



Sandia Remote Sensing E-Magazine

*A publication featuring what's new in
Remote Sensing Technology
at Sandia National Laboratories*



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Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company,
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Recent Accomplishments

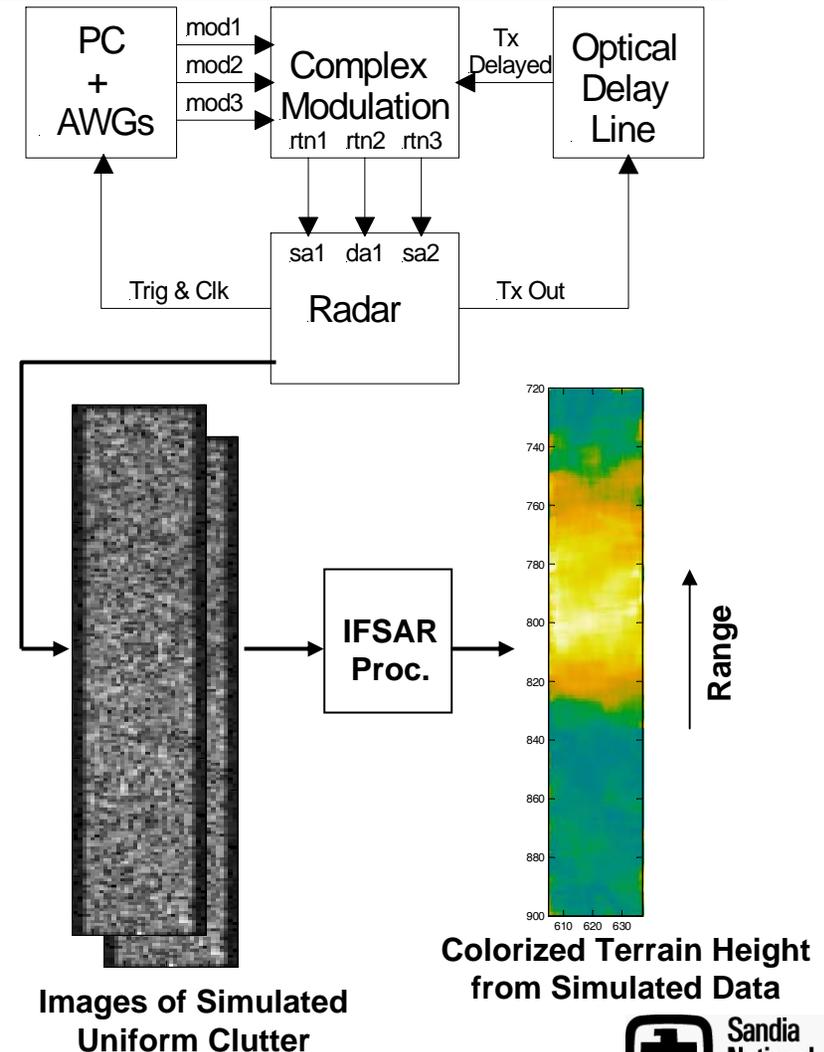
- **MiniSAR System Integration:** The integration of the MiniSAR is formally underway. The radar hardware has been successfully "looped" in the laboratory, confirming initial functionality of signal channels. The overall MiniSAR effort is still on track to fly initially on the Sandia testbed aircraft in the April 2005 timeframe. We are in negotiations for a demonstration of MiniSAR on a small UAV in the Aug/Sep 2005 timeframe.
- **MiniSAR Image Formation:** A detailed fixed point Matlab simulation of an FPGA-based image former was successfully completed. A corresponding image engine design effort is formally underway.
- **GMTI:** A GMTI effort is underway to improve detection and characterization of moving targets. It is expected that part of the improvement will come from new hardware, for example a multiple phase-center antenna, and part will come from additional signal processing. For signal processing, we have looked at using joint time-frequency techniques to analyze target vibration.
- **Image Enhancement:** We are continuing to investigate multiple baseline/frequency methods for resolving IFSAR ambiguity. Also, we are in the process of examining the performance limits of IFSAR.

UHSAR Image of Military Vehicle and Equipment Lot
Ka-Band, 4-inch Resolution
Collected May 10th, 2004

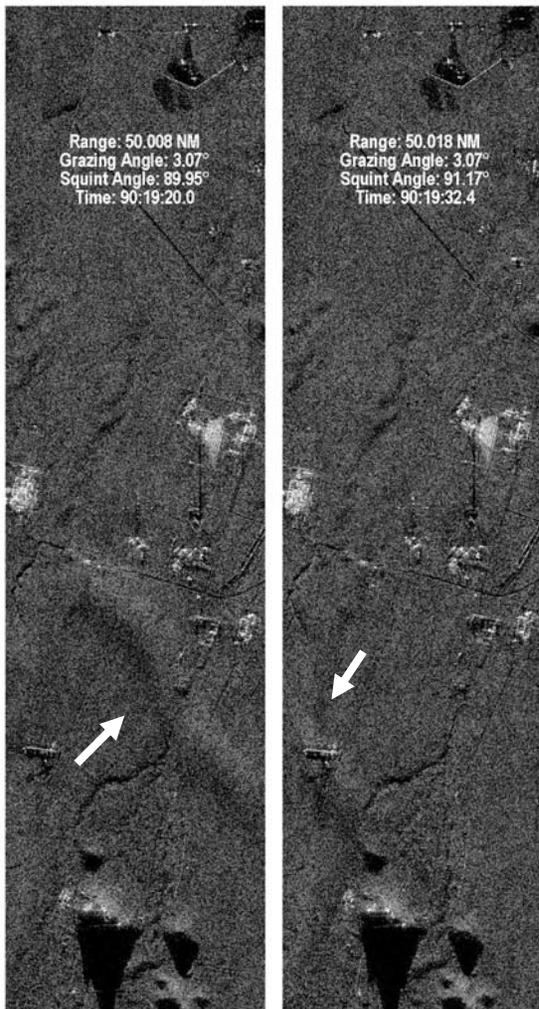


Modulated Optical Delay Line Simulates IFSAR Signals From Terrain Relief

- Optical delay lines have been used for more than a decade at SNL to assist SAR testing.
- Until recently, techniques limited simulated signals to a few point targets at a fixed range with fixed Doppler modulation.
- We recently demonstrated that a region of uniform clutter could be simulated by complex modulation of the optical delay line signal. The modulated signal appears to come from terrain as the radar passes by.
- Using multiple modulations of the delay line signal we also produced multi-channel signals for an IFSAR receiver that has terrain relief.
- Using this laboratory system we can perform more complete end-to-end testing of IFSAR systems.

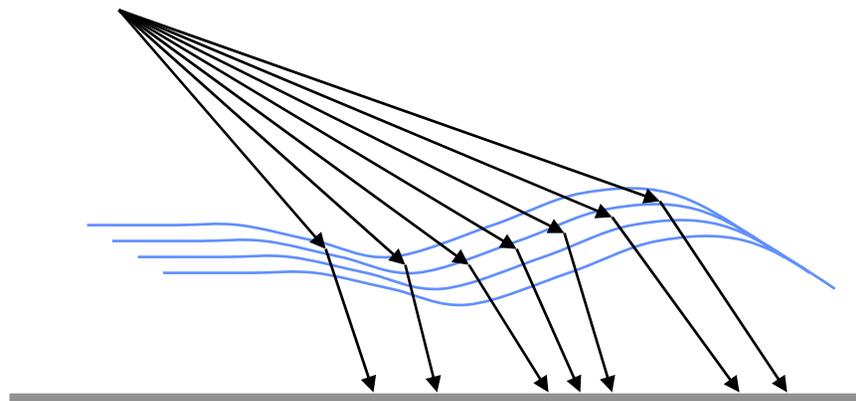


Atmospheric Effects Studies



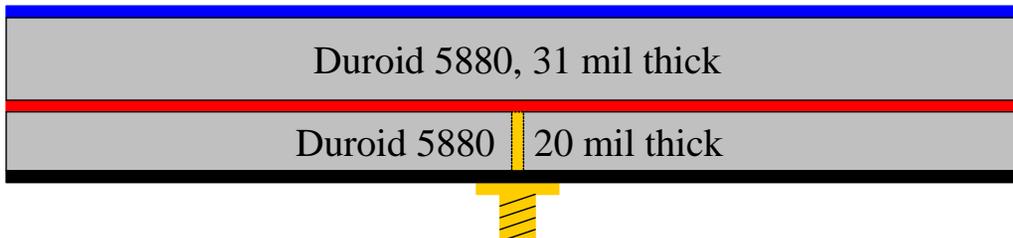
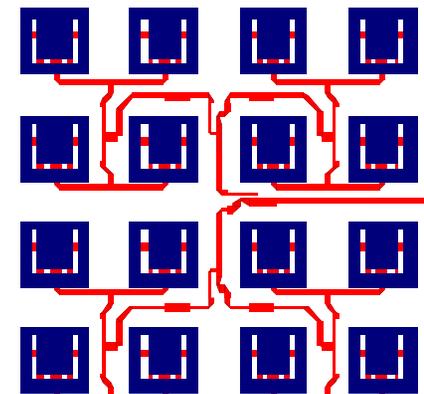
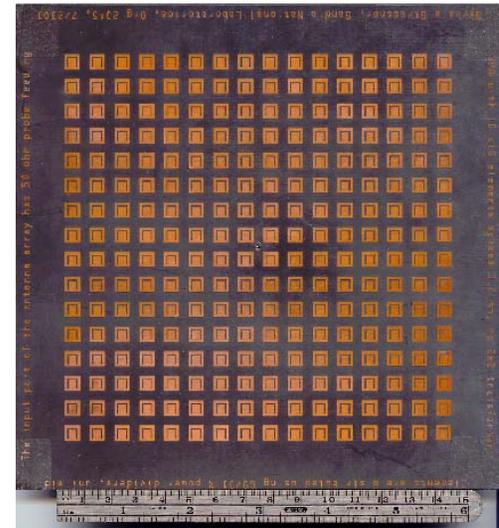
- Relatively recent Synthetic Aperture Radar (SAR) images collected by Sandia's airborne testbed radar occasionally show some image anomalies that are exacerbated with longer synthetic apertures required by finer resolutions at longer ranges. Anomalies include problematic spatially variant phase errors and brightness fluctuations in the image that appear to have no systemic cause.

The working hypothesis for continuing research is that this is being caused by anomalies in the clear-air refractive-index field in the lowest kilometers of the atmosphere due to a variety of boundary layer phenomena.



Lightweight Passive Array Antennas

- Traditional offset-fed reflector impractical
 - Feed too large; requires larger radome (larger swept volume)
- Novel microstrip patch array developed
 - Ultra-broad band: > 20% bandwidth achieved via unique slot coupling to element
 - Simple, multi-layer Duroid construction (53 mils thick)
 - Power distribution taper to reduce sidelobes (currently -18 dB, working toward -28 dB)
 - Ultra-lightweight: 0.4 lbs/ft²
 - Efficiency: approx. 50%-- currently studying approaches to lower loss in feed structure
 - Good IPR performance





Recent Publications

1. **Armin W. Doerry, “Autofocus Correction of Excessive Migration in Synthetic Aperture Radar Images”, Sandia Report SAND2004-4770, September 2004.**
2. **Armin W. Doerry, “GMTI motion compensation”, US Patent 6,765,526, July 20, 2004.**



Additional Information

Visit the following link for additional information:

www.sandia.gov/radar/sar.html