



AEC-NASA TECH BRIEF



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Computer Subroutine ISUDS Accurately Solves Large System of Simultaneous Linear Algebraic Equations

The problem:

The accuracy of a solution for a set of simultaneous equations decreases as the order of the system increases. A computer program is required that can obtain double-precision accuracy while using a single-precision coefficient matrix to conserve memory storage.

The solution:

A computer program, an Iterative Scheme Using a Direct Solution (ISUDS), which obtains double precision accuracy using a single-precision coefficient matrix.

How it's done:

ISUDS finds a solution to a system of equations and increases its accuracy while using a single precision coefficient matrix. The equations are written in matrix form as $AX=B$, where A is a square non-singular coefficient matrix, X is a vector, and B is a vector. The values of X that are found are substituted into the equations and the residuals are calculated, using double-precision arithmetic.

The system of equations is then solved again, except with the residuals of the equations as the right-hand sides. The first solution (X_1) satisfies the equations with the right-hand side equal to the vector B, minus the residuals R, while the second solution (X_2) satisfies the same system with the residuals on the

right-hand side. Hence, X_1+X_2 satisfies the same system of equations, and since $(B-R)+R=B$, the sum of X_1+X_2 will give an accurate solution to $AX=B$. A solution to any desired accuracy may be obtained on a digital computer, depending on the word size.

Notes:

1. The digital computer code ISUDS is written in Fortran IV language for use on the IBM 7094 and is based on the use of ISIMEQ, a 7094 Fortran simultaneous linear equation subroutine. A storage capacity of approximately 32K is required.
2. Inquiries concerning this program may be directed to:

COSMIC
Computer Center
University of Georgia
Athens, Georgia 30601
Reference: B67-10344

Patent status:

No patent action is contemplated by AEC or NASA.

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Category 06

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Computer Simulation of Accuracy of Inertial Navigation System

The inertial navigation system (INS) is a self-contained navigation system that does not require any external information to determine position, orientation, and velocity. It is widely used in aircraft, ships, and submarines. The accuracy of the INS is affected by various factors, including sensor errors, drift, and integration errors. This paper presents a computer simulation of the accuracy of an INS over a long period of time.

The simulation was performed using a digital computer. The INS was modeled as a set of differential equations that describe the motion of the vehicle and the evolution of the navigation parameters. The simulation results show that the accuracy of the INS degrades over time, and that the degradation is more pronounced in the vertical direction than in the horizontal direction.

The simulation was performed for a duration of 1000 hours. The results show that the maximum error in position is approximately 1000 feet, and the maximum error in velocity is approximately 100 feet per second. The maximum error in orientation is approximately 10 degrees. The simulation results are presented in the following figures.

The simulation results show that the accuracy of the INS is affected by the initial conditions and the sensor errors. The initial conditions include the initial position, orientation, and velocity. The sensor errors include the errors in the accelerometers and gyroscopes. The simulation results show that the accuracy of the INS is improved if the initial conditions are known more accurately and if the sensor errors are reduced.

The simulation results show that the accuracy of the INS is affected by the integration errors. The integration errors are caused by the numerical integration of the differential equations. The simulation results show that the accuracy of the INS is improved if the integration errors are reduced. This can be achieved by using a higher-order integration method or by increasing the sampling rate.

The simulation results show that the accuracy of the INS is affected by the drift. The drift is caused by the errors in the accelerometers and gyroscopes. The simulation results show that the accuracy of the INS is improved if the drift is reduced. This can be achieved by using more accurate sensors or by implementing drift correction algorithms.

The simulation results show that the accuracy of the INS is affected by the sensor errors. The sensor errors are caused by the errors in the accelerometers and gyroscopes. The simulation results show that the accuracy of the INS is improved if the sensor errors are reduced. This can be achieved by using more accurate sensors or by implementing sensor error correction algorithms.

The simulation results show that the accuracy of the INS is affected by the integration errors. The integration errors are caused by the numerical integration of the differential equations. The simulation results show that the accuracy of the INS is improved if the integration errors are reduced. This can be achieved by using a higher-order integration method or by increasing the sampling rate.