Computer Code Abstracts

TWOTRAN (x, y)

1. Name of Program: TWOTRAN (x, y)

2. Computer for Which Program is Designed and Programming Language: Written for the Univac-1108 and CDC-6600 in Fortran-IV. No machine language is used.

3. Nature of the Physical Problem Solved: Two dimensional particle transport problems in x-y geometry. Both direct and adjoint, homogeneous (k_{eff} or parametric eigenvalue searches) or inhomogeneous time-independent problems are solved subject to vacuum, reflective, 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 down scattering 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 a positive, weighted, diamond difference scheme[1] or (at the users' option) by the somewhat more accurate (but not positive) equal weight diamond difference scheme.[1] 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,[2] and, at the option of the user, within-group iterations including implicit boundary conditions are accelerated by an automatic Chebychev acceleration.[2]

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 MAX can be used. For 65 536 word machines MAX can be greater than 30 000 words, depending on local system requirements. With a few exceptions, only within-group problem data are stored in fast memory and data for all other groups are stored in auxiliary storage. Estimates of fast storage requirements are made in Ref. 1.

6. Typical Running Times (CDC-6600): Seven-group, linear anisotropic, upscattering, 40×40 S_4 k_{eff} calculation - 57.23 min. One-group, isotropic scattering, 32×32 S_{12} inhomogeneous source calculation - 0.54 min (pure absorber), 1.81 min (c = 0.99). Two-group, linear anisotropic, 10×10 S_6 critical dimension calculation, both x and y dimensions modified - 1.26 min.

7. Unusual Features of the Program: Coarse-mesh and Chebychev convergence accelerations, coarse-mesh spatial and angular organization to permit larger problems, general anisotropic scattering and inhomogeneous source option, input specification of top or right boundary fluxes, built-in discrete ordinates constants (S_2, S_4, . . . , S_{16}), and positive spatial difference scheme.

8. Related Programs: Program replaces the (x,y) geometry option of the 2DF program.[3]

9. Status: In use.

10. Machine Requirements: Four output units (disks, drums, or tapes) in addition to input and output units. A version is available for the CDC-6600 which uses Extended Core Storage instead of these four units and also allows bigger problems by eliminating much of the fast memory requirement.

11. Programming Language: Fortran-IV is used with a small amount of mixed integer-floating arithmetic and generalized subscripting.

12. Operating System or Monitor Under Which Program is Executed: Univac-1108 Gulf General Atomic System or CDC-6600 Scope 3.1 (locally modified).

13. Other Programming of Operating Information or Restrictions: None.

14. Material Available (from the Argonne Code Center and the Oak Ridge Shielding Information Center): Fortran Deck, Test Problems, and Test Problem results. The CDC ECS version is available upon direct request to the author.

15. *Acknowledgment*:
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16. *References*:
[1]K. D. LATHROP, "User's Guide for the TWOTRAN (x, y) Program," Los Alamos Scientific Laboratory report LA-4058 (1969).
[2]K. D. LATHROP, "TWOTRAN, a Fortran Program for Two Dimensional Transport," GA-8747, Gulf General Atomic (1968).
[3]M. SHAPIRO, "2DF," Reactor Code Abstract 173, ANL-7411, Argonne National Laboratory (1968).

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