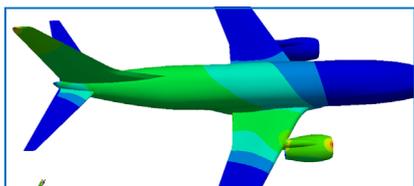




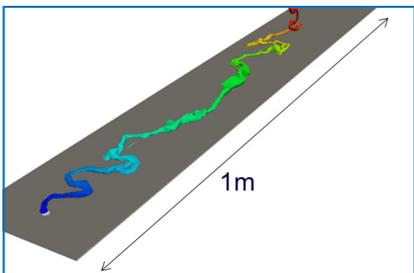
PHYLIGHT

ONERA advisor for aircraft and equipment manufacturers and certifiers on the effects of lightning strikes

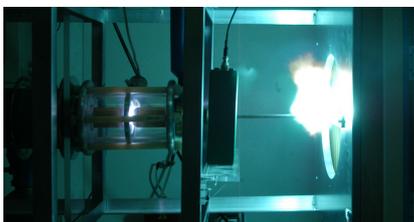
Safety is improving, performance is improving, and certification is evolving. The DGAC (French Civil Aviation Authority) wanted ONERA to undertake fundamental research on lightning strikes for the benefit of the aeronautical community, in order to better understand, analyze and grasp these complex physical phenomena. The CORAC (French Civil Aeronautics Research Council) has prepared the roadmaps for this multidisciplinary work, with the aim of studying in particular the sparking of attachment assemblies, the damage to composite panels and the integration of skin systems.



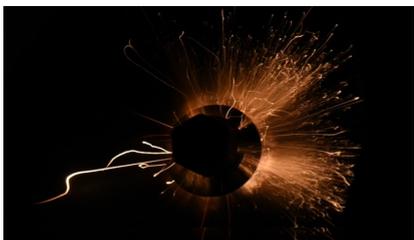
Simulation of the current distribution over the skin



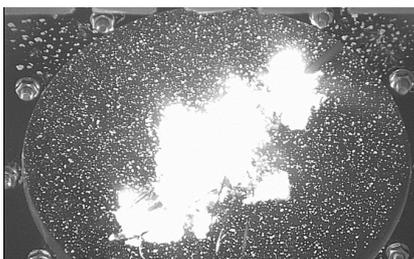
Simulation of lightning arc sweeping – panel displacement 100 m/s



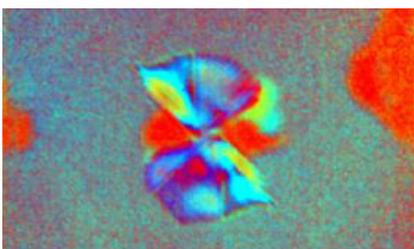
GRIFON lightning generator in operation



Sparks from an aeronautical attachment



Delamination and puncture of an unprotected composite panel during a lightning test



Non-destructive inspection by infrared thermography of an affected composite

Challenges and Perspectives

- Advancement of the theoretical knowledge about the direct effects of lightning strike
- Improvement of diagnostic and measurement methods for engineering and certification testing
- Creation of a knowledge base on the performance of materials and assemblies with respect to lightning
- Proposal of models for the various aspects of the direct effects of lightning, which can be used by the entire aeronautical community concerned

Lines of research

- Characterization of the physical parameters of representative attachment assemblies
- Modelling and fine simulation of the conditions for the appearance of sparks; Proposal of simplified models that can be used on large numbers of configurations
- Identification of the effects of technological parameters affecting the damage of composite structures – paint, protection, layup, etc. – as well as the experimental parameters – dimensions of the test pieces, waveform, and arc ignition
- Fine modeling of the phenomena and comparison with experimental observations

Experimental facilities

- GRIFON lightning generator making it possible to generate a normative wave of 100 kA peak
- Low-level lightning current generators (100 A – 10 kA)
- Fast cameras, infrared camera, spectrometer, image correlation tools, etc
- 3D, 3D surface, temporal and non-linear simulation codes

Objectives for 2020

- The contribution of validated simulation tools to reliably predict test results
- The proposal of robust characterization, testing, and diagnostic methods
- The provision of support to aircraft manufacturers in optimizing compliance demonstrations for certification, in order to control the risks, times and costs (standardization, test matrix reduction, etc.)
- The provision of support to aircraft manufacturers in the specification of protection and manufacturing solutions for margin control

Other research frameworks

- Collaboration with the DGA TA (French Defense Procurement Agency / Aviation Technologies)
- European projects: Clean Sky 2
- Research carried out with ONERA's own funding