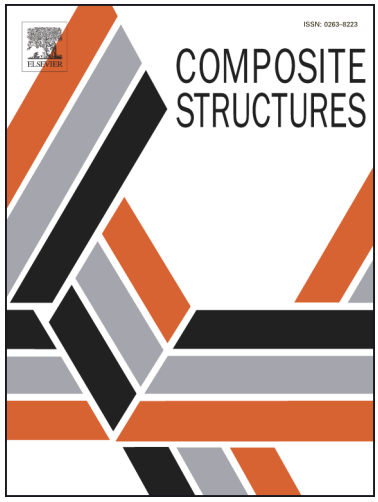

Multi-instrument in-situ damage monitoring in quasi-isotropic cfrp laminates under tension

Fatih E. Oz, Nuri Ersoy, Mahoor Mehdikhani, Stepan V. Lomov

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MULTI-INSTRUMENT *IN-SITU* DAMAGE MONITORING IN QUASI-ISOTROPIC CFRP LAMINATES UNDER TENSION

Fatih E. Oz[1], Nuri Ersoy[2], Mahoor Mehdikhani[3] and Stepan V. Lomov[4]

[1-2]Department of Mechanical Engineering, Bogazici University, Bebek, 34342, Istanbul, Turkey

Email: [1]fatih.oz@boun.edu.tr, [2]nuri.ersoy@boun.edu.tr

[3-4]KU Leuven, Department of Materials Engineering, Kasteelpark Arenberg 44, 3001 Leuven, Belgium

Email: [3]mahoor.mehdikhani@kuleuven.be, [4]stepan.lomov@kuleuven.be

ABSTRACT. Digital Image Correlation monitoring of the surface strains, microscopic *in-situ* observations of the micro-damage on the specimen edge and Acoustic Emission (AE) are utilized simultaneously during tension tests of quasi-isotropic carbon fibre reinforced polymer composites. It is found that the cluster analysis for characteristic parameters of AE events (the main being the signal amplitude and frequency) does not unambiguously identify the type of damage which causes the event. With optical instruments, it is observed that the signatures of AE events depend on the position of the ply where damage happens and on the ply orientation (90° vs 45°). Robust evidences for the variations in AE characteristics of damage modes in different lay-ups are presented. AE events, originated from surface cracks, have high amplitude and low frequency, whereas AE events, originated from transverse cracks in the inner plies, have low amplitude and high frequency characteristics. Any conclusion for fibre breaks are not reached in this study. Therefore, measurements in this study rather point out that the AE events, which could be interpreted as fibre breaks because of their high frequency characteristics, as optical observations prove, correspond to other damage types in quasi-isotropic laminates.

Keywords: Damage mechanics, Acoustic emission, Digital Image Correlation (DIC), Carbon fibre, Polymer-matrix composites (PMC)

1. INTRODUCTION

Damage initiation and progression in composite materials involves complex mechanisms. Understanding these mechanisms is difficult but even detecting damage in composite materials is not an easy task. Tension stress-strain response of carbon fibre reinforced

Corresponding Author: [1]
Fatih Ertugrul Oz, +90212 359 7660, fatih.oz@boun.edu.tr