

Laser generated Ultrasound System (LUS) and its application for the Non-Destructive Testing of metallic components

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One of the investigation areas regarding the Ultrasonic Non-Destructive Test (UT-NDT) is the development of non-contact technologies like Air-Coupled UT, EMAT or UT generated by Laser. These technologies show several interesting advantages like no couplant needed or their application to the inspection of components with complex geometries and extreme surface conditions (temperature, roughness, radiation...). In the Laser Ultrasonics Techniques (LUS), ultrasound is generated by a pulsed laser that produces a thermal expansion of the surface where it impacts and generates vibrations at ultrasonic frequencies. These vibrations can travel through the inside of the material and its surface; and they are reflected, refracted or diffracted in the defects or discontinuities of the material. The disturbances generated by the interaction of the vibration with the defects are detected in another point of the material using a secondary detection system. Tecnatom is working with LUS technology since 2010, acquiring, installing and optimizing a laboratory system for its implementation in the inspection of metallic materials (aluminum, carbon steel and stainless steel). During this time, several works have been carried out to determine the scope of the technology as:

- Initial study for the characterization of the waves generated by the laser.
- Studies in test blocks without discontinuities to determine the experimental conditions in which ultrasonic disturbances are generated in thermo-elastic and ablative regime.
- Simulations and microstructural studies of the pieces to determine both the structural state and the residual stresses caused by the incidence of the laser.
- Inspection of blocks with artificial reflectors, both superficial and embedded, and set-up techniques to increase the amplitude of the detected signal.
- Optimization of the detection system through the combination of technologies.
- Identification of safety criteria, use and improvement of the system for validation use in industrial environments.

In this work, Tecnatom presents the main conclusions of the development carried out to determine the capacities and limitations of the techniques based on Laser Ultrasonics for its application in Non-Destructive Testing for the inspection of metallic components.