Simulation supporting certification

IEMI and NEMP applications

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Abstract - To protect against Intentional Electromagnetic Interferences and Nuclear ElectroMagnetic Pulse, many armament programs rely on numerical simulations to estimate the electromagnetic constraints on the targets.
These numerical simulations can be performed at different stages of a project:
- in the conception phase,
- to optimize architectures and EM protections in terms of cost or performance,
- for retrofitting,
- or even in the test or acceptance phase.

In any case, the confidence in the numerical simulation is a critical point. Can we even reach a sufficient level of quality to consider that numerical simulation enables a credible certification approach? In that way, standards already exist for general industrial applications. Here, this paper presents a methodology associated with a checklist for the most specific IEMI and NEMP applications. Many practical examples will illustrate this approach.

(key words) Numerical simulation, certification, IEMI, NEMP, standard

I. METHODOLOGY AND BASIC PRINCIPLES

At the request of the DGA (Procurement Agency of French Armed Forces), CEA-Gramat proposed an approach to ensure the quality of the numerical simulation process, with the objective of moving towards certification.
This so-called "simulation for certification" approach answers the question: "What are the quality guarantees of a numerical simulation result? What are the criteria, the procedures, the verifications, that the Forces are likely to request in order to get the assurance that the numerical simulation is used appropriately, is robust and reliable?
The diagram below illustrates the proposition with a 3 stages pyramid of quality levels.

Criteria lower down in the hierarchy must be satisfied before simulation quality can attend to criteria higher up
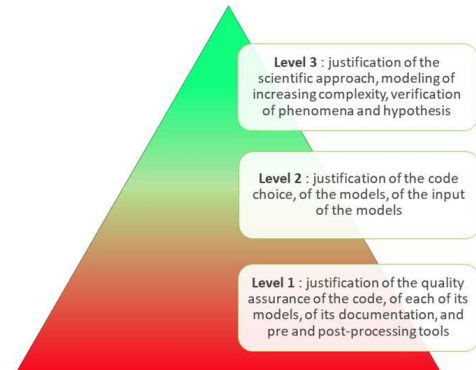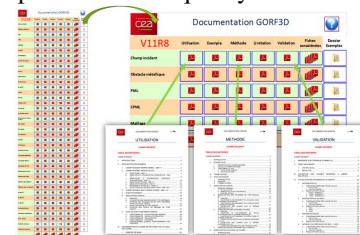In that way, the most complete requirement corresponds successively to respect of levels 1, 2 and 3.

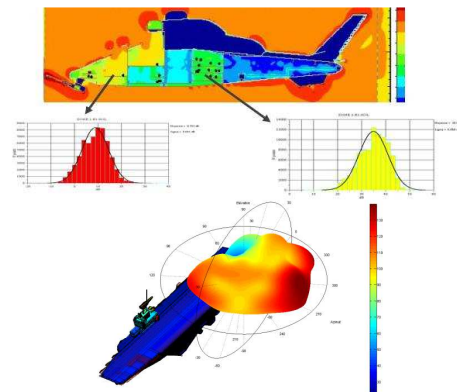Figure 1. 3 stages pyramid of quality level

II. EXAMPES

Based on the diagram in Fig 1, examples will be given for each stage of quality criteria.

Level 1: example of the code quality assurance

Level 2: example of a code choice justification: DFDT for NEMP, MoM for a narrow band IEMI ; thin slot model for faradization defects …

Level 3: example of minimal number of sensors for EM zone characterization, and best coupling incidence analysis with an inverse method, genetic algorithms for optimization…