RAL

DESIGN & DISCOVERY

Open Days July 1990

RUTHERFORD APPLETON LABORATORY

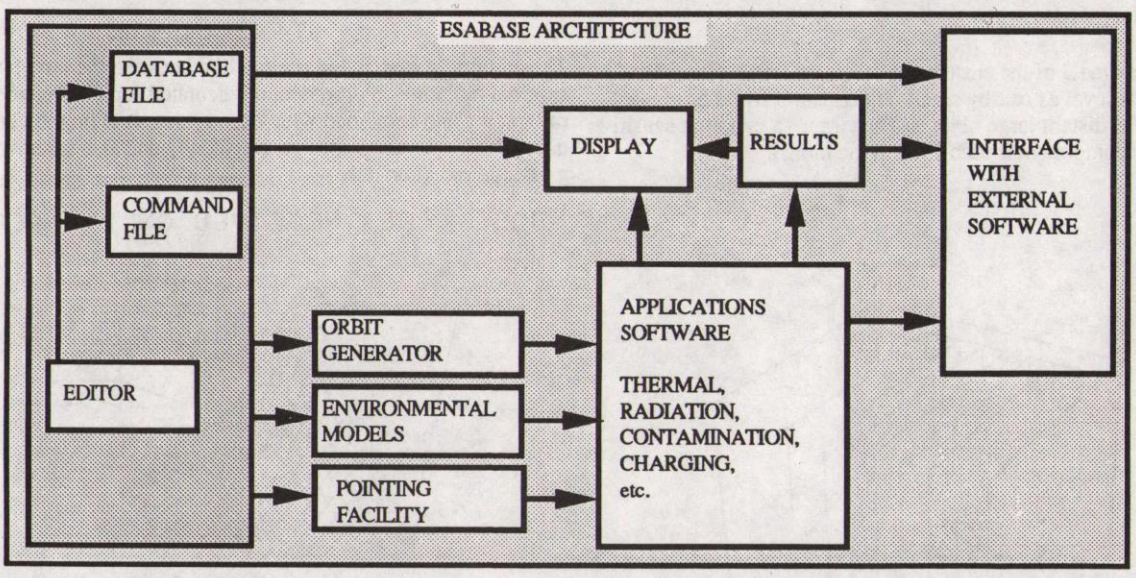
SCIENCE AND ENGINEERING RESEARCH COUNCIL

SPACECRAFT SYSTEMS ENGINEERING - ESABASE SOFTWARE PACKAGE

Instruments to be flown on spacecraft are designed to fulfil their functional requirements e.g. astronomy, remote sensing, communications but must also meet the following engineering requirements

- Mass and Power limitations
- Survive Launch vibration and depressurisation
- Continue to operate when subjected to wide temperature changes
- Withstand the radiation environment (protons and electrons)
- Maintain contamination sensitive surfaces in a clean condition
- Operate for many years

The proposed designs are assessed by generating computer models of the instrument and running appropriate analysis software to test the capability of the design to meet these requirements.
The computer models usually take the form of a geometric representation of the instrument. The individual software packages require a specific form of model to suit the type of analysis and a lot of time and effort is spent generating several models of the same instrument. The European Space Agency (ESA) has produced a software system (ESABASE) designed to overcome this problem. The basic concept is to enable the creation of a three dimensional model of the instrument in a central database and supply software which can generate data sets in a form compatible with the detailed analysis packages. These packages are accessed either as part of the ESABASE system or externally via datafile exchange. The model can be viewed using ESABASE three-dimensional display software.



The following types of analysis are currently possible using ESABASE software or commercial software designed to run on ESABASE.

- Thermal Analysis
- Radiation Analysis
- Contamination Analysis (outgassing)
- Spacecraft Charging
- Atomic Oxygen effects in orbit
- Orbit perturbation analysis
- Mass Analysis
- Attitude and Orbit Control Analysis
- Motor/Thruster Plume effects analysis
- Occultation analysis

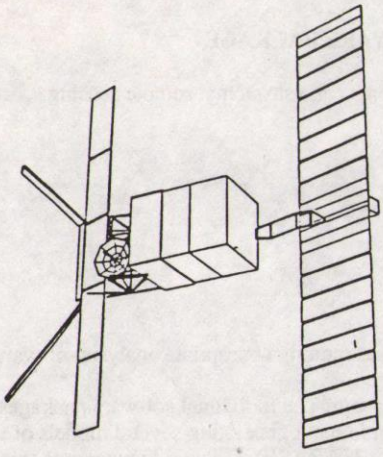
Datafiles can also be supplied to pre-processing packages for subsequent finite element structural analysis.

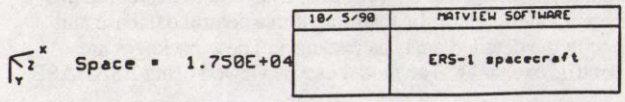
An example of ESABASE in use:

RADIATION SHIELDING ANALYSIS

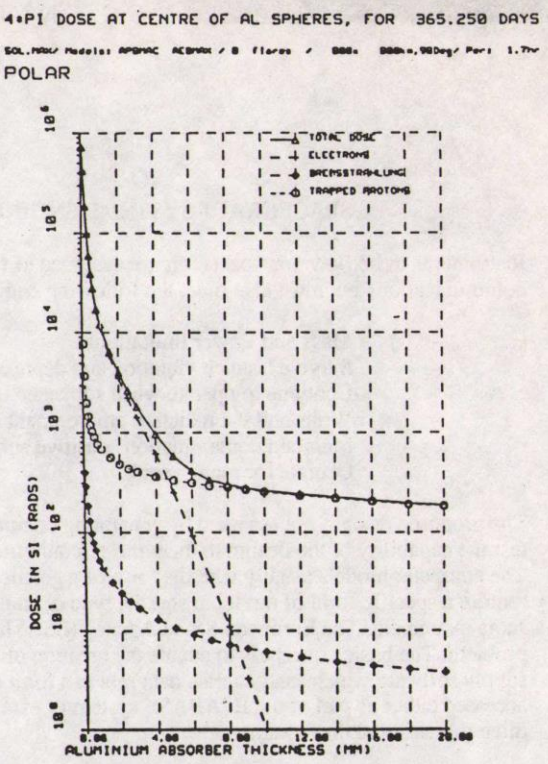
A method of predicting the amount of structural shielding required to protect sensitive components from the earth's radiation environment.

A solid model of the satellite is generated representing each sub-system as a simple shape.

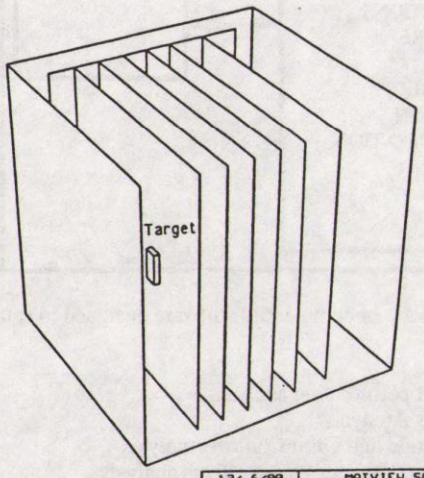


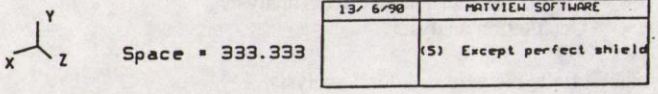


ESABASE contains a model of the earth's radiation environment - protons and electrons- which is used with a satellite orbit program to calculate the amount of radiation the satellite will experience. The radiation data is used in the form radiation dose as a function of shielding thickness.

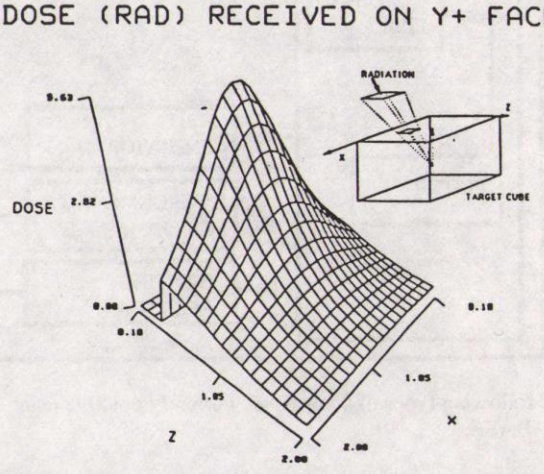


A detailed model of the electronics unit is created - more detail is used at this level as nearby small objects can provide as much shielding as distant large objects. The target - a radiation sensitive electronic component is identified in the model.





The amount of material in the satellite between the target and the external radiation environment is calculated for all directions by ray tracing and combined with 'dose versus shielding thickness' data. The results are presented graphically and also summed to give total radiation dose.



If the dose is unacceptable extra shielding can be modeled in a location indicated by the analysis and the dose calculation repeated.

FURTHER INFORMATION
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