

## **INDUSTRIALISED SHEAROGRAPHY TESTING ON AIRCRAFT COMPOSITES WITH STATE OF THE ART SOFTWARE TOOLS PROVIDING AN EASY AND FAST SCANNING SYSTEM**

J. Collrep and R. Berger, Steinbichler Optotechnik GmbH, Neubeuern, Germany

**Abstract:** Continued development and improvements to laser Shearography measurement techniques have led to greatly improved performance and acceptance of this technique for primary aircraft structure non-destructive inspection (NDI) and is now fully industrialised. With the latest improvements in sensor portability and reduced sensitivity to environmental disturbances, especially ambient vibrations, it is now practical to use laser Shearography with a stationary measurement set-up for quality control in production and NDI technique qualification, as well as for in-service-testing with a robust hand-transportable mobile measuring system suitable for use in hangars and remote locations for routine inspection of commercial aircraft structures. Together with the latest developments in data acquisition, software tools for image processing as well as for test documentation, it is now a total user-friendly system.

**Introduction:** By combining the Steinbichler exclusive use of spatial phase shift technology with the Steinbichler GUI “ISIS,” the technology has now reached the level where it enables a simple, effective and fast measurement capable of solving many existing problems in composite production, quality control and in-field inspection. Beside the very robust measurement itself, the technology also offers full-field, non-destructive inspection capabilities including low-cost laser diodes, one man operation, optimised weight and handling.

**Results:** The Shearography technology has proven its capabilities in many applications throughout various industry sectors e.g. Aerospace, Automotive, Electronic and Tire Inspection. The huge advantage of Shearography testing is, that the field of view can be adjusted from a few square millimeters up to square meters so a wide range of parts can be inspected with just one system. This opens applications on unequipped PCB's, Honeycombs with Aluminium or Carbon Fibre skin, CFRP's, Metal/Rubber joints, Glare® or other composites. The systems are now capable of dealing with measurement tasks from the first approach on easily finding the correct settings, creating automatic programs, interfaces to libraries, CAD Software and 3D Model, one man operation, automatic test report set-up and finally storing / exporting the results in different data formats. The latest developments in software extend the range of applications to cover measurements on shiny surfaces without any surface preparation. The software is Microsoft Windows based and therefore operator training is reduced to a minimum, which once again is one off the direct pay-offs of these systems. Another quite important issue is, that if a combination of stationary and mobile units are both in use at the same site, the software training is only required once since the same software GUI is used on both systems. With the development of the five axis stationary system ISIS 5000, it is now possible to inspect five sides of an object in just one set-up. The System is based on a customised vacuum chamber for exciting the object under adjustable vacuum loading and with a five-axis system, which can move the measuring head in any orientation the part inspection requires. The measuring head contains, beside the Shearography unit, also the thermal excitation system. Therefore, this system allows a combined excitation giving maximum inspection capabilities to the operator. The software features allow a fully automatic surface partitioning in the range of the actual field of view with a pre-set overlap so user inputs are reduced to a minimum. The results are displayed immediately for review and confirmation by the operator, which can then be stored as automatic settings. The operator can select various settings e.g. for loading, delay time and camera setting for one specific part inspection and with a one button operation, these settings can be stored. The automatic programs can be selected automatically by using a barcode as part identification or by manual input by the

operator. The operator can now select whether an automatic test report should be created or not. By selecting the automatic reporting, a new program feature is used, which guides the operator through the document allowing inputs of e.g. customer logo and customer specific templates. Therefore, a software tool is now available which provides a combination of an easy-to-use interface and a modular design. The hardware is based on rugged design features with maximum flexibility and manageability. The *ISISmobile 3000* system is designed for easy and flexible operation in the In-Field Service or in Quality Assurance tasks at the production department. The system allows the operator to place the measuring head in any direction on the object which is for In-Field Service a very important issue. This unit also features a combination of thermal and vacuum excitation which can be used independently from each other. Even with all these features, the unit is still light weight and easy to handle. The standard tablet PC helps the operator to start and review the measurement directly at the location of the measurement while the main PC is used for image processing and data storage. The system can therefore be operated either from the measuring head itself, from the tablet PC or from the main PC. All functions are managed by the mobile controller which contains all the interfaces to the various systems.

**Discussion:** The paper will discuss the development of hardware, software and handling features and will include results from practical measurements on composite aircraft structures, including commercial aircraft, and other structures.

**Conclusions:** It is clearly demonstrated that the Shearography technology has now reached a level which makes it reliable and easy to use for the Aerospace, Automotive and many other industries. With the combination of a very fast optical measurement technology, high reliability and a simple to use software package, these systems are now ready for the industry use. The clear results shown during the presentation leave no doubts about what can be detected and shows that Shearography can be used as an additional tool for inspection of composite parts. The huge inspection time savings will pay off immediately to the operator and considering expectations of 99,9% defect free parts, which is a major advantage.

**References: none**