FASTRAD

NEW TOOL FOR RADIATION PREDICTION

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1. Introduction

We present a 3D CAD software dedicated to total dose calculation for space applications : FASTRAD. This tool allows to modelize all types of systems : component, boards, equipment and satellite and to calculate received dose at any point of the system.

The Graphical User Interface (GUI) is designed to help space engineer in radiation analysis. Whether it is for a fast radiation criticity overview or for a complete and detailed radiation design analysis, FASTRAD joins together :

- A user-friendly interface for a shorter time spent on modeling.
- An efficient received dose calculation routine.
- A presentation of calculations (output files, graphical display mode) which can be directly included in a radiation report.

2. Modelization

The CAD module of FASTRAD has been developed for an industrial use. The user-friendly interface (windows application) has been realized in order to modelize any structure with simple actions. All models are structured in a hierarchy tree which is continuously visible in a window (see the picture below). This window allows to navigate in the different areas of the model very easily.

Predefined shapes can be introduced in the model using toolbar icons : box, slab, cylinder, sector of cylinder, cone, sphere. Translation and rotation can be applied at any level of the hierarchy level
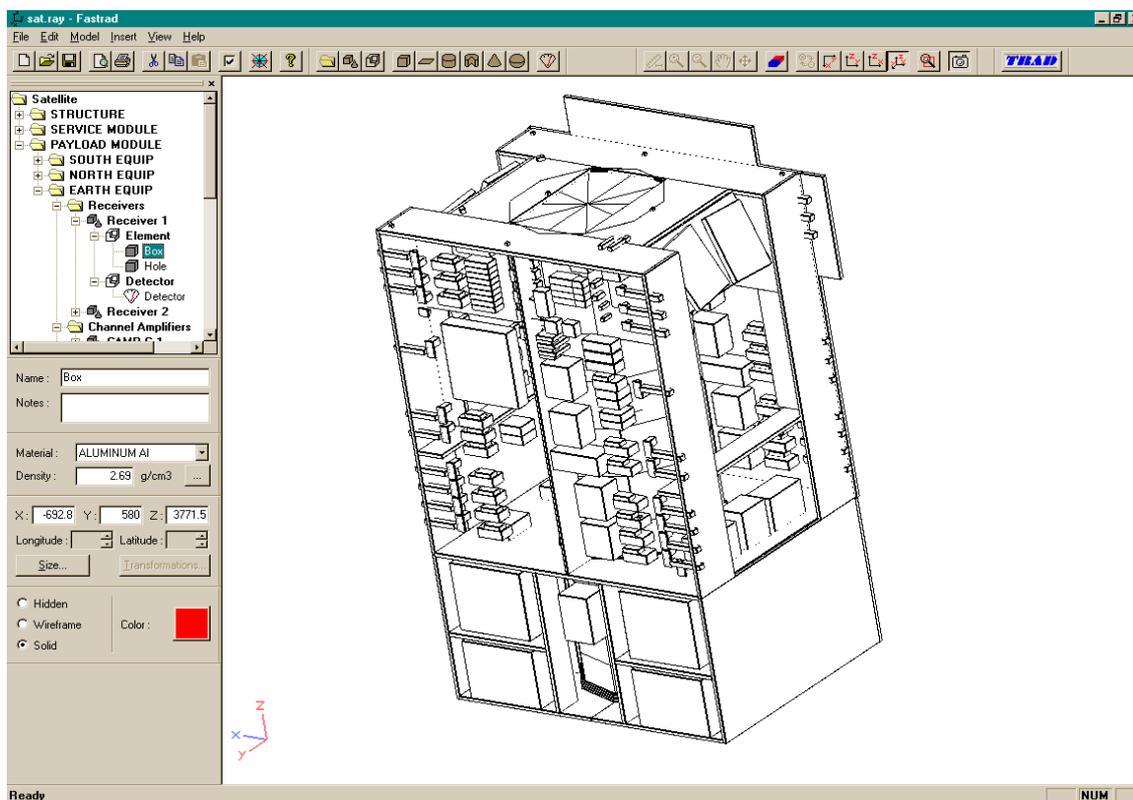

Fig. 1. Overview of FASTRAD interface in screenshot display mode.

On fig 1, the satellite model shows the complexity and the different system level that you can manage with FASTRAD. However note that this software is also well suited for fast analysis that industrial realized in order to quickly identify the radiation dose level.

The visualization has been developed using the OPENGL library. This allows a fully representative 3D view of the objects. Visible properties (Solid view, wireframe or hide case) can be assigned at each solid or group of solids in order to navigate in the 3D model. The handling of objects (translations) can be performed by simple mouse movement in orthogonal views or by direct coordinates settings (for better accuracy). For convenience, CAD tools have been added like the measuring tool which allow to measure the distance between two points of the model.

One of the other help to engineer provided by FASTRAD is the component data base which can be deliver by TRAD on request. This data base permits to decrease significantly the modeling time.

3. Sector analysis

Once the model is realized, FASTRAD can estimate the received dose at any point. Post processing have been introduced in FASTRAD to help radiation engineer

3.1. Ray tracing

The calculation method relies on first, a sector analysis and second, a dose curve that represents the space environment. The user can create a detector at any point of interest. During the sector analysis, the objects properties (material and thickness) encountered by each ray are stored. After the ray tracing step, those data are combined with the dose curve in order to calculate the received dose.

The accuracy of the ray tracing can be set by changing the number of launched rays in azimuthal and polar directions. A reporting file is created that contains the received dose for each selected detector.

A comparison of received doses with the ray tracing module of NOVICE reveals that the differences between calculated values are smaller than 1%.

3.2. Compatibility

The novice code uses a Monte Carlo method to perform particle transport (Tom Jordan, Experimental and Mathematical Physics Consultants, Gaithersburg, MD 20885). FASTRAD is now compatible with this

code. Indeed, you can read NOVICE model with FASTRAD and also generate NOVICE model.

FASTRAD can also be used as an interactive interface with NOVICE, it means that during a FASTRAD session, you can run directly a NOVICE calculation and you can also work the NOVICE result files by the FASTRAD post processing.

Compatibility with ESABASE using STEP format is under development.

3.3. Post processing

3.3.1. Six faces

One of the post processing available in FASTRAD is the six faces equivalent thickness module. This is usefull for industrials who represent the shielding caused by the spacecraft structure by a equivalent 6 faces box. A result window (fig2) shows the report of the calculation :

Results				
Detector N°1				
	calc	mean	min	max
Side + X :	8.32	23.59	5.19	102.76 mm [Al] (284 values)
Side - X :	4.24	10.15	3.28	29.18 mm [Al] (320 values)
Side + Y :	13.53	16.01	12.61	23.10 mm [Al] (302 values)
Side - Y :	3.98	4.58	2.50	8.21 mm [Al] (302 values)
Side + Z :	4.23	15.12	2.68	58.09 mm [Al] (296 values)
Side - Z :	6.15	13.89	4.16	118.31 mm [Al] (296 values)

Fig. 2 : Windows report for the six faces post processing.

3.3.2. Rays view

An other helpful tool is the sector file post processing. For each selected detector FASTRAD uses the sector file created during the ray tracing calculation in order to calculate the minimum and maximum crossed thickness in all directions. Once this information is available, the user can visualized the rays which cross thickness between the minimum and his value of interest (fig 3).

Then, the 3D representation reveals the "radiation weakness" of the structure. Shielding design becomes easier and the eventual mass of shielding can be optimized.
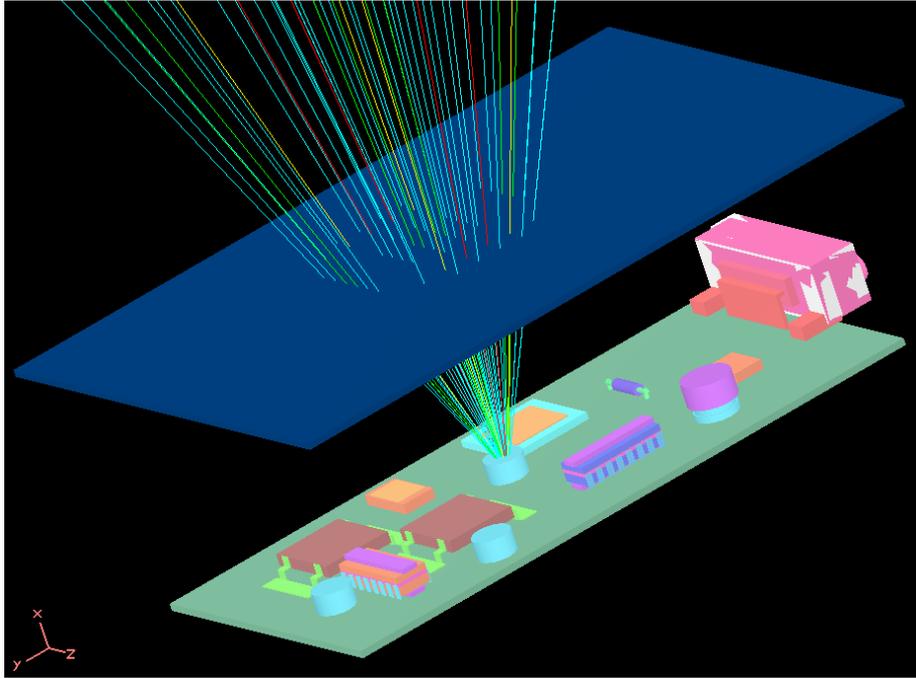
Fig. 3. Post processing of a ray tracing calculation.
The directions of critical rays are clearly identified.

4.   Distribution

FASTRAD is a TRAD software. It is only distributed
by TRAD company. To obtain details about the
purchase of this software, please contact us by e-mail :
trad@trad.fr (or http://www.trad.fr) .