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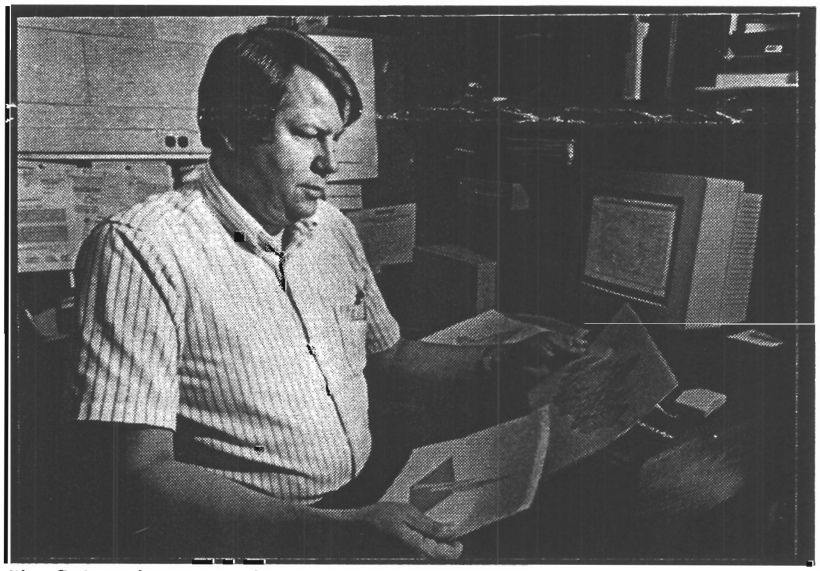
IMPROVING RADAR PERFORMANCE: RESEARCHERS DEVELOP COMPUTER SIMULATION THAT COULD SAVE ENGINEERS TIME AND EFFORT

Radar researchers at the Georgia Tech Research Institute (GTRI) have developed a computer simulation that assesses factors affecting radar system performance and predicts how well a given system will work.

The program could reduce the time and effort radar engineers spend searching for information and testing and compensating for factors called contaminants, said Jim Scheer, principal research engineer.



Jim Scheer inspects printouts that show simulated performance of a radar system. (Color/B&W Available)

Coherent radars differ from older, classical radars in that they measure signal phase, as well as amplitude and time delay. The information in the phase of a signal, combined with appropriate processing, can allow a radar system to detect a target in clutter, image it or determine its speed. Contaminants to coherent radars reduce their ability to perform these functions. In some cases, they produce a "ghost" target on the radar, for example. Because targets of interest have lower radar-cross-section values and thus lower received power than they had in the past, improved performance and accurate prediction by coherent systems is imperative.

Much of the knowledge in this area of research is held by private companies, said Scheer, chief engineer of GTRI's Radar Instrumentation and Development Laboratory. A summary of all contaminant effects does not exist in one publication.

"We embarked upon this program to develop that

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knowledge base here," he said. "It is designed to give the working engineer a hands-on answer to how well his radar will perform, and how good he has to make the devices to get the performance he wants.

The computer simulation runs on BASIC or MATLAB software on IBM-compatible or Macintosh desktop computers. An engineer enters the parameters of a particular radar system, including the relative size of targets the system must detect and the characteristics of the contaminants.

The simulation presents a graphic display indicating how well the system will perform. The program produces color plots of the Fast Fourier Transform (FFT) process in both one- and two-dimensional formats, showing the effects of the contaminants. Researchers continue to improve the system, making it more flexible and able to address individual users' needs.

The simulation is just one of the results of a three-year internally funded research project dedicated to building understanding of coherent radar performance. The researchers are also offering short courses on the information and have a contract to publish a book by the end of 1992. They conducted extensive literature searches, talked with experts, used the information they collected to predict radar performance and then tested their predictions.

"We got good correlation between predicted and measured results," he said. "For the selected validation tests performed, the lab results agreed with the predicted results within a dB."

Contaminants on which the researchers compiled information include:

*Phase noise in oscillators, which can reduce a radar's ability to detect and measure target velocity in the presence of background clutter;

*Errors in in-phase and quadrature (I and Q), which can result in "ghost" targets that to do not really exist; and

*A-to-D quantization effects, errors in amplitude and spectrum that result when a signal is converted from an analog signal to a digital number.

The researchers also address how to test components, systems and subsystems to determine the value of contaminants without taking the radar into the field and using it to detect and/or track a target. They have developed a short course specifically geared to contaminant analysis in specific types of radar systems including frequency modulated continuous wave (FMCW), pulse compression, coherent tracking, moving target indicator, pulse Doppler, phased-array, imaging, high-range resolution and high cross-range resolution, Scheer said.

Other researchers participating in the original project include Dr. George Ewell, Fred Nathanson, Dr. Jim Echard, Dr. Mark Richards, Sam Piper and a co-op student, Brian Drachman.

The research was funded by one of GTRI's Senior Technology Guidance Council awards.

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The simulation software is distributed at short courses radar specialists are teaching at locations including Eglin Air Force Base, the Georgia Tech campus and Germany.

The group's findings will be published in book form in 1992 by Artech House and will be followed by a 1993 publication including the software.

Portions of this research are featured in "The Quantization Noise Spectrum of a Sinusoid in Colored Noise" by J.D. Echard and M.L. Watt, released in April, 1992 in the 1991 GTRI Technical Journal.