APPLICATION OF THE ELECTRONIC SPECKLE PATTERN INTERFEROMETRY (ESPI) TECHNIQUE FOR THE CHARACTERIZATION OF DAMAGE IN COMPOSITE LAMINATES

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Composite laminates under service loading undergo complex combinations of thermal and mechanical loading leading to microdamage accumulation in the plies. The most common damage mode is intralaminar cracking in layers. The crack opening displacement (COD) and the crack sliding displacement (CSD) during loading reduce the average stress in the damaged layer, thus reducing the laminate stiffness. In other words, the elastic modulus in the loading direction and the corresponding Poisson's ratio decrease.
These parameters depend on material properties of the damaged layer and surrounding layers, on layer orientation and thickness. Previously these parameters have been calculated using finite element method (FEM) assuming linear elastic material with idealized geometry of cracks [1]. The only correct way to validate these assumptions is through experiments.

The main objective of this paper is to measure these parameters for different laminate lay-ups in this way providing models with valuable information for validation of used assumptions and for defining limits of their application.
In particular, the displacement field on the edges of a $[0/\ 70_4/\ -70_4]_s$ and $[0/55_4/\ -55_4]_s$ glass fiber/epoxy laminate specimens with multiple intralaminar cracks is studied and the (COD) dependence on the applied mechanical load is measured. The specimen full-field displacement measurement is carried out using ESPI (Electronic Speckle Pattern Interferometry) [2,3]. ESPI is an optical technique that provides the displacement for every point on a surface and offers the possibility to measure both, the in-plane and out-of-plane displacement without surface preparation.
The displacement jumps corresponding to cracks are clearly visible and can be used to determine the opening displacement along the cracks. The effect of crack interaction on the (COD) at high crack density is also investigated.

REFERENCES

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