Computer Code Abstract

TWOTRAN PNVW

1. Name of Program: TWOTRAN PNVW [PNVW = Spherical Harmonics (PN), Variable-Weighted (VW)]
2. Computer for Which Program Is Designed and Others upon Which It Is Operable: CDC 7600, CDC 6600.
3. Nature of Physical Problem Solved: TWOTRAN PNVW (Ref. 1) solves two-dimensional particle transport problems for x-y, r-z, and r-θ geometries. Both direct and adjoint, homogeneous (k_{eff} or parametric eigenvalue searches) or inhomogeneous, time-independent problems are solved subject to vacuum, reflective, periodic, or input specification of boundary flux conditions. Both anisotropic inhomogeneous problems and general anisotropic scattering problems are treated.
4. Method of Solution: The code is designed to solve discrete ordinates equations that have been converted to equations like spherical harmonics equations to eliminate ray effects. The conversion is accomplished by using a specially constructed source. Construction of the special source is optional so that normal discrete ordinates equation solutions are also possible. Space dependence is approximated using a variable-weighted diamond difference scheme for calculating spatial derivatives. Energy dependence is treated by the multigroup approximation. Anisotropic scattering and anisotropic inhomogeneous sources are represented by finite spherical harmonics expansions. Within group iterations, k_{eff} iterations and eigenvalue search iterations are accelerated by a coarse-mesh particle rebalancing algorithm.
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 common vector length less than MAXLEN can be used. MAXLEN is slightly greater than 40 000 words for the CDC 7600. With a few exceptions, only within-group problem data are stored in fast memory. Data for all other groups are stored in auxiliary storage. Arbitrary numbers of groups of up- or downscattering are allowed.
6. Typical Machine Time: A one-group, S_8 converted to P_5, isotropic problem with a mesh size of 20 × 20 ran in 0.2 min on the CDC 7600.
7. Unusual Features of the Program: Unusual features include optional spherical harmonic or discrete ordinate solution, 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}), and FIDO cross-section input option.
8. Related Programs: General-Geometry TWOTRAN (Ref. 2).
9. Status: In use.
10. Machine Requirements: Five output units (disk, drums, or tapes) in addition to two system input/output units are required. A CDC extended core storage unit or a large bulk memory is also required. (Disk, 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 and generalized subscripting. Minor use is made of 10-H Hollerith formats, decode and encode statements. Double precision is used to calculate (but not to store) orthonormal polynomials.
12. Operating System or Monitor under Which Program Is Executed: CROS (Ref. 3) (Los Alamos operating system for CDC 7600).
13. Other Programming or Operating Information or Restrictions: None.
14. Material Available: Manual, FORTRAN deck, test problems, and test problem results are available from the Argonne Code Center.
15. Acknowledgement: This work was performed under the auspices of the U.S. Atomic Energy Commission.
16. *References*:

[1]K. D. LATHROP, F. W. BRINKLEY, and P. ROOD, "Theory and Use of the Spherical Harmonics, First Collision Source, and Variable Weight Versions of the TWOTRAN Program," LA-4600, Los Alamos Scientific Laboratory (1972).

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

[3]RAY DAVENPORT, Ed., *Elementary Guide to the Control Data 7600,* Programmer's Information Manual, Vol. 5A, University of California, Los Alamos Scientific Laboratory (1972).

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