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# A DIGITAL PROCESSOR FOR THE PRODUCTION OF SEASAT SYNTHETIC APERTURE RADAR IMAGERY

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With the launch of Seasat-A in June, 1978, the first spaceborne Synthetic Aperture Radar data was made available to the remote sensing community. While the mission only lasted 3½ months, a large volume of SAR data was recorded during this period, and recent image production is beginning to show the remarkable clarity of the data.

Synthetic Aperture Radar processing requires that many hundreds of operations be done per output pixel, and this high computation load has been handled in the past by optical computing techniques. While optical techniques have been very successful, they possess several limitations that digital processing can hope to improve. The limitations include the limited dynamic range and resolution of film recordings, the light diffusion in optical systems, the difficulty of achieving automatic focussing and the inability to cope with artifacts in the data.

An experimental digital Seasat SAR processor has been built at MDA which has demonstrated that Seasat images can be produced to the full resolution and dynamic range inherent in the SAR data. This paper will outline the digital processing steps in that processor from the reception of the raw digitized SAR signal data to the production of a final digital image tape.

The principal problem in the design of a data processor for spaceborne SAR data is the phenomenon of range cell migration. This refers to the fact that as individual reflectors are traversed by the illuminating beam, their slant range variation greatly exceeds the width of one range cell or the range resolution. In the satellite case, earth rotation, satellite attitude variations, and the extreme distances inherent in the earth/satellite geometry all combine to magnify the range cell migration extent to proportions considerably in excess of that normally encountered with airborne platforms. This phenomenon couples the range and azimuth encoding in the SAR signal data and has required the development of new signal processing algorithms to reconstruct the SAR image.

In this paper, the problem of range cell migration correction is addressed in the context of azimuth look extraction and compression via fast convolution.

Sample Seasat imagery produced by the processor are included.

Copies of this paper in its entirety will be available for distribution at the symposium.

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B. Sc., 1966, Electrical Engineering from Queen's University; M.A., 1968, and Ph.D., 1972 both in Electrical Engineering from the University of British Columbia. At MDA, Dr. Bennett's area of expertise is in digital signal processing where he has played key roles in the design and construction of systems employing digital filters and fast fourier transform (FFT) analyzers. He has been involved in theoretical investigations pertaining to the design of a digital processor for satellite borne synthetic aperture radar (SEASAT-A) and in the conceptual design of a real-time airborne SAR processor. Dr. Bennett is currently synthetic aperture radar program manager.

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B.A. Sc., 1961, Engineering Physics, University of Toronto; M.A., 1962, Control Systems, University of Toronto; and Ph.D., 1966, Computing and Automation, Imperial College, University of London. Since joining MDA, Dr. Cumming has been applying his previous signal processing experience to the design of a synthetic aperture radar digital processor for the SEASAT processor. He is currently senior analyst in the synthetic aperture radar area.