N74-14587

# FUTURE NSMO PLANS FOR MAINTENANCE OF NASTRAN

By Deene J. Weidman

NASA Langley Research Center

## INTRODUCTION

The objectives of the NASTRAN computer program system are to provide a general structural analysis capability for NASA centers and major NASA contractors and to allow effective use of NASA structural analysis capability in other agencies and industries throughout the nation. In addition, the importance of the Space Shuttle project to the nation's space program makes it imperative to provide timely improvements to NASTRAN to support analysis and design of the Shuttle vehicle. Shuttle improvements are expected to have general application.

Use of NASTRAN has increased steadily since the second NASTRAN Users' Colloquium September 11-12, 1972 (ref. 1). The total number of individual users is now estimated to be 2200, an increase of about 50 percent in the past year. NASTRAN is known to be installed at 240 computer sites in the United States and abroad as identified in the following list:

- 9 NASA centers
- 10 Department of Defense sites
- 18 Aerospace company users
- 22 Small aircraft company users
- 181 Nonaerospace users including -
  - 34 Computer company sites
  - 9 Automotive company sites
  - 17 Universities
  - 121 Other users

These estimates are based on the NSMO Newsletter mailing list and are, therefore, believed to be somewhat conservative.

## PLANNED DEVELOPMENTS

The overall development plan for NASTRAN is shown in figure 1. The four items on the left of figure 1 are ongoing developments this fiscal year. The

design and coding for Level 16 is nearly complete. Because substantial changes have been incorporated into Level 16, extensive debugging, checkout, and thorough exercising of this code are planned which will lead to general public release about the end of calendar year 1974. Automated substructuring, diagnostics and DMAP improvements, and other shuttle improvements are all funded by the Space Shuttle project and will not be introduced into the standard NASTRAN system until after release of Level 16. A subsonic flutter package has been developed for NASTRAN and is operational in-house. Plans call for its installation into the standard NASTRAN system also after the release of Level 16. A long-range study of the impact of fourth-generation computers on NASTRAN is being initiated in-house and may become a contract activity later.

Following fiscal year 1974, new capability development will be principally focused on fundamental improvements such as an improved graphics package, expansion of NASTRAN's nonlinear elastic and plasticity capabilities, and incorporation of some new finite elements. New capabilities will be introduced at less frequent intervals than in the past and release of future levels of NASTRAN will correspondingly occur at a reduced rate. Further into the future, it is envisioned that there may be a complete overhaul of NASTRAN (NASTRAN II(?)) to incorporate advanced finite-element technology, to allow for potential fourth-generation computer usage, and to take advantage of advanced techniques for program organization and data management. A steady incorporation of efficiency improvements and error correction is also necessary to keep a program system of the size and complexity as NASTRAN viable.

## CAPABILITY IMPROVEMENTS IN LEVEL 16 OVER LEVEL 15

NASTRAN Level 16 will contain three kinds of improvements compared with Level 15: (1) new capabilities developed by others and installed under contract by NSMO, (2) improvements to existing capabilities in response to aerospace industry requests, and (3) addition of some higher quality finite elements. The first kind of improvement includes a feature which can drastically reduce input, storage, and run times for structures which have cyclic geometric symmetries, a module which resizes once all elements in a structure using a specified allowable stress and a simple stress-ratio resizing algorithm, and complete heat-transfer capability including conduction, convection, and radiation. The second kind of improvement includes an improved differential stiffness capability allowing iteration, the ability to output shear-force information in terms of shear flows, the sorting of stress results from various load cases by element, and an automation of the partitioning vector generation required for substructuring. The third kind of improvement includes isoparametric solid finite elements, rigid elements, improved ring and plate elements, and two improved quadrilateral membrane elements.

## EFFICIENCY IMPROVEMENTS IN LEVEL 16 OVER LEVEL 15

A large amount of basic NASTRAN code will be redone in Level 16 to provide major improvements in efficiency - reduced run-time and storage requirements. Probably the most extensive change will be incorporation of a new technique for assembling stiffness and mass matrices. Improvements in symmetric matrix decomposition, the forward and backward substitution, and multiply-add matrices will be included, and the multipoint constraint and dynamic data recovery features will be improved. Single- and double-precision options will be included for IBM, CDC, and UNIVAC computers. Improvements in input/output routines will include string notation for data, nontransmit read, and random- and direct-access features. Detailed discussion of these future efficiency improvements is contained in reference 2.

## NEW ERROR CORRECTION PROCEDURE

An overview of the NASTRAN error correction procedure is shown in figure 2. In all cases of receipt of a user report, an action is taken, and a reply letter is sent to the user. For each user-reported inconsistency, NSMO determines into which of three categories the report falls. Those reports that do not appear to be user misunderstandings are assigned an SPR (Software Problem Report) number and priority and then delivered to the maintenance contractor for evaluation and correction. A substantial number of SPR's are not "errors" but in reality represent a need for improvement in the system.

The lower half of figure 2 shows the activities of the maintenance contractor for each SPR he receives. The maintenance contractor screens out any user errors and previously reported bugs (PRB). For valid SPR's, a run using the user-submitted deck is always performed and the contractor determines the cause of the error and the needed correction. At this point, figure 2 shows a proposed departure from current practice. An "ALTER" form would be generated by the maintenance contractor which specifies all code corrections needed to resolve each SPR along with information to aid in installing the corrections in users' decks. Responsibility for making the corrections would be the users! ALTER forms might be released at frequent intervals to the user community via the NASTRAN Newsletter. Evaluation of this and other avenues to quicker error correction response to users is currently underway; of course, error corrections will be incorporated in each new archive level as issued. The final maintenance contractor tasks for each SPR are a validation run of the corrected code on the user's problem and any required documentation updates. Then NSMO verifies the successful completion of the contractor's tasks for each SPR.

## CONCLUDING REMARKS

NASTRAN provides a general structural analysis capability for NASA, NASA contractors, and other agencies and industries. In particular it is expected to support structural analysis and design of the Space Shuttle vehicle. A steady growth in the general use of NASTRAN is evident with an estimated 50-percent increase in the number of individual users in the past year. Development plans call for less frequent addition of new capability and corresponding release of future levels at a reduced rate. Near term focus in NSMO will be to implement new error correction procedures to improve communication with users and speed up the error correction process.

## REFERENCES


1. Anon.: NASTRAN: Users' Experiences. NASA TM X-2637, 1972.

2. McCormick, Caleb W.: Review of NASTRAN Development Relative to Efficiency of Execution. NASTRAN: Users' Experiences, NASA TM X-2893, 1973, pp. 7-28. (Paper no. 2 of this compilation.)

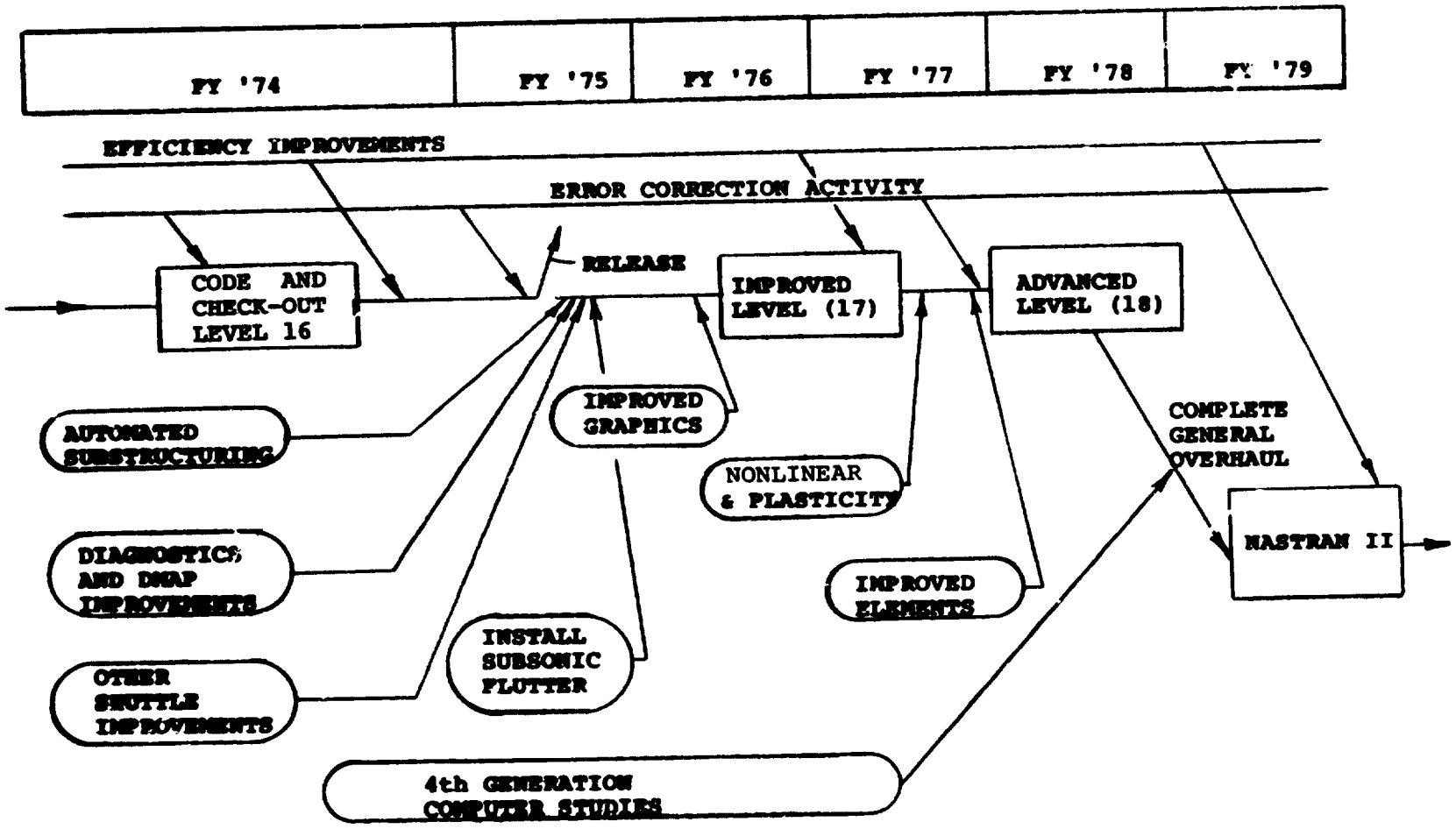


Figure 1.- Planned NASTRAN developments.

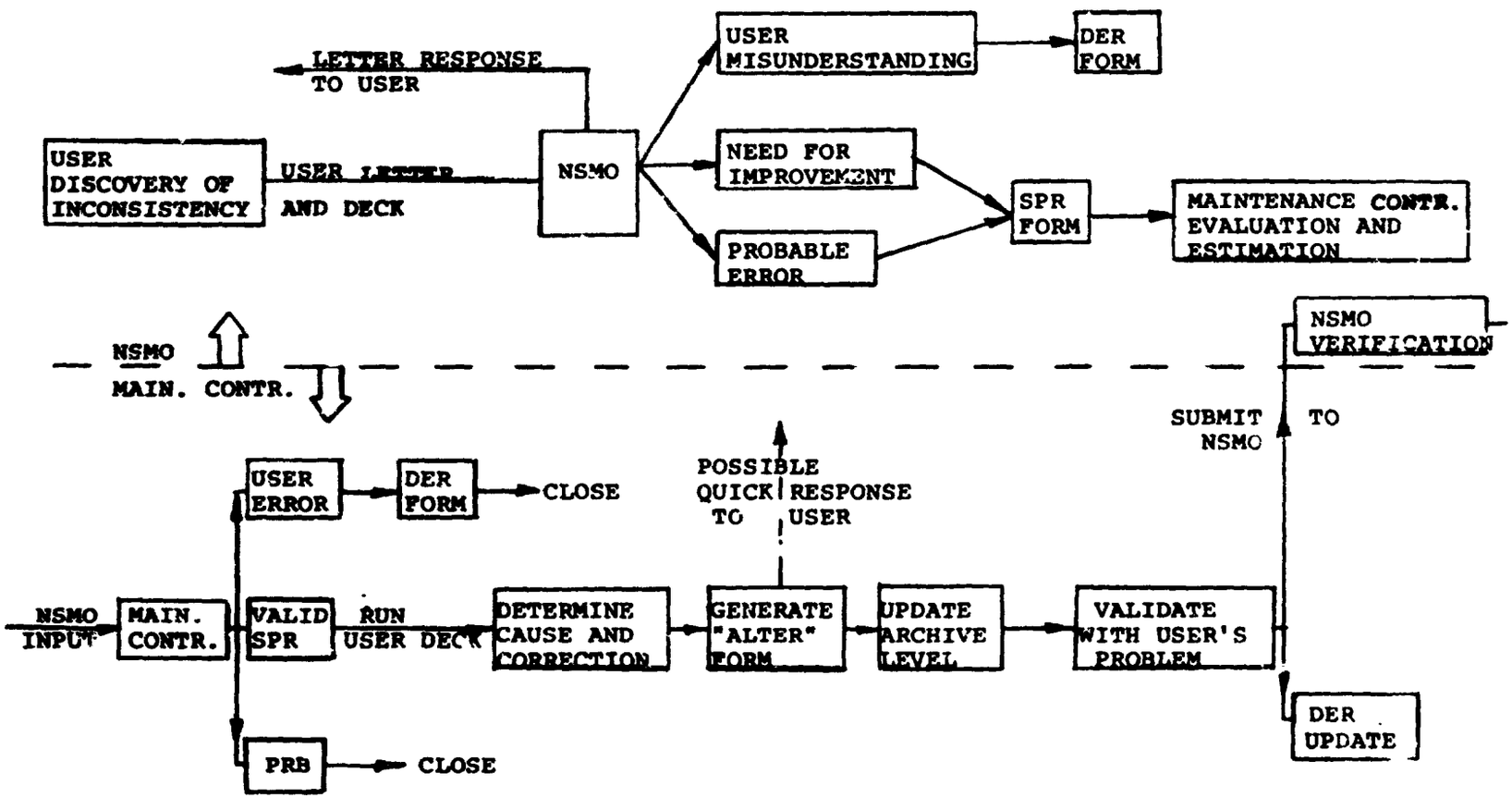


Figure 2.- NASTRAN error correction activity.