15 Dec. 2004

FCC
Experimental Radio Service
P.O. Box 358320
Pittsburgh, PA 15251-5320

To Whom It May Concern,

On behalf of my colleagues and myself, we would like to apply for an Experimental Radio Service authorization to operate a low-power research radar system which we are developing for NASA. The system is a small interferometric synthetic aperture radar (IFSAR) system which will be used to study changes in terrain over time as part of NASA's Global Change Initiative. We have been previously granted a STA authorization (file number S-2353-EX-96) for this experiment.

I hope we have provided enough information to enable a favorable approval decision. This experiment is important in the development of advanced radar remote sensing systems. If you have questions, concerns or require further clarification, please don't hesitate to contact me.

Sincerely,

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Attachment 1

Purpose of operation:

A key component in NASA's studies of global change is the ability to make high resolution, high accuracy measurements of topography and vegetation cover in order to study long and short term changes in these interactions. IFSAR technology can provide the needed measurements. While IFSAR systems have been successfully flown by NASA on large airborne platforms, these sensors are expensive to operate and do not provide the required resolution for many local studies. To fill this need, we developed a small, low-cost IFSAR system under contract with NASA. We are now upgrading the computer component of the sensor. The IFSAR will be flown in small six passenger airplane.

In IFSAR a radar antenna mounted on an aircraft and pointing down and to the side (see Fig. 1) transmits a series of coherent, high bandwidth radar pulses. The resulting backscatter 'echoes' from the earth's surface are measured by two radar antennas mounted on the same platform, but displaced from each other in elevation. The signals received by each antenna are recorded separately and then correlated to produce two high-resolution, complex images of the radar returns from the imaged area. After correlation, the resulting complex images are registered and the phase difference between the measurements resulting from the differential time-of-flight are calculated for each pixel. This phase difference is used to estimate the topography of the imaged surface.

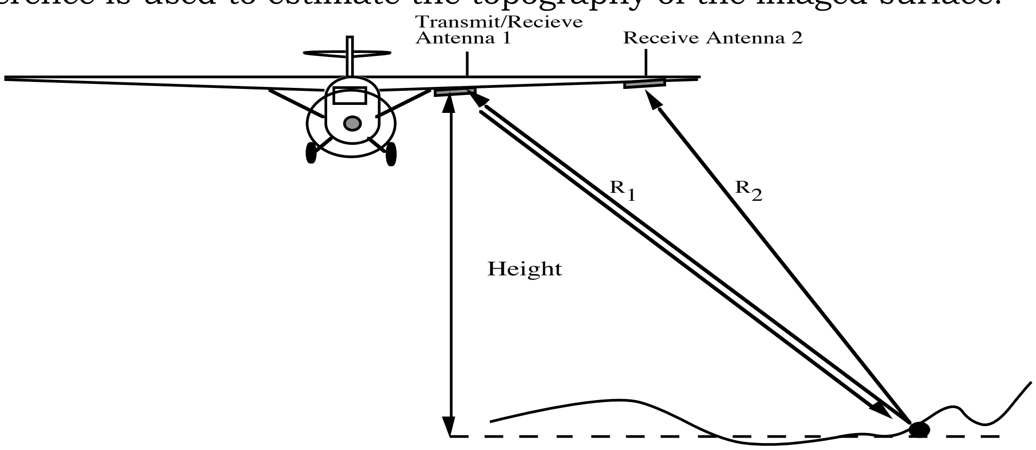

Figure 1. IFSAR geometry.

The accuracy and resolution of the topography estimate is dependent on the characteristics of the transmitted signal. Very wide bandwidth signal modulation (200 MHz) is required to achieve the desired <1 m resolution (4 look). The 200 MHz signal bandwidth is driven by the firm resolution requirements under contract with NASA.

The IFSAR transmitter will be a low PRF (500-1000 Hz) pulsed airborne radar with a peak power of <10 W (average power <15 mW) operating over a bandwidth of 9.9 GHz ± 100 MHz using DSB LFM modulation. The radar will be used in experiments in remote sensing in generally remote areas over very limited time intervals.

Operation location and height:

Our IFSAR will be operated from a small plane flying at 1000-3000 feet altitude. The transmit signal will be directed toward the ground and the backscattered signal received by two other antennas. The transmit antenna beam width is approximately 45°x12° with the peak gain pointed at right angles to the along-track flight direction with an elevation (from nadir) angle of approximately 45°. The plane will fly at approximately 100 mph. The radar will be operated only over small study areas which will be primarily uninhabited areas in central and northern Utah and northern Arizona, Colorado, and Nevada. The collected data will be used to study land slides, mining activities, and water use in order to demonstrate the utility of this instrument in such studies.

Description of the transmit signal:

The transmit frequency will be 9.9 GHz ± 100 MHz. To generate the transmit signal, a baseband signal is generated and filtered to a 100 MHz bandwidth. The baseband signal will be an amplitude-weighted (windowed) linear FM chirp with reduced amplitude at the frequency extremes (see Fig. 2). The transmit signal will be generated by DSB modulation of the baseband signal to a 9.9 GHz center frequency (see Fig. 2). After DSB modulation, the transmit signal will be bandpass filtered.

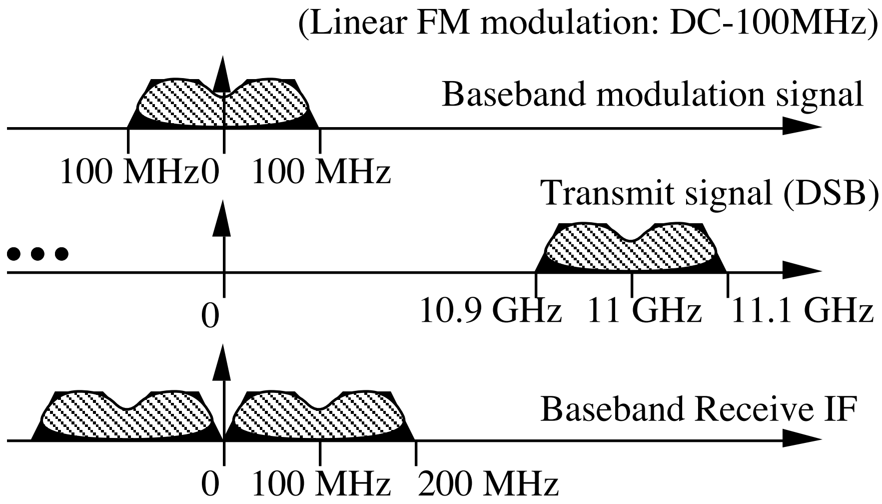

Figure 2. Frequency plan.

The transmit LO (9.9 GHz) is generated by multiplication of an ovenized 100 MHz STALO and carefully filtered to remove spurious harmonics. The reference for the generation of the baseband signal is this same STALO. The transmitter is disabled during the interpulse period.

A linear amplifier with a peak output power of 10 W will be used. The peak radiated power will be less than 5 W this after factoring in cable and vswr losses. The pulse length and PRF will be variable with a pulse length of 0.3-5.0 us and a PRF of 100-2000 Hz (see Fig. 3). The worst-case average transmit power will be 15 mW. The average power spectral density of the transmit pulse will be -101 dBW/Hz. During a transmit pulse the power spectral density will be approximately -75 dBW/Hz.

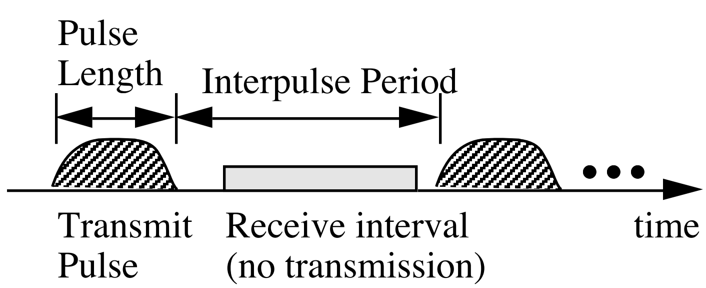

Figure 3. Transmit timing.

Time period of operation:

We have previously flight tested our SAR instrument and would like to make further tests and run additional observational experiments during 2004 and 2005. A prior STA for our equipment is (File Number: 00131-EX-RR-2001, WA2XXQ, 1 July 2001 – 1 July 2003). The RF emissions, antennas, and operations for the planned experiments are identical to this past STA. We would like the new license authorization to become effective in April 2005.

Equipment Description:

The custom IFSAR system has been assembled and tested at Brigham Young University. RF modulation and filtering are done in a custom RF assembly built by a well known microwave company (MITEQ). The final amplifier is a solid-state linear amplifier custom made for us by a commercial company and includes provisions for limiting any out-of-band signals