"canned" software. On the contrary, textbooks on numerical analysis are written to give the practitioners some appreciation of what is going on inside canned computerized routines so that they can make intelligent choices about choosing them and intelligent diagnosis when things do not turn out as expected.

This is where EISPACK came in; it made reliable "canned" software a reality. Emerging from research in software engineering, with a parallel goal of creating a useful product, it is the original, and many believe still the best, package of general use routines for solving matrix eigensystem problems. It was born in a prototype effort to create highly reliable software from innovative mathematical concepts.

EISPACK developers took stable numerical analysis methods, or **algorithms**, which previously had been inaccessible to the great majority of scientific computer installations, and made them easily usable and widely available . Algorithms for matrix eigensystem solution, which were summarized in a handbook published in 1971, were said to be **stable** because of the way they handle an inherent difficulty in numerical computation—the accumulation of round-off errors. With earlier methods of computation, errors accumulated and overwhelmed the answers, making the results not only wrong but dangerous if used in critical applications.

The project involved organizing these stable algorithms into categories related to various user problems and writing them in the popular programming language **FORTRAN**. The result was extremely reliable subprograms that researchers could readily incorporate into larger computer programs. The EISPACK software was then tested extensively at some 20 sites and "certified" for reliability by the research and development team which included scientists from Argonne National Laboratory, the University of Texas at Austin, and Stanford University.

By mid-1972 EISPACK was ready for public distribution. Arrangements were made to distribute EISPACK for a handling fee. Documentation describing the use of EISPACK accompanied the software and was extended and published in 1974 and republished in 1977 to accompany a second release of EISPACK containing additional subprograms.

Within 2 years, work began on a package of mathematical software to solve classes of linear systems. The pattern of collaborative work established for EISPACK had proved so successful that it was taken as a model for the new package, to be called LINPACK. Again, computationally sound algorithms were known, and the effort was to organize them in reliable software.

LINPACK is a contraction for "Linear Systems Package." Systems of linear equations—or, as they are called in elementary algebra, **simultaneous equations**—describe, for example, the distribution of electrical currents or voltages in electrical networks, such as electricity distribution systems. They represent the distribution of the mass flow rate of water in complex hydraulic systems, such as city water systems. And, they provide a way to approximate solutions of otherwise unsolvable equations describing the forces surrounding the nucleus of an atom.

In experimental studies, linear systems of equations enable investigators to summarize a mass of data in order to obtain formulas for interpolating between observed values or to deduce calibration curves. In this role, they provide a means to confirm or refute a theoretical relation, to compare several sets of data in order to ascertain if they can be represented by the same sets of equations, or to choose a theoretical model.

In psychology, sociology, and economics, a technique based on systems of linear equations, called multiple regression analysis, is one of the most widely used of all statistical tools. It ascertains the relation between three or more quantitative variables so that one variable can be predicted from all of the others. Multiple regression requires that extensive systems of linear equations and large arrays of data be denoted compactly and be operated upon efficiently.

LINPACK is designed with large systems in mind. In studying problems of the type encountered in modern science and engineering, it is frequently necessary to solve 150 or 200 simultaneous equations. This task presents practically insurmountable difficulties if undertaken with other than the best numerical methods.

With the algorithms in LINPACK, the computation to solve such a system may be reduced to only thousands of multiplications—a task a supercomputer can accomplish in fractions of a sec-