EcoSAR: Ecological Synthetic Aperture Radar Development

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ABSTRACT

This article contains information on EcoSAR. EcoSAR is the advanced airborne polar metric and single pass interferometric P-band SAR instruments under development at the NASA Goddard Space Flight Center, through NASA’s instrument Incubator Program (IIP). EcoSar will provide two and three-dimensional fine scale measurements of terrestrial ecosystem structure and biomass onboard the NASA P3 aircraft. These measurements directly support science requirements for the study of the carbon cycle and its relationship to climate change. To evaluate plant growth on earth from an airborne platform, both construction of the radar and subsequent testing of the radar using advanced radar test equipment to help develop and improve the radar system was necessary. This article describes the development, testing, and deployment of the EcoSAR system.

KEYWORDS

EcoSAR, Plant Growth, Radar, Synthetic Aperture Radar

INTRODUCTION

What follows is a research report detailing the steps taken to deploy a satellite by applying signal-processing hardware and software. One should be able to follow these steps with the specified set of hardware and software to get the same configuration on the proper RF and satellite communications device design. These projects were implemented under the supervision of NASA scientists and faculty advisors in dedicated NASA labs. Following lessons learned here and authors’ previous experiences in data visualization and signal processing research and training relevant labs were designed to enhance the Computer Engineering program at the Virginia State University (VSU).

EcoSar will employ advanced technologies and techniques in order to enable polar metric and interferometric measurements of Ecosystem Structure and biomass. P-band radar signals penetrate forest structures and reflect predominately from tree trunks, large branches, and the ground. Radar polarimetry provides information about the scattering mechanism of the forest structure, permitting the estimation of its properties and characteristics. Synthetic Aperture Radar Interferometry (InSAR) is highly sensitive to the spatial variability of vertical structure parameters and provides quantitative information on the layered structure of the vegetation, such as depth and density. Polarimetric interferometry SAR (POInSAR) combines polarimetry and interferometry providing sensitivity to vertical distribution of scattering mechanisms. Furthermore, the variation in interferometric phase height with polarization permits to derive tree height.

EcoSAR will employ a digital beam forming architecture composed of two wideband dual-polarization array antennas, a radar digital unit (RDU). The two antenna arrays will be mounted...
under the P3 aircraft wings forming a baseline of 25 meters. The EcoSAR antenna arrays design is very challenging since it requires wide bandwidth, high cross-polarization isolation, and scanning capability. These requirements tend to work against each other.

**METHODOLOGY**

To obtain data and look and the productivity of the radar instrument, our EcoSAR team has come up with a methodical way to build and test the radar and eventually be able to test the whole system of radars to conclude that it is working to its full capability. The EcoSAR system has a front and back side. Each side has 2 trays with 4 boxes on each tray. The EcoSAR amounts to four trays and 16 boxes in one rack. Each box has to be constructed and tested before it can be mounted onto a tray (see Figures 1-4).

Once the box is received back from the mechanical engineer, coax cables are fed through with SMA connectors to the motherboard of the radar box. Each cable has an identified place on the connection to the mother board. In the 4 holes in Figure 2, two punched out SMA connecters are fed through the circular holes, a power connecter and 25 dB are inserted through these holes.

After the box is screwed up and all the coax cables inside the box are well tightened, the next step is to button up the box and a couple of devices on the back. We add a total of 5 devices such as two RF switches (the two on the left), a circulator (bottom right), a coupler (top right). An RF switch tells the radar when to switch modes. The radar is capable of switching between transmit and receive modes. Circulators are used as a duplexer, to route signals from transmitter to the antenna and from

Figure 1. One box of EcoSAR
Factors Affecting Attitudes Towards Broadband Adoption in the Kingdom of Saudi Arabia
www.igi-global.com/chapter/factors-affecting-attitudes-towards-broadband/20451?camid=4v1a

www.igi-global.com/chapter/mac-protocols-cognitive-radio-hoc/74426?camid=4v1a