1 Introduction

In 1978, CCRS began flying a Synthetic Aperture Radar (SAR) developed by the Environmental Institute of Michigan (ERIM) [14] on its Convair 580 aircraft. This radar, which became known as the SAR-580 system, was taken over by the Centre in 1980 and its development continued until 1985 in preparation for a completely new radar system. This paper describes the new C-band SAR developed for CCRS as a modern research tool, with MacDonald, Dettwiler and Associates (MDA) as prime contractor.

The new system is a digitally controlled, two-channel radar, operating at C-band (5.30 GHz), transmitting either H or V polarizations, and receiving both polarizations simultaneously. The system features an onboard, 7-look, Real-Time SAR Processor (RTSP) and display for one receive channel with data acquisition in three nominal modes: nadir, narrow swath, and wide swath. General specifications for the system are listed in Table I.

This paper is divided into two main sections. In Section 2, a brief system description gives an overview of the main design and processing features. Section 3 gives a set of test results which show the quality and characteristics of the imagery produced by the system. A summary is given as the concluding section.

Table I: C-band SAR Specifications.

TRANSMITTER		
• frequency	5.30 GHz	(5.6 cm)
• radiated peak power	27 kW	
• polarization cross coupling	<-49 dB	
• PRF	208 Hz	to 382 Hz
• estimated noise equivalent σ_o	-40 dB	
	Narrow Swath	Wide Swath
• chirp length	7 μs	8 μs
• chirp bandwidth	42.0 MHz	11.4 MHz
• nominal average power	90 W	100 W
• chirp coding	non-linear FM	linear FM
RECEIVER		
• minimum range	3.0 km	
• maximum range	68.0 km	
• fine gain control range	63.5 dB	
• coarse attenuation range	42.0 dB	
	Narrow Swath	Wide Swath
• range pulse width	40 ns	120 ns
• input noise floor	-95 dB	-102 dB
• noise figure	5.2 dB	3.7 dB
ANTENNA	H-polarization	V-polarization
• azimuth beamwidth[a]	3.6°	4.2°
• elevation beamwidth	23°	27°
• peak gain	24 dB	22 dB
REAL-TIME PROCESSING		
• 1-7 looks processed for 1 channel		
• slant or ground range presentation		
• 8-bit detected signal per pixel		
• 4096 range pixels/line		
	Narrow Swath	Wide Swath
• azimuth resolution	6 m	10 m
• range resolution	6 m	20 m
• look beamwidth	0.3°	0.19°
GROSS		
• power consumption	5 kW	
• weight[b]	450 kg	

[a]Azimuth beamwidths will be modified to 3.04° in April, 1988.
[b]Weight excluding antenna and peripherals.

2 System Description

2.1 Conceptual Design and Architecture

During the conceptual design phase of the CCRS C-band SAR, it was decided to create a research radar system that would:

- Offer a variety of imaging parameters to cover foreseen SAR remote sensing research needs;
- Minimize the probability of operator error;
- Be calibratable;
- Function as a test bed for further SAR development research;
- Be field maintainable.

The radar developed to meet these goals. To cover the range of incidence angles and swath widths required for remote sensing research, two resolution cell sizes were incorporated into three imaging modes to provide high resolution (~6×6 m) capability from nadir to 82° with a 16.4 km (slant range) swath and low resolution (~20×10 m) capability from 45° to 87° incidence angle with a 61 km swath. These modes are shown diagramatically in Fig. 1. Through extensive use of digital technology and microprocessors, the other design goals of potential calibration, ease of operation and maintenance, and future development potential have largely been met.

The radar can be divided into the major subsystems illustrated in Fig. 2. The SAR Transceiver Subsystem (STS), described in Section 2.2, provides for the coherent generation, transmission and reception of the radar signals. The STS contains fast programmable gain control to reduce the very large dynamic range of the radar returns prior to digitization. This Sensitivity Time Control (STC) system is described separately in Section 2.4. Radar control is described in Section 2.3. Section 2.5 is a terse description of the the motion compensation system. The RTSP (Section 2.6) performs the digital processing required to produce high-resolution SAR imagery. Sections 2.7 and 2.8 contain descriptions of user accessible modes and outputs respectively.