Modelling the thermal field in metallic + composite materials during lightning/wind turbine blade interaction.

Student Project Proposal

APPLY

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Image from: Seaward Group USAWind

Background

Wind Turbines' size is increasing year after year, and the only way to sustain this growth is by use of carbon fibre composite materials to create the blades. Since this material is an electrical conductor, the whole blade should be protected against lightning events. This is achieved with a lightning protection system (LPS), which may incorporate a thin metallic mesh covering most of the blade's external surface. When the blade experiences a lightning attachment in the area covered by this thin metal mesh, temperatures increase locally thousands of degrees, which may damage the metal mesh and may affect the composite material underneath. Having a reliable mathematical tool able to predict the effects of this extreme thermal interaction would be very beneficial to design more reliable lightning protection systems able to withstand lightning conditions with no performance degradation.

Scope

The aim of this study is to create a mathematical model of the lightning plasma/blade surface thermal interaction, including:

- A review of the literature and tools related to this subject.
- Development of a finite element model using COMSOL/ANSYS able to quantify the size of the vaporized/damaged metal mesh and the temperature field penetrating the composite material underneath the metallic mesh.
- Validation of the model results against literature values and/or experimental results from Vestas.

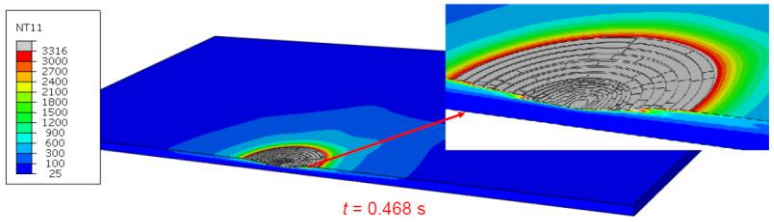

Figure 10. Temperature contour plots and thermal ablation profiles in the CFRP composite laminate panel at t=0.150 s and t=0.468 s due to lightning continuing current component C using the developed computational procedure.

•Example from: Y.Wang et al., Thermal Ablation in Fiber-Reinforced Composite Laminates Subjected to Continuing Lightning Current, 57th AIAA/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference.

Keywords:
Lightning, wind turbine blades, thermal modelling, COMSOL/ANSYS.