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Brief 69-10574

# NASA TECH BRIEF



## Spacecraft Thermal Radiation Environment Computer Program

### The problem:

A method is needed to find the total thermal radiative flux on each set of exposed surface elements of a spacecraft in the vicinity of a celestial body.

### The solution:

The Spacecraft Thermal Radiation Environment Program is developed to compute the total thermal radiation flux on each of a set of exposed surface elements of a spacecraft in the vicinity of a celestial body.

### How it's done:

The incident flux consists of solar, both direct and planetary-reflected, and planetary-emitted infrared radiation as functions of time. The trajectory is an internally computed Keplerian motion of a point-mass spacecraft about a spherically symmetric planet. All possible Keplerian trajectories (i.e., circular, elliptic, parabolic, and hyperbolic) can be generated. Orientation of the spacecraft may also be inertially fixed, such as the Lunar Orbiter, or may be input in tabular form as an arbitrary function of time. The surface radiative properties (i.e., temperature, emittance, and absorptance) of a rotating planet can be either (1) invariant, or (2) arbitrary functions of colatitude, longitude and time.

The present form of the program allows for description of the spacecraft shape in terms of up to ten "primary" surfaces. These surfaces may be portions of planes, spheres, cylinders, or any quadratic form. Each primary surface may be subdivided into "nodal" areas. The external surface nodes may be defined in a manner compatible with the nodal network used for internal thermal analysis. Up to 200 surface nodes may be used. The surface nodes are further divided into elemental areas called viewpoints. The radiative properties of each node (i.e., area, absorptance, view factor, etc.) are assumed to be concentrated at the viewpoints on the node. No limitation is placed on the number of viewpoints used.

Environment heat inputs are individually determined by calculating the effect of the ambient radiation field on each viewpoint. Nodal heat loads are computed by summing the inputs from all viewpoints on the node. By use of a large number of elemental areas, partial or complete shadowing of surface nodes (by protruding surfaces such as solar panels) can be taken into account to any desired degree of detail.

### Notes:

1. This program is written in FORTRAN IV language for use on the IBM-360 computer.
2. Organizations, including those in nonaerospace work, will find use for this program in the areas of astronomical sciences and engineering concerned with heating, air conditioning, and controlled lighting systems where radiation loads are factors.
3. Inquiries concerning this innovation may be directed to:

   COSMIC
   Barrow Hall
   University of Georgia
   Athens, Georgia 30601
   Reference: B69-10574

### Patent status:

No patent action is contemplated by NASA.

Source: James H. Scates and Cecil J. Paoletti of
The Boeing Company
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