DIPARTIMENTO DI INGEGNERIA
CORSO DI DOTTORATO IN INGEGNERIA INDUSTRIALE E DELL'INFORMAZIONE -
PHD COURSE IN INDUSTRIAL AND INFORMATION ENGINEERING - 35TH CYCLE

Title of the research activity:	Development of simultaneous non-contact stress and tension measurement techniques
State of the Art:	The non-contact measurement technique known as "Digital image correlation" (DIC) is a well-known experimental method for analyzing the surface deformation field of samples and mechanical components for the development of high-performance data processing and image acquisition systems, with a large number of applications in experimental mechanics [8-9]. The thermoelastic measurement technique (TSA) [1-2] is usually used to study the stress field on the surface of samples or mechanical components. [5] On the basis of the fundamental law of thermoelasticity introduced by Kelvin [2], the temperature variation of a homogeneous, isotropic body, stressed in the linear field, is closely related to the tensional state that is generated on the surface of the body [3]. The DIC, on the other hand, is able to supply the entire deformation tensor, from which the stator component can be obtained, as the sum of the elements on the main diagonal of the tensor itself. In the first instance the two measurement principles seem unable to coexist since an optimal DIC input constitutes an interfering input for the TSA and vice versa [6]. In Digital Image Correlation, in fact, high displacements of the investigated object are preferred, provided they are contained in the field of view; in thermoelasticity instead it is necessary to stress the object keeping it possibly still [7] or in any case subjecting it to small movements [10]. In the TSA it is necessary to have a superficial uniformity in terms of IR emission [4], while the DIC requires a speckle.
Short description and objectives of the research activity:	The proposed research has the objective, using the latest data acquisition and processing techniques, to analyze stresses and deformations of an organic tissue or complex material subjected to traction through an integration of the DIC techniques with the TSA. We propose to demonstrate the possibility of extending the use of these techniques also on organic components such as non-linear fabrics or complex materials. The objective is the development of new methods of processing the results obtainable with both DIC and TSA measurement techniques, applied to a single thermal film obtained with a thermal imaging camera. The possibility of being able to integrate the two full-field optical measurement techniques is linked to their different spatial resolution,

	which makes it possible to obtain an ideal analysis surface for the application of both. It is therefore possible to obtain a deformation map by applying the DIC directly to the thermal video from which a voltage map was previously obtained. In this way, with a single acquisition, we are able to have a qualitative stress map and a deformation reference, thanks to which we can directly evaluate the voltage distribution also in quantitative terms without having to resort to other deformation measurements (eg strain gauge)
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