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Numerical Solutions of Differential Equations

Various numerical methods of solving differential equations were analyzed and refined in an effort to develop a method which was adaptable to a large class of problems; the prime capabilities of the method were to include accuracy, numerical stability and economic use of computer time.

After an extensive literature review, a number of known methods, i.e., the central differences method, Adam's formula and the Runge-Kutta technique were modified and programmed. Unimpressive results, primarily due to computer limitations, and the recent development of numerous new techniques made it imperative to improve the programming procedures.

Subsequently, double-precision programs were developed for Runge-Kutta processes, predictor-corrector methods and the new methods developed by Shanks. High-order correctors, including those of Adams and Fehlberg, were matched with new starting processes by Shanks. After extensive testing, the comparison of predictor-corrector processes with one-step processes was undertaken. The computing process was streamlined by a program which permitted choices as to the equation solved, the order of the equation stepsizes, starter, predictor, and the number of corrections per step. Initial results, which indicated that much computing time was wasted in repeated applications of the corrector each step, led to a modified method which made efficient use of a predictor-corrector method.

The most successful effort was the investigation of multi-step processes in which the corrector was changed at each step. The change of corrector at each step was accomplished with a modest increase in computing time.

Note:

The following documentation may be obtained from:

Clearinghouse for Federal Scientific
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Reference: NASA TND-2946 (N65-29964), on the Efficient Use of Predicator-Corrector Methods in the Numerical Solution of Differential Equations

Patent status:

No patent action is contemplated by NASA.

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