Computer Code Abstract

General-Geometry TWOTRAN

1. Name of Program: General-Geometry TWOTRAN.

2. Computer for Which Program is Designed: CDC-6600 with extended core storage. Extended core storage can be replaced by other peripheral storage with minor reprogramming.

3. Name of the Physical Problem Solved: Two-dimensional particle transport problems in X-Y, R-Z, and R-θ geometries are solved. Both direct and adjoint, homogeneous (k_{eff} or parametric eigenvalue searches) or inhomogeneous time-independent problems are solved subject to vacuum, reflective, white, periodic, or input specification of boundary flux conditions. Both anisotropic inhomogeneous problems and general anisotropic scattering problems are treated. Arbitrary numbers of groups of up- or downscattering are allowed.

4. Method of Solution: Energy dependence is treated by the multigroup approximation and the angular dependence by a discrete ordinates approximation. Space dependence is approximated by the diamond difference scheme with a set-to-zero negative flux control. Anisotropic scattering and anisotropic inhomogeneous sources are represented by finite spherical harmonics expansions. Within-group iterations, upscattering iterations, k_{eff} iterations, and eigenvalue search iterations are accelerated by a coarse-mesh particle rebalancing algorithm.[1]

5. Restrictions on the Complexity of the Problem: The variable dimensioning capability of FORTRAN-IV is used so that any combination of problem parameters leading to a blank common vector length less than LENXCA can be used. For a 65K machine LENXCA can be greater than 34 000, depending on local system requirements. With a few exceptions, only within-group problem data are stored in fast memory; data for all other groups are stored in auxiliary bulk memory such as extended core storage.

6. Typical Running Times (CDC-6600):

   a. (X, Y), seven-group, linear anisotropic, upscattering 40×40, S_4, k_{eff} calculation 64.73 min

   b. (R, θ), nine-group, linear anisotropic, upscattering 42×10, S_4, k_{eff} calculation 12.83 min

   c. (R, Z), ten-group, P_2 scattering, 21×20, S_8, source problem 21.34 min.

7. Unusual Features of the Program: Coarse-mesh convergence acceleration; coarse-mesh spatial and angular organization to permit larger problems; general anisotropic scattering and inhomogeneous source option; input specification of top, bottom, or right boundary fluxes; built-in discrete-ordinates constants (S_2, S_4, ..., S_{16}); diamond difference scheme with negative flux fixup; detailed edit provisions; pointwise cross-section density variation option; overlay program organization; and general dump and restart options.

8. Related Programs: TWOTRAN (x, y).[2,3] Program replaces the 2DF program.[4]

9. Status: In use.

10. Machine Requirements: Five output units (disks, drums, or tapes) in addition to three system input/output units; a CDC extended core storage unit or a large bulk memory. (Disks, drums, or tapes can be substituted for this requirement.)

11. Programming Language: FORTRAN-IV is used with a small amount of mixed integer floating arithmetic, generalized subscripting, encode statements, and minor use of 10H Hollerith formats.

12. Operating System or Monitor Under Which Program is Executed: CDC-6600 Scope 3.1 (locally modified).

13. Other Programming or Operation Information or Restrictions: The program uses a local cross-section library (subroutine LAXS), an algorithm to reduce core size (subroutine REDUCE), a special decimal dump for CDC mode errors, and special plotting routimes for contour and projective flux displays. These features may be removed simply.

14. Material Available: The following material is available from the Argonne Code Center and the Oak Ridge Shielding Information Center: FORTRAN deck, test problems, and test problem results.

15. *Acknowledgment*: This work was performed under the auspices of the U.S. Atomic Energy Commission.

16. *References:*

[1]K. D. LATHROP and F. W. BRINKLEY, "Theory and Use of the General Geometry TWOTRAN Program," LA-4432, Los Alamos Scientific Laboratory (1970).

[2]K. D. LATHROP, "User's Guide for the TWOTRAN (x,y) Program," LA-4058, Los Alamos Scientific Laboratory (1969).

[3]K. D. LATHROP, "TWOTRAN, a Fortran Program for Two Dimensional Transport," GA-8747, Gulf General Atomic (1968).

[4]M. SHAPIRO, "2DF," Reactor Code Abstract 173, ANL-7411, Argonne National Laboratory (1968).

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