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## Calculation of the Inertia Tensor and Center of Gravity of Complex Bodies

### The problem:

To develop a utility program which would calculate the inertia tensor and center of gravity of a body from its component parts.

### The solution:

This program calculates the inertia tensor and center of gravity of any body (train, plane, automobile, etc.) from its component parts.

### How it's done:

For each component part of a body, the inertia tensor is calculated about its own principal axes. Then, for each part, a new inertia tensor is calculated with respect to the body's reference axes (rotation), and all parts are combined (translation) to calculate the center of gravity and inertia tensor of the body.

The output of the program is in two parts. The first is a listing of the local (component part) moments and products of inertia after rotation and the second is the body inertia tensor and center of gravity after translation. The program may be used for either type of calculation independently and separately, if desired.

The method used to calculate the new component-part inertia tensor after rotation is based on the relationship, $I = R\bar{I}R^T$, where $\bar{I}$ is the original inertia tensor of the component, R is the rotation matrix, and $R^T$ is R transposed. The calculations for I within the program are made in terms of the rotation matrix, which is itself calculated internal to the program.

The inertia tensors of the individual components are combined using translation techniques to produce the total body inertia tensor and the center of gravity location.

### Notes:

1. The program is written in FORTRAN II-D language for use on the IBM 1620 computer.
2. Inquiries concerning this innovation may be directed to:

   COSMIC
   Barrow Hall
   University of Georgia
   Athens, Georgia 30601
   Reference: B70-10158

### Patent status:

No patent action is contemplated by NASA.

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