Ph.D. position – Laser ultrasonic methods for the evaluation of aeronautical adhesive bonding

The basic principle of generating sound with light is the following: when a laser is absorbed in a medium, a local heat arises, leading to a local thermal expansion of the medium. This expansion then generates propagating elastic waves, the frequency spectrum of which is partly related to the laser pulse duration: the shorter the duration, the broader the frequency content. This generation process along with a convenient optical method to detect the sample displacement field (interferometer, vibrometer, …) makes laser ultrasonic methods suitable for non-destructive testing (NDT) application, and is of great interest since it is a non-contact/non-invasive technique. The Laser Ultrasonic Group at LAUM is working on NDT applications for ten years and has many research interests, such as laser-generated guided waves and nonlinear optothermoacoustic method to name but a few. The PhD research proposed here by LAUM together with SAFRAN will be devoted to develop laser ultrasonic methods combining guided waves and nonlinear phenomena with the intention to evaluate aeronautical adhesive bonding.

Adhesive bonding of aircraft pieces is indeed more and more widespread since it allows a huge gain of mass compared to classic bonding such as rivets. Besides, adhesive bonding does not require drilling the pieces before assembling them. The use of adhesive bonding thus limits the occurrence of weak points where stress concentration can occur, which is essential for limiting fatigue cracks in structure. Mastering and understanding the properties of adhesive bonding are important for aeronautical industries such as SAFRAN.

The goal of the experimental part of the PhD research will be to propose advanced laser ultrasonic methods to evaluate adhesive bonding and to extend the applications of these techniques for non-destructive characterization of the nonlinear bonding between material interfaces. The goal of the theoretical part of the PhD will be the understanding of the roles played in the observed phenomena by different types of surface preparation before bonding, by the structuration of the adhesive layer, and by its elastic properties. Numerical/analytical calculation will be also developed in order to have an insightful understanding of the experimental results.

Keywords: adhesive bonding, laser ultrasound, experiment/theory, guided waves, nonlinear optothermoacoustic method

Please send your applications to the following contacts:

- Vincent Tournat vincent.tournat@univ-lemans.fr
- Samuel Raetz samuel.raetz@univ-lemans.fr
- Mathieu Ducousso mathieu.ducousso@safran.fr