JOURNAL OF COMPUTATIONAL PHYSICS 2, 334–335 (1968)

NOTE

A Set of FORTRAN Subroutines for Handling Bases of Group Representations[1]

One realization for bases of representations of the U_r and GL_r algebras are tensors of rank n whose components are linear combinations of monomials of the form

$$X_{i_1}^{(1)} X_{i_2}^{(2)} \dots X_{i_n}^{(n)} \tag{1}$$

where the range of the subindices is $1, 2, \dots, r =$ number of commuting generators. In this realization, the generators of the general linear algebra are

$$C_j{}^k = \sum_{l=1}^{n} X_j^{(l)} \frac{\partial}{\partial X_k^{(l)}}. \tag{2}$$

If we are concerned with an irreducible representation of U_r or GL_r, the superindices in (1) will carry the symmetry properties of the associated Young diagram.

A problem frequently encountered in Applied Mathematics is the actual computation of the basis for some irreducible representation of the Unitary groups [1]. A set of input, operation and output subroutines for handling such tensors has been devised. With known techniques [1], we can generate the complete basis, starting from the highest weight component, by successive application of the U_r lowering operators classified by the canonical chain of subgroups $U_r \supset U_{r-1} \supset \cdots \supset U_2$.

In theoretical nuclear physics, one has been faced with the problem [2] of calculating the matrix elements of operators, iterated combinations of (2) between kets (1), bases for irreducible representations of U_6 classified by the Elliot chain [3], $U_6 \supset U_3 \supset R_3$. The hand calculation becomes prohibitively long and tedious. Using the subroutines which lower the irreducible representation of R_3 contained in U_3, keeping it of maximum weight in R_3, the complete basis can be generated and the matrix elements can be produced for nondiagonal operators such as the pairing and spin–orbit interactions.

[1] The author wishes to acknowledge a graduate scholarship by the Instituto Nacional de la Investigación Científica, México D. F., México.

Each monomial (1) is characterized by its set of indices i_1, i_2,..., i_n. A tensor component is handled as the collection of its monomials and their linear combination coefficients.

The Input subroutine reads this polynomials from the data cards, and is stored in the memory. Basic operation subroutines include the execution of linear combinations, scalar products and the application of the algebra generators (2). The output subroutine prints the end polynomial in a convenient format.

These subroutines as well as the input, output, and other specifications are available in deck or listing form from the author.

References

1. J. C. Nagel and M. Moshinsky, *J. Math. Phys.* **6**, 682 (1965).
2. J. Flores, E. Chacón, P. A. Mello, and M. de Llano, *Nucl. Phys.* **72**, 352 (1965); *ibid.* **72**, 379 (1965).
3. J. P. Elliott, *Proc. Roy. Soc.* (*London*) **A245**, 128 (1958).

Kurt Bernardo Wolf

Physics Department
Tel-Aviv University
Tel-Aviv, Israel