Ultrasonic assisted processes for machining of high precision components

Goal of the project: The main goal of this project is to develop an industrial module capable of ultrasonic assisted drilling/ grinding, being this system independent, removable and transportable to be used in any machine tool using standards cone adaptors such as HSK. The main innovation objectives of the project are the development of specially designed components: transducer, sonotrode, generator, tool-holder and electrical transmission.

Short description of the project: Metal cutting is one of the most important industrial processes of all manufacturing activities. Drilling represents about 30% of the total manufacturing time complementing other processes, such as turning and milling, while grinding is the most important process in the manufacturing of high precision and high quality components. The drilling process is common for the manufacturing of structural parts and components in the aeronautic sector. Most of these parts are made of titanium alloys, aluminium alloys or carbon fibre reinforced composites, and they normally need a lot of drilling operations. Furthermore, these structural parts require high precision to assure the integrity of the component in use, so the improvement of the process performance becomes a challenge that could be achieved by using ultrasonic assisted drilling to obtain precise hole diameter and cilindricity avoiding the generation of burrs. The grinding is a common process in all sectors of activity manufacturing mechanical components when high precision is required (automotive, machine tools, aeronautics, etc.).

Most of previous works in the use of ultrasonic assisted machining are oriented to the development of grinding processes.

Implementation period:
01.01.2010-31.12.2012

Project implemented by:
Department of Materials and Manufacturing Engineering from UPT in partnership with ISIM Timisoara, SC SMD electronics SRL Timisoara, Fundación Tekniker from Eibar-Spain, LAIP S.A. - Spain and MYL S.A. - Spain.

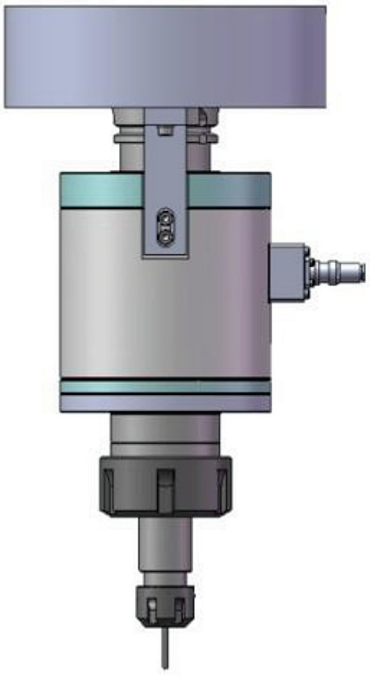
Main activities:
The activities of the project were divided in 3 phases. In the first phase, the system specifications concerning the ultrasonic system design and the machining process were done. The second phase was consisting in the development of the ultrasonic system. UPT, ISIM and SMD have designed the ultrasonic generator according to the defined specifications. TEKNIKER, UPT and ISIM have designed the ultrasonic vibratory system. TEKNIKER, MYL and ISIM have defined the electrical connection system to power the rotating ultrasonic vibratory system with the ultrasonic generator. All the partners have participated in the mechanical design and the integration of the components developed before. This phase also has included the manufacturing and assembling of the system developed. In the third phase, the validation, the development of the machining processes was done, including experimental research on ultrasonic assisted drilling and grinding processes.

Results:
It has been realized an ultrasonic activation systems (resonance frequency 40 KHz).
•Analysis of ultrasonic assisted drilling:
After some preliminary tests it was established that the ultrasonic activation should be focused for drilling small diameter parts between 3 and 8 mm. The experimental results were statistically processed and interpreted.

"Scientists investigate that which already is; Engineers create that which has never been."

Albert Einstein

•Analysis of ultrasonic assisted grinding: Using the same ultrasonic activation device, an experimental program was realized for ultrasonic assisted grinding process.
In both processes the reducing on cutting forces was observed, especially for drilling processes (in some conditions the cutting forces reduction was 20%).



Fields of interest: The industrial needs driving the development of this technology is the manufacturing of high quality components made of materials with low machinability (Ti alloys, ceramics, hardened steels…) or very particular behaviour (carbon fibre reinforced composites, Al alloys…), providing an efficient manufacturing process suitable to be adapted to most of the machine tools and enhancing the capability of these. The introduction of new advanced technologies, like ultrasonic assisted drilling and grinding, that allow the production of high quality components becomes an important factor to maintain the competitiveness of the European industries against low labour cost markets outside EC.

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Research centre for Integrated Engineering

Applicability and transferability of the results:
•Development of a new industrial system for ultrasonic assisted drilling/grinding usable in any machine-tool.
•Improvement in the knowledge and design capabilities in the field of ultrasonics.
•Improvement of the drilling process in the manufacturing of high precision aeronautic components.
•Improvement of the grinding process in the manufacturing of high precision components.

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