SIMULATION OF LIGHTNING-INDUCED MECHANICAL DAMAGE IN CFRP LAMINATES

Albertino Arteiro[1,2*], Daniel Alonso[1], Christian Karch[3], Pedro P. Camanho[1,2]

[1]DEMec, Faculdade de Engenharia, Universidade do Porto, Porto, Portugal
[2]INEGI, Universidade do Porto, Porto, Portugal
[3]Airbus Defence and Space GmbH, Manching, Germany
* aarteiro@fe.up.pt

Industry statistics show that lightning strikes account for approximately 34% of all in-service damage caused to aeroplanes. Because low-conductive CFRPs are more vulnerable to lightning-induced damage than metals, their extensive use in airframes, which in new generation wide-body aeroplanes ascends to over 50% in structural weight and 90% in surface area, requires the integration of additional protective layers to minimise the direct effects of lightning strikes. As the industry moves towards hybrid experimental/numerical design and certification processes, the development of reliable models that are able to accurately capture the main effects of lightning strikes in the context of damage tolerance criteria becomes crucial. In the present work, physically-based models of the mechanical loads induced by lightning strikes [1] are implemented into a three-dimensional (3D) finite element framework and combined with a modified continuum damage mechanics model for CFRPs to predict mechanical damage in composite structures subjected to this type of events. Figure 1 shows the comparison between the numerical results and the experimental VISAR measurements for different expanded copper foils (ECFs) [2]. As can be observed, the predictions of the out-of-plane velocity represent very well the experimental results at the different measurement points, in particular the peak velocities. **Acknowledgements**: This work was partially performed within the project *CNT Based Materials for EMI Shielding and LSP*. Financial support from German BMVg under Contract No. E/E210/AG008/GF057 is gratefully acknowledged.

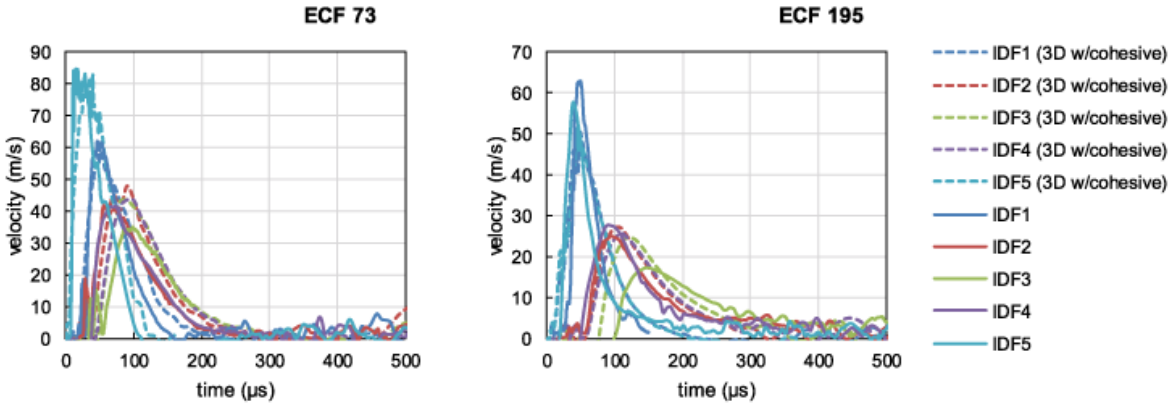

Figure 1. Finite element predictions (dashed lines) and VISAR measurements (full lines) for different ECFs.

References

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