The 8th European Congress on Computational Methods in Applied Sciences and Engineering
ECCOMAS Congress 2022
5-9 June 2022, Oslo, Norway

EXTENDED FAILURE MODELS FOR GLOBAL AND LOCAL ANALYSES OF COMPOSITE AEROSTRUCTURES

Giuseppe Corrado[1,2*], **Albertino Arteiro**[1], **José Reinoso**[3], **Florian Glock**[2] **and Fernass Daoud**[2]

[1]Department of Mechanical Engineering, Faculty of Engineering, University of Porto, Porto, Portugal
[2]Airbus Defence and Space GmbH, Manching, Germany
[3]Group of Elasticity and Strength of Materials, University of Seville, Seville, Spain
* gcorrado@fe.up.pt

Keywords: *Damage models, Computational methods, Fibre-reinforced polymers*

Detailed numerical models for large aerospace products result in prohibitive computational costs with the current state of technology. Therefore, to overcome the need of high-fidelity models involving millions of degrees of freedom, efficient modelling strategies have been recently proposed, such as global/local approaches. In this framework, "hot-spot" identification analysis can be used to highlight the most critical structural details where a local model would have a crucial role in capturing more accurately the structural behavior.

The methodology presented in this work consists in the implementation of a 3D invariant-based failure model [1] in a user subroutine to perform "hot-spot" first-ply failure analysis and predict the onset of intralaminar damage in large-scale models, identifying the critical failure mode. Then, after identifying the "hot-spots" for the onset of ply failure, a damage model was employed to predict ultimate strength of the most critical areas. Because these critical areas are often characterised by high levels of triaxility (e.g., bolted connections), a composite material model proposed in the literature [2], representing the quasi-brittle behaviour of composite structures, was extended to account for the effect of general 3D stress states in the initiation and broadening of fibre kinking using the 3D invariant-based failure theory. This approach was validated against experimental results from the literature, revealing the accuracy of the "hot-spot" first-ply failure analysis and the suitability of the proposed damage model for local detailed analysis of composite aerostructures.

REFERENCES

[1] P.P. Camanho, A. Arteiro, A.R. Melro, G. Catalanotti and M. Vogler (2015) Three-dimensional invariant-based failure criteria for fibre-reinforced composites. *International Journal of Solids and Structures*, **55**, 92-107.

[2] F. Zhuang, A. Arteiro, C. Furtado , P. Chen, P.P. Camanho (2019) Mesoscale modelling of damage in single- and double-shear composite bolted joints. *Composite Structures*, **226**, 111210.