Computer Code Abstract

BALTORO

A General Purpose Code for Coupling of Monte Carlo and Discrete Ordinates Radiation Transport Calculations

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1. Program Identification: BALTORO is a general purpose code for coupling Monte Carlo and discrete ordinates radiation transport calculations.

2. Function: The objective is to use the external coupling of neutron and gamma radiation transport data obtained from the three-dimensional MORSE Monte Carlo code[1] and the one-dimensional discrete ordinates ANISN code[2] to find the numerical solutions to problems involving (a) the quantity of a radiation-induced nuclear effect occurring in a neutron field in an infinite homogeneous medium perturbed by a complex object containing a radiation source and (b) the score from a radiation yielding nuclear effect occurring in a neutron field in an infinite homogeneous medium perturbed by a complex object containing a radiation detector. It is possible to create data bases for unperturbed media and for source or detector tools (probes) that could be repeatedly coupled by the user by selecting them in various combinations and by specifying responses of those effects considered and of other items of interest. This code is fully described in Ref. 3.

3. Method of Solution: The approach of Hoffman et al.[4] has been applied and extended here. The unperturbed (UN) approximation, the adjoint difference (AD) approximation (volume coupling), and the surface integral (SI) approximation (boundary coupling) are calculated for problems of type (a) or (b). The multigroup approximation for the energy dependence and the $P_L S_N$ approximation for the angular dependence[5] are applied. The Green's function data obtained from the multiple case output multifile of ANISN (Ref. 2) are retrieved from the Legendre moments of angular fluxes and linearly interpolated between the radial mesh points, including the density scaling. The source, collision, and escape event data from the MORSE (Ref. 1) random walk for the perturbed region are retrieved from the collision tape. Both the forward MORSE and adjoint ANISN calculations for type (a) problems or the adjoint MORSE and forward ANISN calculations for type (b) problems can be performed separately. The generalized scoring routine has been written for BALTORO, and the SAMBO package[6] routines are called upon for analyses of the results, including statistical estimates of the variances between batches.

4. Associated Codes and Data Files: The multigroup data library (e.g., DLC-23 or DLC-31) and the MORSE and ANISN codes[1,2] are needed to create data files (the collision tape, the Green's function multifile, and the cross-section tapes) used by BALTORO. They have been incorporated into our code system. These codes could be replaced by others, providing the appropriate data management.

5. Restrictions: Large data blocks are loaded into COMMON using the flexible dimensioning technique, so the core size, depending on the problem, is limited only by the computer available. The ECS, LCM, or direct access equipment is required for extensive data management.

6. Limitations: A matrix medium should be the infinite homogeneous medium. The probe geometry and the source or detector energy spectrum must be modeled by the Monte Carlo package. A user-chosen isotropic effect that is not affecting the transport process can be considered with no time dependence at points not too close to the perturbed region. In practice the assumed[3] interface boundary conditions are reached only approximately.

7. Computer: CDC 6600, CYBER-72 model.

8. Running Time: Several to a few hundreds of central processor seconds can be required when using the CDC 6600 with direct access mass storage, depending on the number of groups and space mesh points, orders of approximation, number of histories analyzed, and number of points and energetic responses given by a user. This is the execution time for processing a history close to one from the Monte Carlo run with no deep penetration. A significant increase in the time efficiency can be expected with the use of the ECS or LCM equipment, since transferring the data is the most time-consuming operation in the code.

9. Programming Language: FORTRAN.

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10. Operating System: The CYBER version of BALTORO operates under the SCOPE 3.4 system with the FTN compiler. The SEGLOAD version of the LOADER and the UPDATE, EDITLIB, REPEAT, and EDITOR system programs have been useful, but they are not necessary.

11. Machine Requirements: The CDC computer with the large core device or at least with the direct-addressable disks is required.

12. Computer Software Requirements: The CERNCOMPUTER Library routine MEMORY for dynamic reservation of the COMMON field and the system-library mass storage INPUT/OUTPUT routines (OPENMS, WRITMS, READMS, and CLOSMS) for a record-addressable file have been used and they may be easily replaced in a different system.

13. Material Available: The source code for BALTORO and routines preparing the interface data in the MORSE and ANISN codes are available from the author on magnetic tape, as are the operating-system cards and INPUT/OUTPUT for two test problems, types (a) and (b). The code description[3] is included.

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15. *References:*

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