Computer Code Abstracts

MARC

1. Names of Programs: MARC-2, MARC-3
2. Computer for Which Programs are Designed: Philco-2000
   Programming System: TAC (for use with BKS System).
3. Nature of Problem Solved: Monte Carlo estimation of a regionwise distribution of neutron-absorption probabilities, thermal flux integrals, and fission rates and spectral information in subregions of a two-dimensional quarter-cell, based on a multi-thermal group model. MARC is designed to estimate these thermal absorption rates by solving either the ordinary multigroup transport equation or the adjoint multigroup equation.
4. Method of Solution: The Monte Carlo estimates are obtained by combining a random variable based on the average distance traveled by the neutrons in each group and region with an estimate based on the final distribution of absorptions. This technique is like that introduced in the KAPL program TRAM. The solution of the adjoint equation is based on an extension to non-self-adjoint problems of a technique due to C. W. Maynard which has previously been applied to the BAPL program TRAC-1. This technique makes it possible to reduce significantly the variance in estimating the absorption probability in a single region or group of regions, as well as to estimate the scalar flux at a single point of the quarter-cell by starting all of the neutron histories at this point. In addition, a transformation of the adjoint mode equations is used to reduce the variance in the adjoint mode solution.
5. Basic Physics Approximations in the Problem Formulation: In addition to the multigroup approximations there are the following: Hydrogen scattering from group i to group j is assumed to be independent of the angular distribution of the scattering. This angular distribution is based on an extension of the so-called "transport approximation." Heavy-element scattering is also treated in the "transport approximation" and is assumed to be independent of the energy group. Furthermore, heavy-element scattering does not alter the energy group of the scattered neutron.
6. Restrictions on the Complexity of the Problem:

	MARC-2	MARC-3
Maximum number of energy groups	36	13
Maximum number of subregions of the quarter-cell	60	120
Maximum number of groups of subregions for the edits	40	80

   Machine requirements - 32K core storage with 6 tape units.
7. Typical Running Time: Variable, depending on the statistical accuracy required and the average number of collisions made to absorption. Average problems may be solved in from 5 to 20 minutes on the Philco-2000 (Model 211); 2 to 5 minutes on the Philco-2000 (Model 212).
8. Present Status: In use.
9. *References:*
   *E. M. Gelbard, H. B. Ondis, J. Spanier, "MARC — A Multigroup Monte Carlo Program for the Calculation of Capture Probabilities," WAPD-TM-273, (May,1962).

   *L. A. Ondis II, "MARC Memorandum 1," WAPD-R(B)-444, (March, 1963).

   J. Spanier, "A Unified Approach to Monte Carlo Methods and an Application to a Multigroup Calculation of Absorption Rates," *SIAM Review*, Vol. 4, (April 1962), pp. 115-134.
10. Material Available to domestic users from Philco:
    Binary program decks
    Symbolic program tapes
    Starred references
11. Authors of Programs:
    E. M. Gelbard
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