Program of Research and Experimentation

This is a unique, non-commercial, research-oriented experiment of a radar transmitter and receiver that will improve the radiolocation state of the art. The Synthetic Aperture Radar (hereinafter SAR) was designed and built by The Aerospace Corporation (hereinafter Aerospace) as a research tool. The SAR operating frequencies cover portions of the 92.05 to 99.95 GHz band. The hardware includes a signal generator, power amplifier, variable-frequency modulator and a highly directional antenna, as well as a receiver antenna and demodulator, collocated with the transmitter. The theory of operation of radars, is that transmitted pulsed wideband signal energy is focused in a narrow beam, and signals recived from the illuminated scatterers (e.g. terrain materials) have amplitudes proportional to scatterers' reflectances. In SAR radars, the transmitter has a component of motion in a direction perpendicular to the beam, and the reflected signals are formed into an "image" of the scatterers when resolved into groups of scatterers in a two-dimensional map based on time-of-arrival (range coordinate) and Doppler frequency shift (azimuth coordinate). In the Aerospace SAR hardware, relative SAR platform motion is simulated using motors driving the transceiver along rails generally perpendicular to the beam pointing direction in azimuth. Pulsed signals at the receiver are stored and processed to yield images. Detectable changes in the scatterer amplitudes depend on the wavelength of the illuminating signal and the time-span of the signals processed.

Specific Objectives

The millimeter wavelengths of the Aerospace SAR allow exceedingly small details to be detectable in the radar image, whether they are due to natural or cultural (man-made) actions. Detecting human activity has obvious security applications. However, temperature changes, wind, and ground vibrations effects can mask cultural effects. This image degradations are also dependent on SAR system signal waveforms, rates of relative motion, duration of illumination, platform motion measurement accuracy, and processing complexity. The Aerospace experimental program will continue to yield experimental results demonstrating millimeter SAR

image utility for detecting cultural image effects and for SAR system requirements necessary for the mitigation of image degradations due to natural phenomena.

Contribution to the Radio Art

Understanding and demonstrating the capabilities and limitations of millimeter-wave SAR continue as major objectives of the Aerospace experimental program. Aerospace is uniquely positioned to explore and exploit this technology, given its non-competitive charter and its long experience in radio science, especially in support of national security. As a result of the knowledge gained and subsequent dissemination, Aerospace can provide guidance to other industrial entities in millimeter SAR product requirements and development, further contributing to the radio art as pertains to remote sensing and earth exploration.