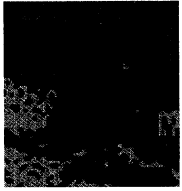


NASA's Software Bank



A SPECIAL NASA SERVICE CONTRIBUTES
TO NATIONAL PRODUCTIVITY BY SUPPLYING
INDUSTRY REUSABLE SOFTWARE AT
LOW COST

In these days when competition among businesses is at an all-time high, companies throughout

the nation are vigorously exploring every possible avenue to cost reductions, in order to increase productivity and competitiveness.

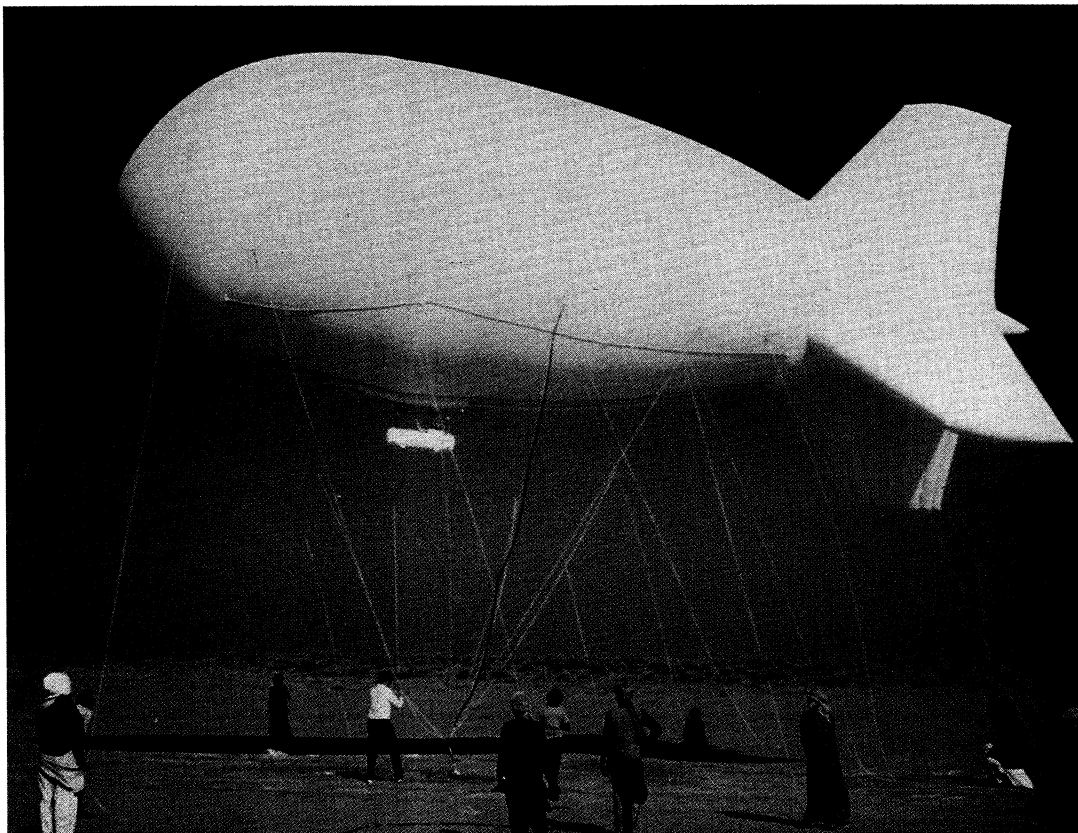
To businesses that are computerized, and today that includes nearly all of them, NASA offers a means of reducing automation costs through a special type of spinoff service operated by the Computer Software Management and Information Center (COSMIC)[®]. COSMIC supplies to American businesses, at relatively low cost, government-developed computer programs that have secondary utility.

Use of such software obviates the need to develop entirely new programs, which is time consuming and expensive; software costs sometimes amount to 30-40 percent of the total cost of computerizing a business or an industrial process. Thus, business users can realize significant savings by taking advantage of a national resource available to them, the large "bank" of computer programs developed in the course of work for NASA, the Department of Defense and other technology generating agencies of the government.

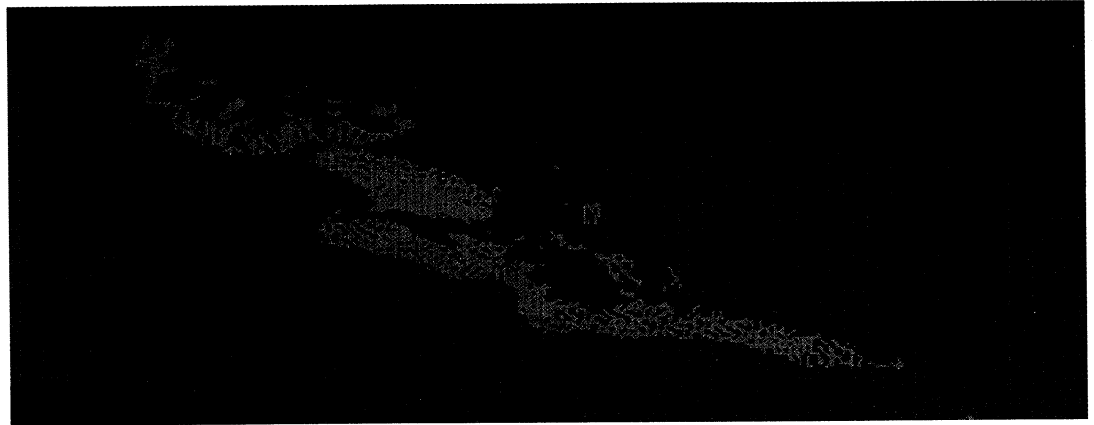
An example of how secondary use of government-developed software technology aids business and industry is the use of a COSMIC program by The Signal Group, Wake Forest, North Carolina, a company that designs and manufactures radio and data communications systems and equipment.

While much of The Signal Group's work is of a conventional nature, the company does "probe the frontier a bit" to provide some unique approaches to clients' needs — for example, a system that links a desert area that has no communications facilities with civilization. The reason: a hunting/falconry party of wealthy Middle Eastern men

Shown being deployed is a tethered blimp, a key element of a novel system that enables blimp-relayed communications between an isolated Middle Eastern desert and a metropolis. The system was developed by The Signal Group; a COSMIC computer program provided an assist in development of the system's software.



This is a typical 3D graphic depiction of a mountain area used in a radio propagation study of the desert communications system.



must penetrate deep into the desert to the best hunting grounds, yet they must also keep in touch with their businesses and their families in the city.

The Signal Group's answer in that instance was a portable system that includes the latest in two-way radio technology along with a small, inflatable blimp tethered 3,000 feet above the desert floor on a Kevlar line; the blimp serves as a solar-powered relay station for radio communications.

A COSMIC program helped The Signal Group provide this advanced service during the system development phase. The company first had to perform transmission studies to assess the reliability of voice and data communications. An important influence in system performance is how radio waves propagate over the particular terrain in which the system is intended to operate.

In the U.S., these studies could readily be accomplished by computer analysis of digitized terrain data. Satellite derived terrain data has been compiled for most of Earth's land masses, but in some parts of the world governments consider computer records of their geography strategically important. Dissemination of such data, therefore, is severely restricted if not totally prohibited. That rules out computer prediction of RF propagation.

A "BANK" OF GOVERNMENT DEVELOPED COMPUTER PROGRAMS CONSTITUTES A NATIONAL RESOURCE

Since a number of The Signal Group's clients fall under such a restriction, the company undertook development of a process that would use terrain data from available printed maps to create a proprietary analysis of RF propagation.

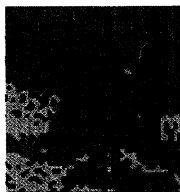
Topographic maps encompass a wide variety of sometimes outdated projections, spheroid models, and scales. The Signal Group wanted to develop a method that would be essentially universal with respect to input, but during the research phase of the software design effort a number of conflicting aspects of the cartographic process were encountered.

A program obtained from COSMIC offered a solution. Titled *Transverse Mercator Map Projection of the Spheroid Using Transformation of the Elliptic Integral* and originally developed by Jet Propulsion Laboratory, the program not only helped resolve the conflicts encountered, it also provided The Signal Group a capability to perform certain types of analyses not previously possible.

(Continued)

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NASA's Software Bank (Continued)



Located at the University of Georgia, COSMIC gets a continual flow of government-developed software and Center personnel identify those programs that can be adapted to secondary usage. Much of the software is directly applicable to secondary application; most of it can be adapted to special purposes at far less than the cost of developing a new program.

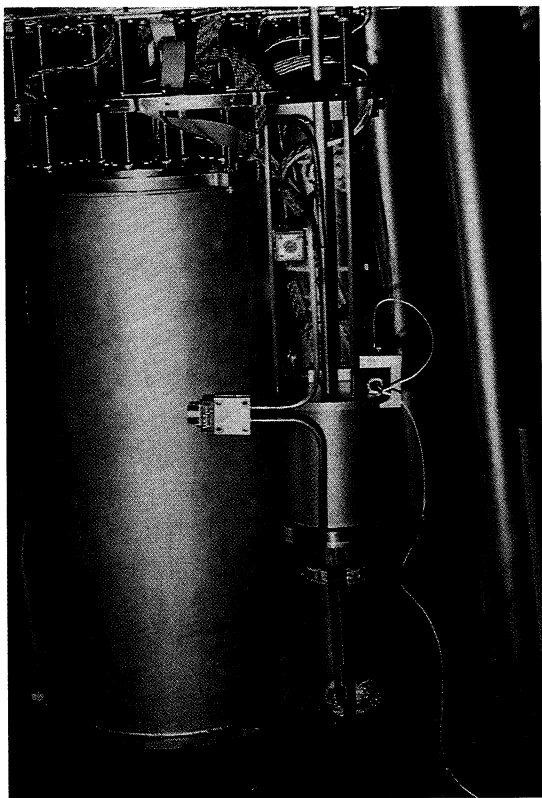
The Center stores the programs and informs potential users of their availability through the publication *NASA Tech Briefs* (see page 141).

COSMIC's library numbers more than 1,200 programs applicable to a broad spectrum of business and industrial applications. COSMIC customers can purchase a program for a fraction of its original cost; in most instances, users get a return many times their investment. Industry's acceptance has been extraordinary. The Center has distributed thousands of programs, some of which have made possible savings in the millions. Thus, COSMIC's service represents one of the broadest areas of economic benefit from spinoff technology.

Here are some additional examples of how COSMIC's service aids users:

Astronautics Corporation of America, Madison, Wisconsin designs and manufactures electronic equipment and aerospace systems. Among advanced research and development projects under way at the company's Astronautics Technology Center is an investigation of possible materials and designs for magnetic refrigerators, which operate under the

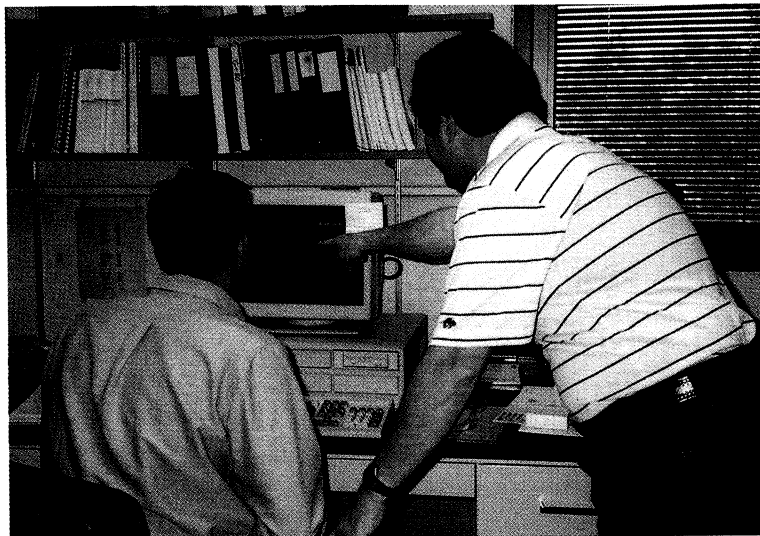
Astronautics Corporation's Active Magnetic Regenerator proof of principle apparatus, a device used to test different types of materials that might be employed in magnetic refrigerators. The company uses COSMIC software in its research and development on refrigerators that operate below minus 321 degrees Fahrenheit.



principle that some materials heat up when placed in a magnetic field and cool down when removed from it. Applications of these low temperature (below minus 321 degrees Fahrenheit) refrigerators include cooling superconducting magnets used in magnetic resonance imaging systems at hospitals, in particle accelerators for high energy physics research, and in magnetic containment vessels for fusion energy research.

In Astronautics Corporation's quest for efficient magnetic refrigerator devices, Technology Center personnel use the COSMIC-supplied SINDA '85/FLUINT, a software system developed by NASA for solving physical problems governed by diffusion-type equations. Initially, engineers employ SINDA '85/FLUINT in the conceptual design process; the various possibilities for a design are modeled with the COSMIC program to allow comparison of relative efficiencies for selection of the best concept. SINDA '85/FLUINT is later used to develop a more complex model for predicting temperature distribution in the refrigerator.

Another example involves use of a COSMIC program called NETS (*A Neural Network Development Tool*) in a university artificial intelligence research program. Originally developed by Johnson Space Center, NETS is a software system for mimicking the human brain. It is designed to help scientists engaged in exploring artificial intelligence solve problems that involve learning and pattern matching.



Dr. Jerry Darsey (standing) shows University of Arkansas at Little Rock student Archie Stone a result of calculations generated by COSMIC's NETS program, a software system for applying artificial intelligence. The pair are part of a University of Arkansas/Oak Ridge National Laboratory team seeking to "train" a computer to recognize pattern relationships in chemical systems.

Dr. Jerry Darsey of the University of Arkansas (UArk) at Little Rock, Dr. Don Noid of Oak Ridge National Laboratory, and students of the UArk Chemistry Department are collaborating on a project to apply NETS to pattern matching of chemical systems. A successful effort could greatly help chemists identify mixtures of compounds without lengthy and sometimes costly separation procedures.

Using NETS as a framework, the group has trained the computer to recognize certain pattern relationships in a known compound and associate the results to an unknown compound. Dr. Darsey terms the research "promising" and adds, "Designing a molecule or compound on a computer before we even go into the laboratory may be possible."

A third COSMIC application exemplifies how use of NASA technology can give a small business a competitive edge over large companies.

Esse Systems, Portland, Oregon is a small consulting company that designs computer programs for regional manufacturers. Typically, Esse's work involves writing custom software that would help a client automate a portion of his operation.

Believing that better information management is the key to helping clients improve productivity, the firm began exploring expert systems, computer programs that make decisions based on what an expert in the field would do if faced with a problem.

Esse first looked at a number of existing tools for writing expert systems. The firm settled on CLIPS (*C Language Integrated Production System*), a software shell for developing expert systems that originated at Johnson Space Center. With CLIPS, Esse initiated a prototype computer program that would act as a scheduling expert; the company felt that clients could save a great deal of time and use human experts more efficiently by automating many routine, repetitive scheduling decisions, freeing employees to spend time on other matters that required creative thinking.

After developing its prototype expert system and publishing a 32-page *Expert Systems Primer*, Esse Systems is now providing clients service in that area. The company's first contract involves development and implementation of an expert system to schedule reactors for Siltec Silicon, a Salem, Oregon semiconductor manufacturer. The three-phase project promises to provide significant time and cost savings for Siltec.

"We bid the job against some prestigious companies," says Esse Systems software engineer Ken Dellinger. "One reason we got the job was our understanding of the problems and our grasp of the technology available to solve the problem. By capitalizing on NASA technology, we're able to provide our customers with expert systems faster and more economically than we could if we had to start from scratch." ●