Computer Code Abstracts

TWOTRAN–II

1. Name of Program: TWOTRAN-II, an interfaced, exportable version of the TWOTRAN code[1] for two-dimensional transport.

2. Computer for Which Program is Designed and Others on Which It Is Operable: CDC 7600, CDC 6600, IBM 360/195.

3. Nature of Physical Problem Solved: TWOTRAN-II (Ref. 2) solves the two-dimensional multigroup transport equation in (x,y), (r,θ), and (r,z) geometries. Both regular and adjoint, inhomogeneous and homogeneous (k_{eff} and eigenvalue searches) problems subject to vacuum, reflective, periodic, white, or input specified boundary flux conditions are solved. General anisotropic scattering is allowed and anisotropic inhomogeneous sources are permitted.

4. Method of Solution: The discrete ordinates approximation for the angular variable is used in finite difference form which is solved with the central (diamond) difference approximation. Negative fluxes are eliminated by a local set-to-zero and correct algorithm. Standard inner (within-group) and outer iterative cycles are accelerated by coarse-mesh rebalancing on a coarse mesh which may be independent of the material mesh.

5. Restrictions on the Complexity of the Problem: Variable dimensioning is used so that any combination of problem parameters leading to a container array less than MAXLEN can be accommodated. On the CDC machines, MAXLEN can be slightly greater than 40 000 words and peripheral storage is used for most group-dependent data. On IBM machines, TWOTRAN-II will execute in the four-byte mode so that MAXLEN can be several hundred thousand (depending on local machine memory size) and most problems can be core contained. Detailed memory requirements are given in Ref. 2.

6. Typical Machine Time: A six-group, S_4, 42×42 mesh point, k_{eff} calculation of an EBR-II model requires about 3.9 min of CDC 7600 time. The same problem required slightly less time on the IBM 360/195.

7. Unusual Features of the Program: Provision is made for creation of standard interface output files for S_n constants, angle-integrated fluxes, and angular fluxes. Standard interface input files for sources, fluxes, cross sections, and S_n constants may be read. All binary operations are localized in subroutines called REED and RITE. Detailed edit options, including angular fluxes, dumps, and restart capability are provided. Optional use of an arbitrary rebalance mesh independent of the material mesh is allowed.

8. Related Programs: TWOTRAN-II is an improved version of the TWOTRAN program.[1] Users now having the general-geometry TWOTRAN program should consider the advantages of switching to TWOTRAN-II before expending the effort. Consultation with the authors is encouraged. Many comment cards were added and much simplifying programming was performed to make TWOTRAN-II as easy to understand as possible.

9. Status: In use.

10. Machine Requirements: Five output units, five interface units (use of interface units is optional), and two system input/output units are required. A large bulk memory is desirable, but it can be replaced by disk, drum, or tape storage.

11. Programming Language: FORTRAN IV. A major effort was made to remove nonstandard and installation-dependent usages.

12. Material Available: Source deck, test problems, results of executed test problems, and manual are available from the Argonne Code Center and the Oak Ridge Radiation Shielding Information Center.

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

14. *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 and F. W. BRINKLEY, "TWOTRAN-II: An Interfaced, Exportable Version of the TWOTRAN Code for Two-Dimensional Transport," LA-4848, Los Alamos Scientific Laboratory (1973).

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TRIPLET

1. Name of Code: TRIPLET: a two-dimensional, multigroup, *TRI*angular mesh, *PL*anar geometry, *E*xplicit *T*ransport code.[1]

2. Computer for Which Program is Designed and Others on Which It Is Operable: CDC 7600, CDC 6600, IBM 360/195.

3. Nature of Physical Problem Solved: TRIPLET solves the two-dimensional multigroup transport equation in planar geometries using a regular triangular mesh. The triangles are constrained to lie on bands but may be of arbitrary shape. Regular and adjoint, inhomogeneous and homogeneous (k_{eff} and eigenvalue searches) problems subject to vacuum, reflective, or source boundary conditions are solved. A special boundary condition for hexagonal cell calculations is included. General anisotropic scattering is allowed and anisotropic distributed sources are permitted.

4. Method of Solution: The discrete ordinates approximation is used for the angular variables. A finite element method in which the angular flux is assumed to be given by a low-order polynomial in each triangle is used to solve the discrete ordinates equations. Angular fluxes are allowed to be discontinuous across triangle boundaries, and the order of the polynomial is input data to the code. Both inner (within-group) and outer iteration cycles are accelerated by either system or fine-mesh rebalance.

5. Restrictions on the Complexity of the Problem: Variable dimensioning is used so that any combination of problem parameters leading to a container array less than MAXLEN can be accommodated. On CDC machines, MAXLEN can be about 40 000 words and peripheral storage is used for most group-dependent data. On IBM machines, TRIPLET will execute in single precision (four bytes per word) so that MAXLEN can be several hundred thousand (depending on local machine memory size) and most problems can be core contained. Detailed memory requirements are given in Ref. 1.

6. Typical Machine Time: A six-group, S_2, 1700-triangle, k_{eff} calculation of an EBR-II core requires ~4.4 min of CDC 7600 time. The same problem required slightly less time on the IBM 360/195. Running times vary almost linearly with the total number of unknowns.

7. Unusual Features of the Program: TRIPLET allows nonrectangular system boundaries and differing numbers of triangles on each band, so that mesh cells can be concentrated in regions of interest. A completely arbitrary number and orientation of discrete ordinate directions is allowed. A convenient dump and restart capability is provided. Very flexible edit options include zone edits, which give balance tables and microscopic, macroscopic, and constituent activities, and point edits, which give information about detailed flux shapes across each mesh cell. Sources, fluxes, S_n constants, and cross sections may be input from standard interface files. Creation of standard interface output files for S_n constants and scalar and angular fluxes is optional. All binary data transfers are localized in subroutines called REED and RITE.

8. Related Programs: TRIPLET is based in large part on the two-dimensional orthogonal mesh code TWOTRAN-II (Ref. 2), an improved version of the TWOTRAN program.

9. Computer Hardware Requirements: Six output (scratch) units, five interface units (use of interface units is optional), and two system input/output units are required. A large bulk memory is necessary if core storage is inadequate, as on the CDC machines.

10. Computer Software Requirements: The code runs under SCOPE 3.2 System for the CDC 6600 version, the Los Alamos Scientific Laboratory Chili Ridge Operating System (CROS) for the CDC 7600, and the IBM OS 360 (MVT) for the IBM 360 version.

11. Material Available: The code package, available from the Code Center at Argonne National Laboratory contains the following material:
    1. the reference document[1]
    2. a reel of magnetic tape with the following files: (a) a card-image copy of the BCD source deck, and (b) a card-image copy of the BCD test problems deck
    3. results of the executed test problems.

12. *References:*

[1]W. H. REED, T. R. HILL, F. W. BRINKLEY, and K. D. LATHROP, "TRIPLET: A Two-Dimensional, Multigroup, Triangular Mesh, Planar Geometry, Explicit Transport Code," LA-5428-MS, Los Alamos Scientific Laboratory (1973).

[2]K. D. LATHROP and F. W. BRINKLEY, "TWOTRAN-II: An Interfaced, Exportable Version of the TWOTRAN Code for Two-Dimensional Transport," LA-4848-MS, Los Alamos Scientific Laboratory (1973).

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