

Fig. 1 – ALEEN-L Tool



Fig. 2 – SGO ITD main drivers and goals

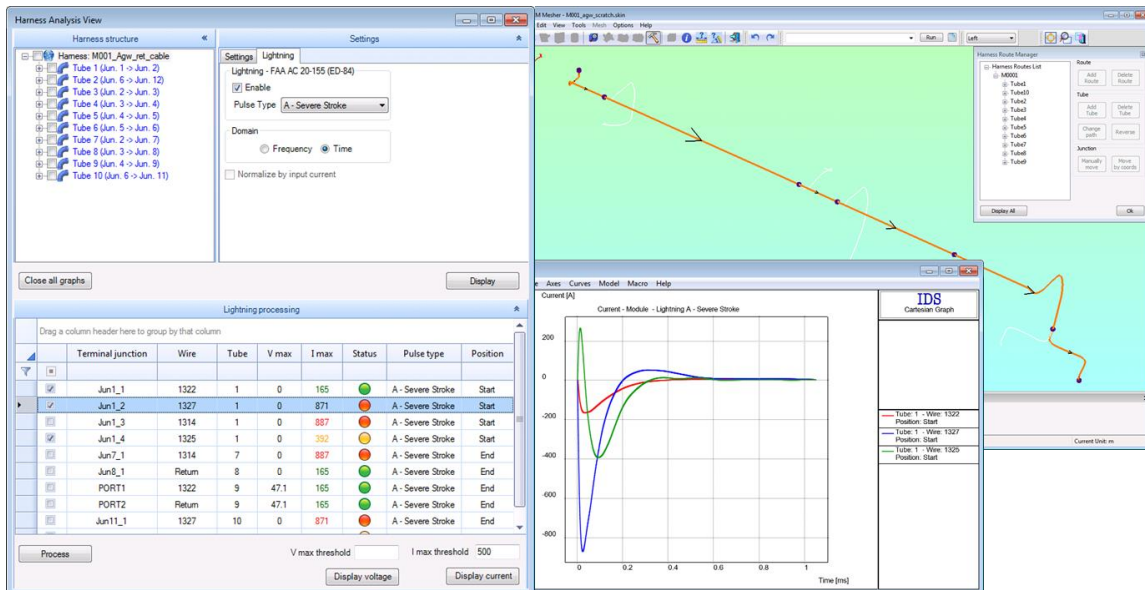


Fig. 3 – ALEEN-L result display dialog box

# ARROW

Aircraft lightning thREAT Reduction thROUGH Wiring optimization

Home
Project Description
Partners
News And Events
Outcomes
Reserved Area
Contacts

### Project Overview

The metallic bodies of "standard" aircrafts are commonly used as conductive electrical pathways for the return of direct and alternating currents, faults currents, lightning currents and also other functions related to voltage differentials, electrostatic charge draining, electromagnetic shielding etc.

Solutions adopted on metallic body aircrafts are not applicable when composite structures are used because they don't assure the necessary conductivity, and a dedicated conductive electrical pathway (hereafter referred as ALEEN, ALmost Equipotential Electrical Network) has to be integrated into the aircraft body for this specific electrical pathway function. Such a network can be practically realized in several different ways (e.g. with parallel and nonparallel paths, through structural metallic beams and seats rails, through dedicated strips and wires ...) but in any case it is obvious that not only this network can never be an ideal ground for installed cable-harnesses but also that it cannot be as protective as a metallic body respect to the lightning aggression.

In this frame, not only the compatibility of the critical/essential electrical and electronic systems with respect to indirect effects of lightning has to be assured, but also the aircraft-structure, the ALEEN, the cable-harness configuration and the cable-harness protection must be considered as a whole in order to optimize the overall wiring design and therefore to avoid over-dimensioning which could lead to undesired mass increase.

This is the goal ARROW wants to reach trough a modelling procedure which is able to cover the following main requirements:

- reproduce the real aircraft geometry, both external and internal, with high fidelity of the relevant features for EM conduction and EM scattering;
- consider the real aircraft materials (composite walls, anisotropic expanded foils, grids, finite conductivity...) and real electrical connexions between them;
- model the 3D harness configuration (cable-bundles, cables, loads and generators etc.) with high fidelity;
- correctly reproduce the EM excitation due to lightning, both in terms of entry/exit points and waveforms as suggested by applicable standards;
- model the effect of the aircraft body and appendages on the excitation of the cable-harness;
- must be usable in the frame of "design/optimization" activities from expert users, who want to apply their skills by using the modelling procedure as a support in their decisions. In this sense the procedure must be computationally effective, in order to allow repeated analysis in a short time;
- must be reliable. When uncertainty cannot be avoided (for example, a certain level of uncertainty is typically unavoidable for some input data), it must provide the means to manage the uncertainty and to allow the designer/analyst to identify conservative solutions.

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[Back to Top](#)

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