Structural Data Checks With Computer Graphics

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Previous reporting described the use of Computer Graphics for generating and checking of the bulk input data required by the NASTRAN or IDEAS structural analysis programs. Modifications to the checking method are described in this reporting. A new version of the Object Inspection Program now resides in the Graphics 1557 Controller so that multiple sets of line directives that outline the elements of the structure may be inserted at one time. Then each group of elements, limited in numbers to ease the visual observation, may be checked individually or added to the other groups so that assemblies of these groups can be viewed in one display for checking. A sample sequence of the displays is described.

I. Introduction

A new version of the Object Inspection Program was coded to reside in the Graphics 1557 Controller or Minicomputer which controls the 1558 console with the cathode ray tube and a keyboard for inserting directions into the 1557 controller.

To improve the checking of structural elements used to model a complete structure in the NASTRAN or IDEAS structural analysis programs (Ref. 1), modifications were made in the Object Inspection Program so that multiple sets of elements consisting of individual elements or combinations of elements could be transmitted into the 1557 controller from the 1108 computer with a single transferring call.

This allowed inspection of one element at a time (useful for checking solid elements) by rotation of the object on display to allow a three dimensional check. The new capability for adding one element to another then allowed a buildup of the elements in order to check the assemblies of elements. Also, the 1108 computer costs were minimized with the decrease in the number of required accesses to the 1108 computer.

Smaller assemblies of bar-trusses could also be displayed one at a time and added to check their mated assembly.

II. Description

A set of line directives that describes a structural truss consisting of bars is shown in Fig. 1. This display has 57 line directives and 20 nodes or joints. Depressing key W brings up to display the second set of bars with the same number of line directives and nodes as shown in Fig. 2.

Figure 3 shows three sets together, Fig. 4 shows four sets, and Fig. 5 shows eight radial sets plus three sets comprizing the elevation bearing supporting truss.

Each unit may be inspected in turn by the rotation controlling keys on the 1558 console. The rotation motion seems to accent the 3-dimensional view of the structure. Depressing the S key produces two images in perspective geometry, which, by use of two lenses about three feet from the cathode ray tube, may be viewed as a three-dimensional object with true depth perception. It should be obvious that checking of a unit or set with fewer line directives as in Fig. 1 should be easier than the checking of a unit like Fig. 5 or even Fig. 4.

Figure 5 includes all of the sets. (11 sets, 180 nodes, 589 line directives with duplications at the joint planes of the sets) and the complete picture is based on a scaling factor which uses about 80% of the 30 × 30 cm of the cathode ray tube face. This scaling factor is not critical as shown by Fig. 6 where the scaling factor was multiplied by 2. At the borders of the frame, the Object Inspection program replaces all nodes outside of the frame by the intersection point of the line directives with the border line. This results in a true display up to the border of the frame with indications of the line directives outside of the border coincident with the border. As the display is rotated, the line directives appear to come out of the border with the correct geometry of the display as it rotates.

These figures are reproductions of the hard copies made by the Stromberg Carlson 4020/F80 camera using the plot stacking tape written by the 1108 main computer. The 1108 was directed to write on this tape by an 1108 software package actuated by keys on the 1558 display console when the desired display was stopped on the cathode ray tube.

Reference

1. Katow, M. S., and Cooper, B. M., "NASTRAN Data Generation and Management Using Interactive Graphics," NASTRAN: Users Experiences, NASA Tech. Memo TM x-2637, Sept. 1972, pp. 399–406. Also appears in *The Deep Space Network Progress Report*, Technical Report 32-1526, Vol. XI, pp. 104–107, Oct 15, 1972.

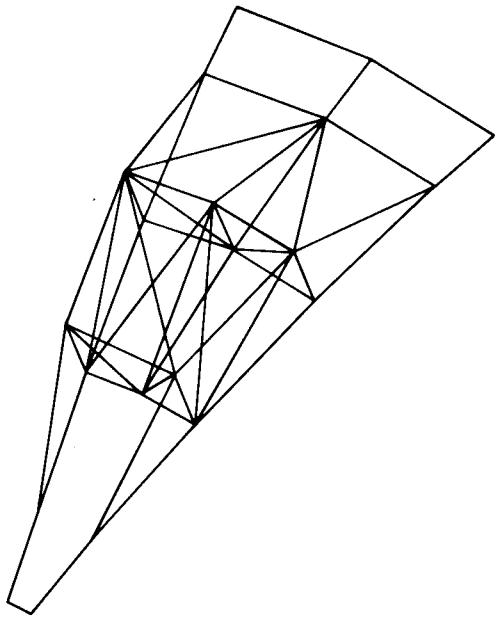

Fig. 1. First set of bars

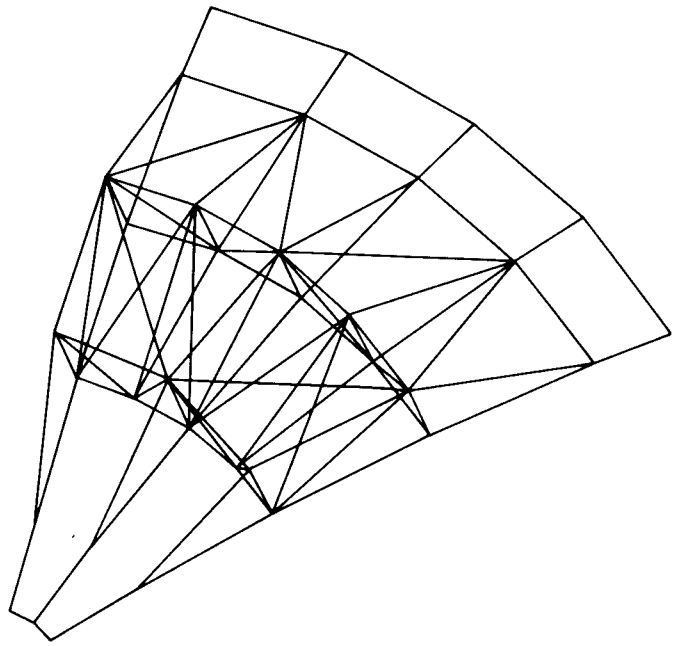

Fig. 2. 2 Combined sets of bars

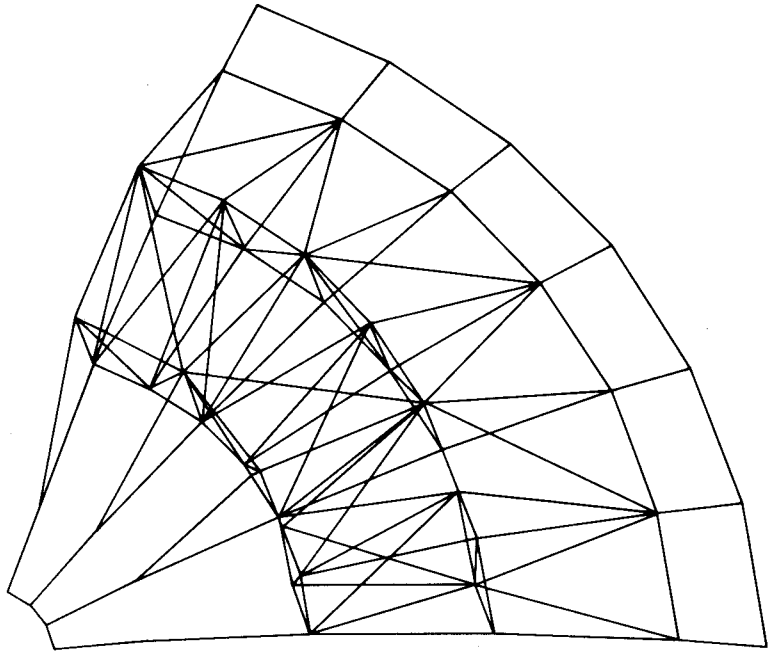

Fig. 3. 3 Combined sets of bars

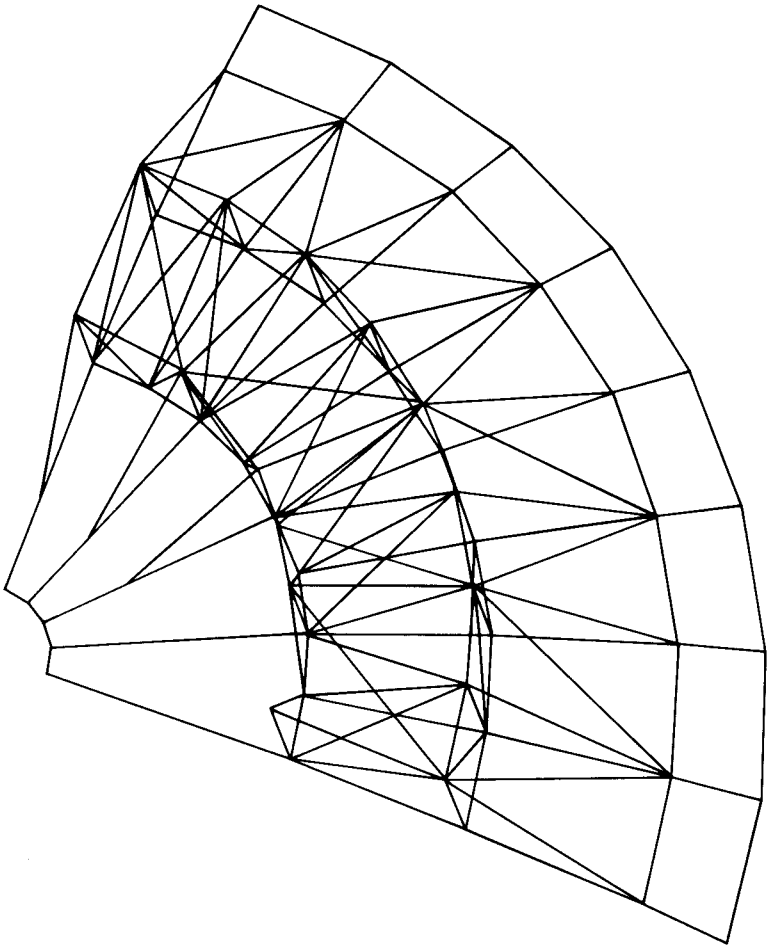

Fig. 4. 4 Combined sets of bars

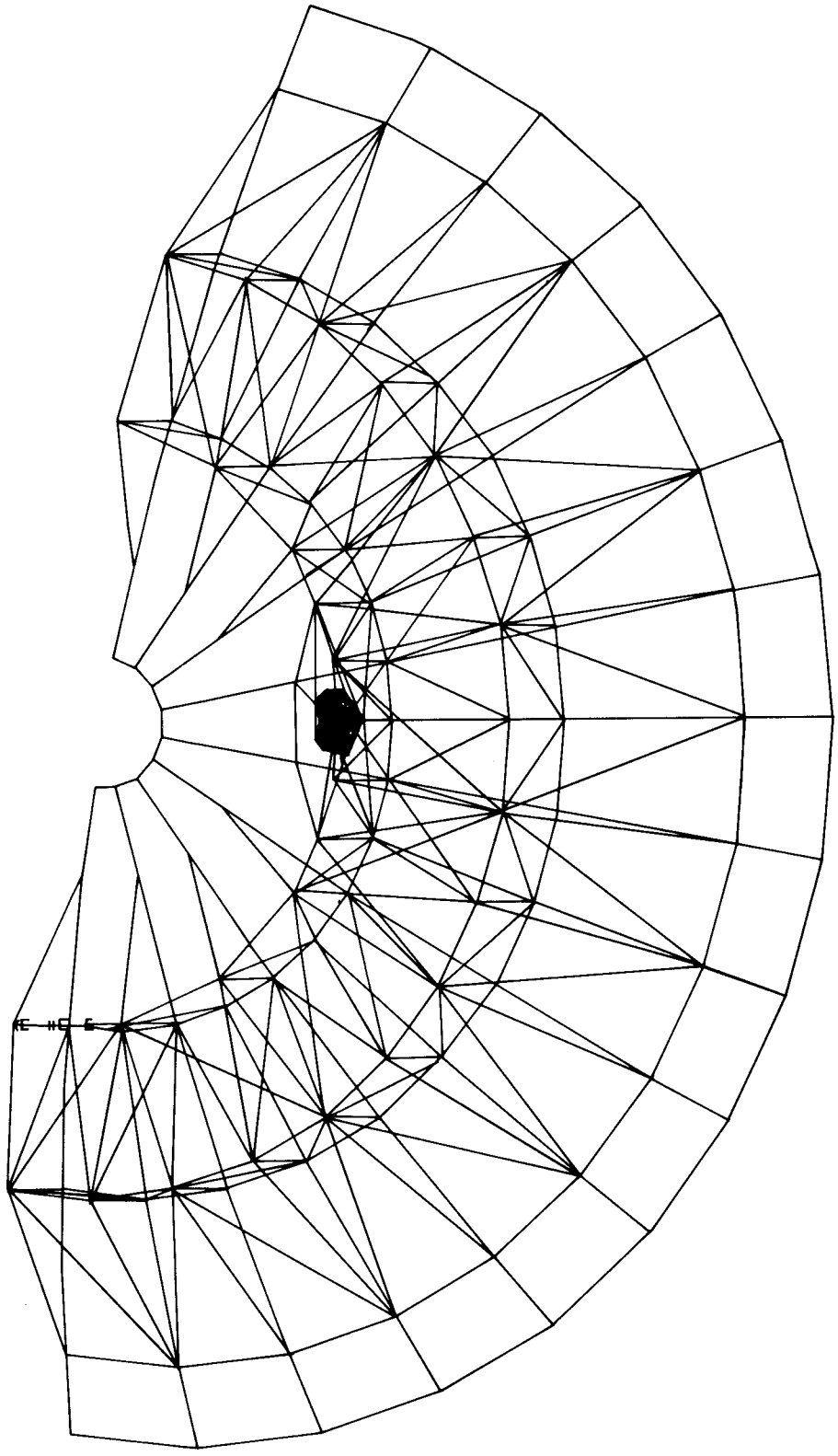

Fig. 5. 8 Combined sets of bars

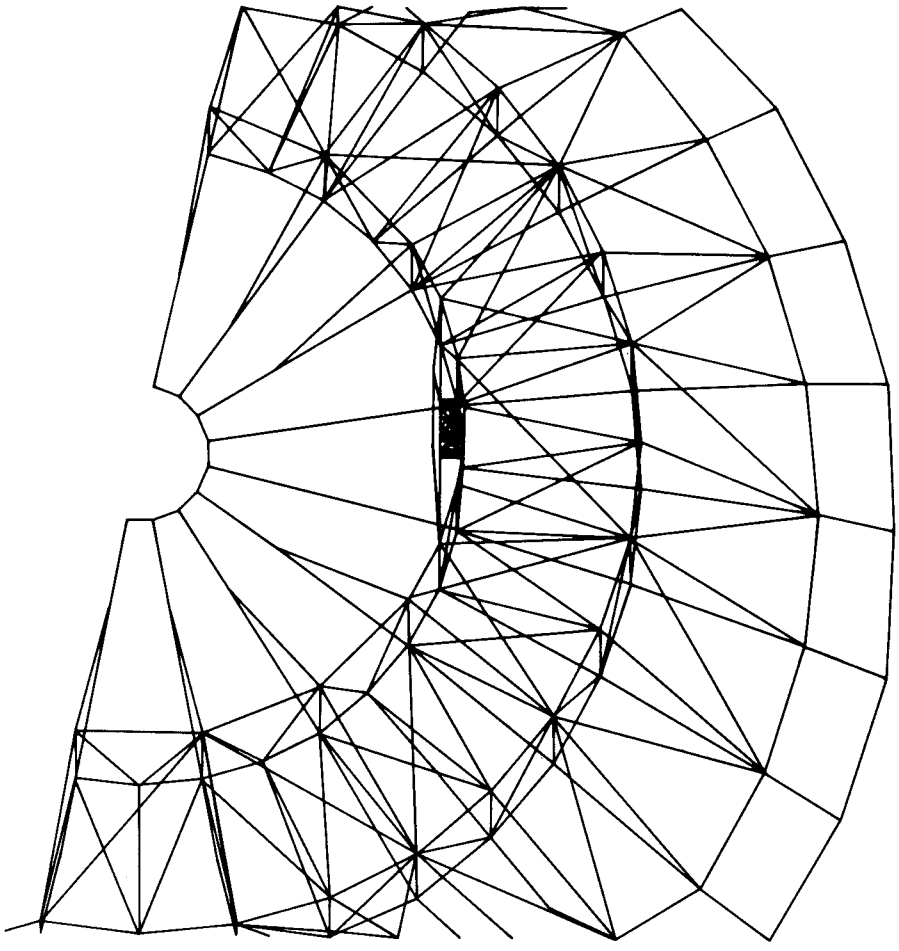

Fig. 6. Enlarged view