

APPLICATION OF A NEW ALGEBRAIC MANIPULATOR THEORY*

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Abstract. We have developed a new algebraic manipulator at the Naval Observatory, for application to lunar and planetary theories. The manipulator is quite general in that it is written in IBM FORTRAN IV language, but otherwise is independent of the bit and word structure of any particular computer. If the user desires, the number of polynomial and trigonometric arguments may be varied without limit. The math and order subroutines use an efficient one-to-one core mapping process. A higher level set of operation codes to simplify programming is built in. For example, the problem $h = [(ab)/(cd)]^{1/2}$, where a, b, c, d are series, is computed by the statement: CALL EXPR (H, '*', A, B, '*', C, D, 'DV', \$1, \$2, 'R', \$3, '=').

Applications to planetary theory are already developed with enough accuracy for analytical partial derivatives. Special problems encountered in the analytical theory of Pluto will be described, since Pluto represents a 'worst case' situation in planetary theory. The manipulation had to be performed with a nonsingular element set. Operations had to be reordered to improved convergence, and a 3-to-2 resonance with Neptune had to be assumed. Even then, the analytical partial derivatives for Pluto had to be developed with nearly four significant figures because of the relatively short arc of observations and the consequent difficulty of separating unknowns.

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