode the system may generate any curve desired for the welding outline) for a wide range of materials, with a maximum speed of 10mm/s and the positioning precision of less than 20 μ m;

2.5 μ m resolution.

Command logic NC-CAD creates, edits and uses numeric command programs according to ISO 66025 standard. NC programs are written and edited by a text editor, allowing graphical simulation and then the transfer to the welding system (Menu Machine). Basically the codification functions are G functions (which allow the movement) and M functions (machine functions), beside main functions there are also some complementary functions.

The CNC mode allows transfer to working area of the CAD model accordingly to coordinates.

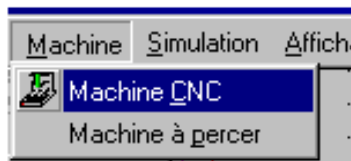


Figure 2. Activation of CNC menu.

Working program NC-CAD6 allows opening a new file for the visualization of the future welding outline or for modifying an already existing file. In CNC menu there is a text editor for creating, editing and running CNC programs.

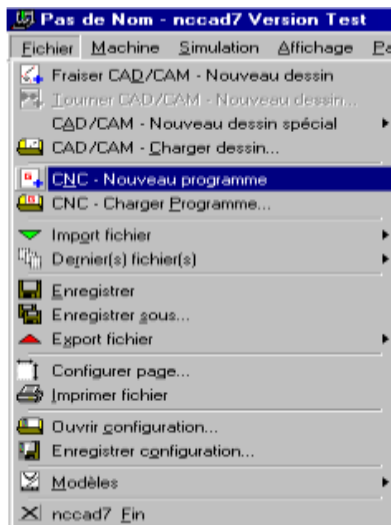


Figure 3. Creating a new drawing.

If the user chooses manufacturing in CNC mode or CAD/CAM mode there is also the possibility of activating the menu which allows accessing CAM manufacturing functions, the group Edit which allows modifying and correcting a drawing and there is also the CAD group, a standard which allows creating a 2D drawing and the 3D group which allows 3D drawing, fig 4.

For example, when accessing Fichier CAD/CAM – Nouveau dessin to create a new drawing, the drawing area is opened which corresponds to Y –axis dimensions of the table, left-right and X axis of the CNC machine.

The operator may select a shape, for example, Rectangle from the standard CAD group and build a rectangle, fig 5.

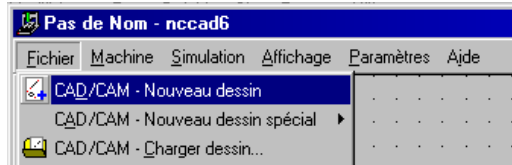


Figure 4. Opening CAD/CAM –new drawing working area.

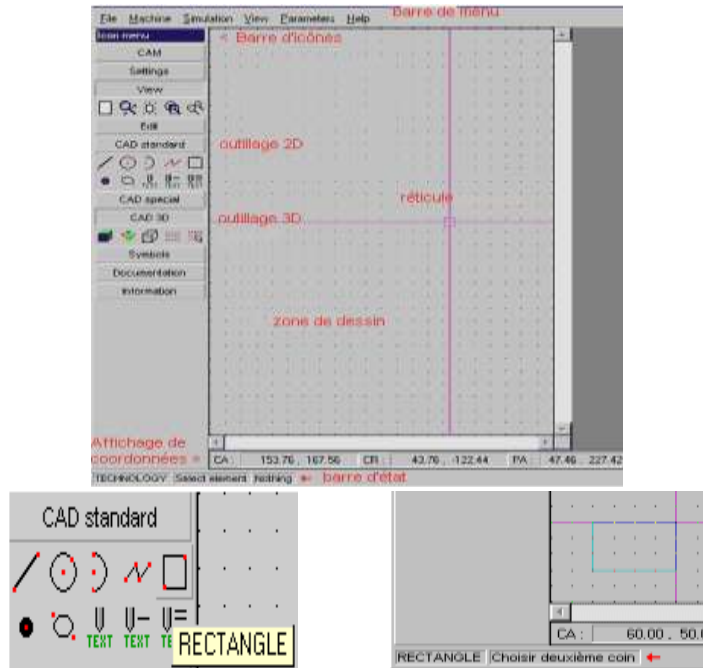


Figure 5. Description of CAD standard icon.

In order to process CAD drawing, user must activate Technologie icon from CAM group, place the pointer over a dot from the rectangle and mark it by a click. In Technologie window the values are validated by OK, fig. 6.



Figure 6. Validating values by OK button.

Next, Machine/Machine CNC menu is opened, and from Comande manuelle window, Degagement fin d'usinage button is activated, fig 7, the origin of the part is set, and Lancement du programme button is then activated.

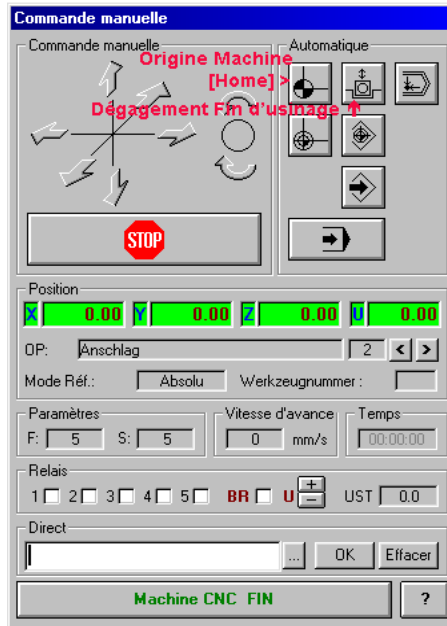


Figure 7. Activating degagement fin d'usinage button

This dialogue window uses a large part of the computer resources, all the functions are suggestively printed on the screen, beside automated command there is also an option for manual command.

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Pas de Nom - nccad6
Fichier Machine Simulation Affichage Paramètres Aide
G01 X7.55
G01 X15.22 Y0
G01 X32.81 Y23.03 Z-9.68
G01 X16.36
G01 X40 Y3.6

Fichier Machine Simulation Affichage Paramètres Aide
G00 X0 Y0 Z5 ;position départ
M10 O6.1 ;broche marche
G01 Z-1 F100 ;profondeur et F

G01 X7.55
G01 X15.22 Y0
G01 X32.81 Y23.03 Z-9.68
G01 Y16.36
G01 X40 Y3.6

G00 Z5 ;en haut
M10 O6.0 ;broche arrêt
G00 X0 Y200 ;dégagement pièce
  
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In fig. 8. are shown more materialized outlines of welding in CNC system, for stainless steels, [1, 5, 7].

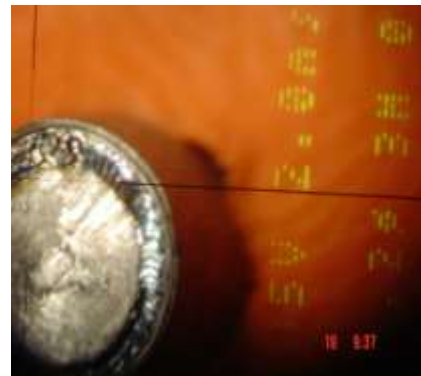
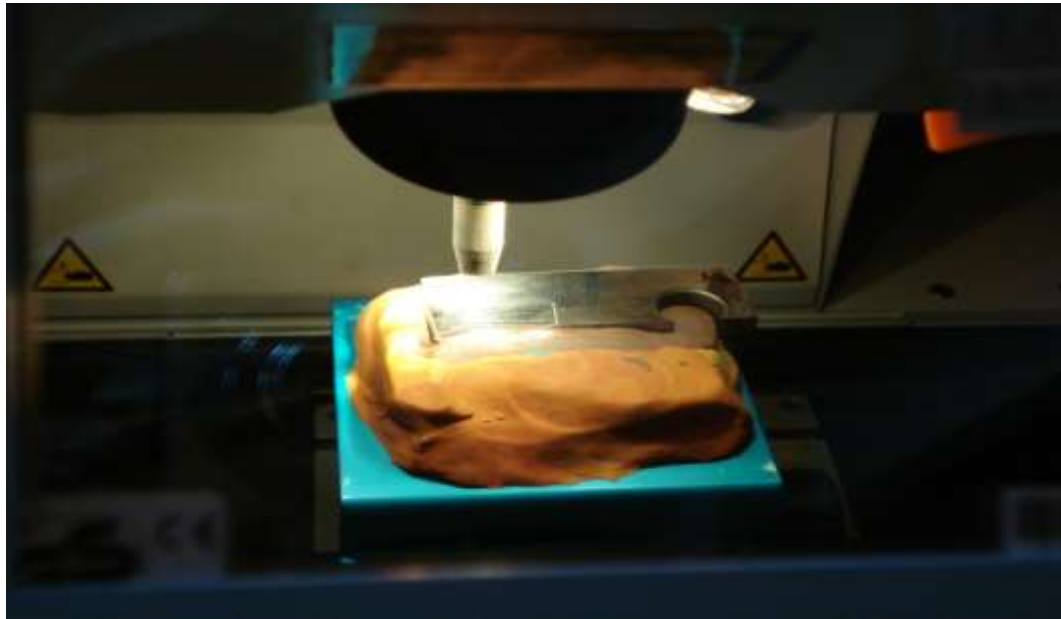


Figure 9. Examples of welded parts in CNC mode using ROFIN SW6002 laser installation.



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Conclusions

This presentation intends to show the advantages of using CNC systems, in order to produce laser welding by complex outlines, but well defined [7]. The only risk is producing vaporization of the metal and thus compromising the welded assembly.

Obviously, there has to be done also a correlation of the working parameters: radiation power, action time, frequency of the laser impulse, accordingly to the characteristics of the welded materials. The major risk is producing vaporization of the metal and thus compromising the welded assembly.

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