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NEW ACOUSTO-OPTIC RADAR WARNING RECEIVER MAY PROVIDE FASTER & MORE ACCURATE INFORMATION ON HOSTILE RADARS

An improved acousto-optic radar warning receiver developed at the Georgia Institute of Technology may provide future combat pilots with faster and more accurate warning of hostile radar activity.

Optical signal processing techniques allow the receiver to simultaneously handle a wide range of frequencies and analyze several signals in parallel -- while providing frequency resolution precise enough to separate hostile signals from friendly ones.

"As the density of the signal environment increases, the possibility of making a mistake increases because the signals are so close together," said Harold Engler, principal research engineer at the Georgia Tech Research Institute (GTRI). "You can diminish the risk of making an error with this approach."

Researchers Harold Engler, William Rhodes, Allen Garrison and David Hartup examine a laboratory scale version of their acousto-optic radar warning receiver. (Color/B&W Available)

Military pilots flying above enemy territory need to know when a hostile radar system is tracking them so they can take defensive action. In areas with large numbers of potentially hostile signals, even small improvements in processing time and accuracy can be significant.

"The aircraft must receive all of these signals and somehow process them to quickly decide which ones require attention and where the source is located," Engler added.

An interdisciplinary research team composed of Engler, David C. Hartup and Allen K. Garrison of GTRI --

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along with William T. Rhodes of Georgia Tech's Center for Optical Science and Engineering (COSE) -- designed and tested the enhanced optical system.

"We have developed a new type of architecture that has advantages over previously developed optical processing architectures while avoiding some of the major problems inherent in electronic processors," said Hartup. "The system generates accurate information about the burst rate and center frequency of each signal it receives."

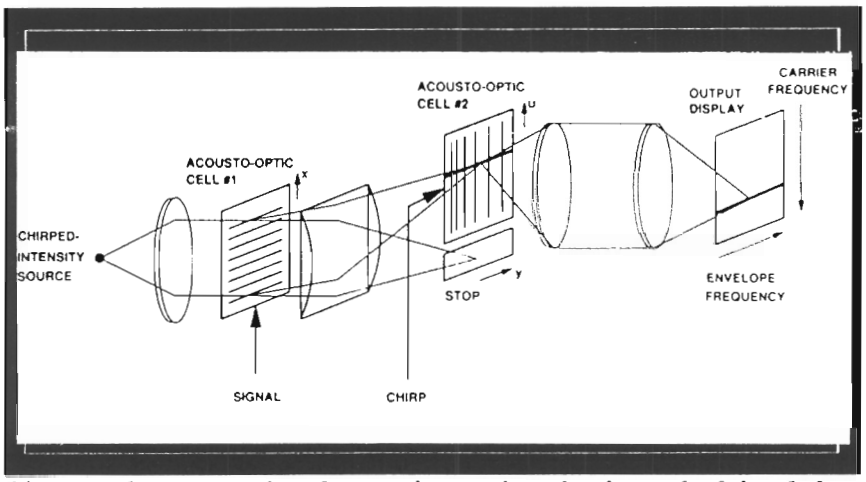

Diagram of acousto-optic radar warning receiver showing path of signals from source to display output.

The Georgia Tech engineers considered using electronic signal processors operating in parallel, but the number of processors required and the problems of interconnecting them made that approach too difficult.

"If you were to try to do the same thing electronically, you would need at least a hundred or as many as a thousand processors," Hartup noted. "Electronically it can be very complicated, but optically it can be very simple."

Two acousto-optic cells, each with a specific processing task, form the heart of the radar warning receiver.

At the first cell, a transducer converts electronic signals from potentially-hostile radar emitters to acoustic energy. That energy is then coupled into the cell, where the acoustic energy affects its optical properties. Infrared laser light is then passed through the cell, which diffracts the light in a different direction for each center frequency it receives.

The diffracted light then strikes a second acousto-optic cell, which further diffracts the laser light so that the burst rate associated with each center frequency can be determined. Finally, detectors convert the diffracted light patterns to electrical signals which can be displayed.

Although the types of processing performed by each acousto-optic cell have been independently demonstrated before, the researchers say the novel combination of the processing steps gives the Georgia Tech architecture several performance advantages over existing radar warning receivers.

The new system provides automatic separation of signals, eliminating the need for an extra processing step to de-interleave information from multiple signals. At the same time, the processor keeps the frequency and burst rate of each signal together, avoiding the need to re-associate separate measurements of these signal parameters.

The researchers hope to enhance their system by adding an ability to automatically match the diffraction patterns against a known library of threat radars. This step will add an optical emitter identification feature.

The researchers also hope to miniaturize the receiver equipment, which is now operating as a laboratory-scale proof-of-concept prototype.

A patent application has been submitted to protect the processing architecture, which was developed with internal Georgia Tech funding. Information on the research was published in April 1992 in Volume 1 of the GTRI Technical Journal. It has also been published in Proceedings of the SPIE.

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