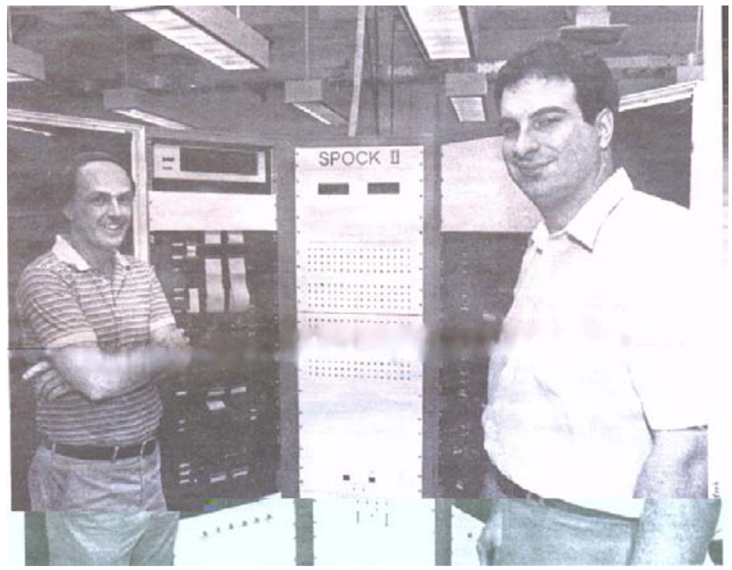
About AAFA Members

Cecil O. Alford, AAFA #0751

PHOTOGRAPH:
Dr. Cecil Alford (L), SPOCK II (C) and Dr. Jim Hamblen are all smiles as their research efforts pay off In a $21.3 million Strategic Defense Initiative contract. (This is the heading for the photo of Spock and Cecil Alford and James Hamblen.)



Comment by Cecil Alford The following article was published in the Georgia Tech Whistle, Volume 11, Number 21, July 29, 1985. Mark Hodges interviewed the two of us and took the picture. The article was sent out to newspapers all over the U.S. and was picked up by quite a few. Some who saw the article in their local newspaper, and knew one or the other of us, mailed us copies of the article.

Electrical Engineering Professors SPOCK Earns Tech Largest Research Contract In Its 100 Years

By Mark Hodges, Research Communications Office, Georgia Institute of Technology

A computer named SPOCK, playing a role in Star Wars, has won Georgia Tech the largest contract in its research history. This Star Wars isn t a movie. It s the catch phrase for the Strategic Defense Initiative (SDI), a $1.5 billion effort to build a defense shield against the threat of a nuclear missile attack on the United States.

SPOCK is a computer which figures heavily in a five-year, $21.3 million SDI contract awarded to Tech by the Army s Ballistic Missile Defense Command Advanced Technology Center. Through this program, Georgia Tech engineers are designing ultrafast computers so that an autopilot on a satellite can track, intercept, and destroy missiles high in the earth s atmosphere and even out into space.

Tech s research in this field of computer engineering began in 1975, when Dr. Cecil Alford, an electrical engineering professor, and a Ph.D. student, Mike McQuade, designed a prototype computer they called SPOCK I. This acronym only coincidentally matched the name of the popular science fiction character. It actually was a shortened form of Special Purpose Operational Computing Kernel.

The computer is a parallel processing system, meaning it is capable of simultaneously solving a very high number of mathematical problems. The Army saw such promise in SPOCK I that, after three years, the Ballistic Missile Defense Command awarded Dr. Alford a small, five year contract to design a more sophisticated version of the computer which came to be known as SPOCK II. A former Ph.D. student of Alford s, now assistant professor of electrical engineering, Dr. Jim Hamblen, designed the second SPOCK. Hamblen is co-principal investigator with Alford on the current project. We started out building a computer that we thought was useful just in the scientific community, Alford says. Then, when the Strategic Defense Initiative began it became obvious that large amounts of data have to be computed almost instantaneously for any space-based defense system to work. This is a good example of how adequate funding can stimulate good science. We ve been able to make strides with SPOCK that we d never have been able to do otherwise.

It now appears that Alford and his

associates will be able to design a computer with considerably greater power than the first and second generation SPOCK s. SPOCK II has 32 parallel processing elements. The new contract calls for Georgia Tech to design and evaluate a third-generation SPOCK computer with 128 of these elements. Faculty and students also will be producing a version of SPOCK II with VLSI microchips 100 times more powerful than those currently in use. This research will pave the way for them to design a SPOCK IV computer with a phenomenal 1,000 processing elements.

High-speed computation isn t the only objective of the program. The researchers also will be designing a system which doesn t require extensive software. The Army doesn t want a computer that they have to add several thousand lines of computer programs to," Alford explains. They re too hard to keep checked out. So our design minimizes software.

The program is barely underway, but its presence at Tech has made the Institute an important player in the Strategic Defense Initiative. Several months ago, two other Electrical Engineering School faculty members, Dr. Tom Gaylord and Dr. Bill Rhodes, received a large contract to design an optical computer for the Initiative. Other research proposals are now in the works on the campus, and as SD! evolves, Georgia Tech may start to play other key roles in the pioneering research effort.

Additional comments by Cecil O. Alford, Nov. 5, 1999: The research continued for a full five years running out the full contract. During the fourth year, 1989, we wrote a new proposal for an additional five year effort with potential funding of $7.5M. By 1991 this contract was in trouble as Star Wars began to wind down and money was pulled out of the program. We eventually ended the program around 1994 having spent around $24M on first class research. Many students were involved in the research, several receiving their Master of Electrical and Computer Engineering degree and/or their Doctor of Philosophy degree.

James Hamblen was not the first student to work on this project. The honor goes to Mike McQuade, who built the very first version called Spock I. He earned his Ph.D. degree and now works for Dupont. Hamblen is an Associate Professor in the School of Electrical and Computer Engineering at Georgia Tech.

Mark was somewhat confused over the technology and did not give an accurate description of the project and its application. The essentials are as follows. In those days we anticipated a missile attack which might contain a large number of missiles carrying nuclear warheads. The mission of SDI was to develop a shield to protect the U.S. from this threat. Many people were involved in developing technology to support this program. The program at Georgia Tech centered on developing on-board computers to steer the missiles (often called an autopilot borrowing the term from the old days), and a ground based computer to pass information from ground based radar to the missiles. The computer in the picture was the Georgia Tech version of a potential ground based computer to solve this problem. We built the hardware and developed the software and demonstrated the performance numerous times to government and industry personnel. This particular computer is called a parallel computer since it contains 32 processing units which are running at the same time solving one single complex problem. This was necessary to get the compute speed that was needed. Our technology was running at the enormous rate of 20 Mhz, which was state-of-the-art in those days. The most amazing thing is that we took a software system, written in Fortran for the U.S.Army and ported it to our computer. This was done to assure the Army that our work was based on their software system and not something that we had generated for show. We then demonstrated this software running on SPOCK II, at real-time speeds. This means the computer was solving the program fast enough to keep up with the real missiles when they replaced their software counterpart in the software. The next thing we did was to convert our software code to ADA, which was the standard for the military. We then demonstrated this code running even faster than the Fortran code, which was absolutely incredible and many refused to believe it. It took lots of patience and hours of explanations since no one had ever achieved anything this spectacular using ADA code.

The second thing we did was to build an on-board processor to guide the missile. In the initial phase of flight the missile is launched by the ground based computer and is directed to a point in space. The ground based computer controls this part of the trajectory. Information is being sent to the ground based computer concerning the incoming missiles which must be destroyed. The job of the ground based computer is to place attacking missiles in position to counter these incoming warheads. When the interceptor missiles reach a certain point in space they are in a position to see the warheads using an on-board seeker (a device much like the new digital cameras). Now comes the major problem of the interceptor. The seeker will see many warheads and must select one as its target. This requires enormous processing capability to track the warheads, select one for a target, and then continue to track this target and guide the interceptor on a course that will collide with the target. Georgia Tech, on this project, built another parallel processor, much, much smaller than SPOCK II, to accomplish this purpose. This computer was also built and tested using the SPOCK II computer to simulate the warheads and the interceptor, without the flight processor. The actual hardware for the flight processor was connected to SPOCK II to calculate all the guidance functions for the interceptor as SPOCK II simulated the warheads and the interceptor. Using this technology we were able to demonstrate that our flight processor was capable of solving the required equations to guide the interceptor on a collision course with the warhead. This simulation of a missile attack and an interceptor response was demonstrated many times to military and industrial personnel.

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