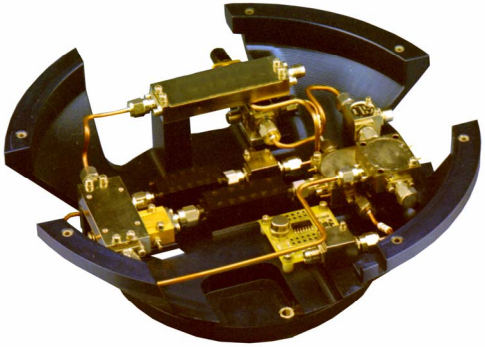
Sandia Remote Sensing E-Magazine

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



May 2005

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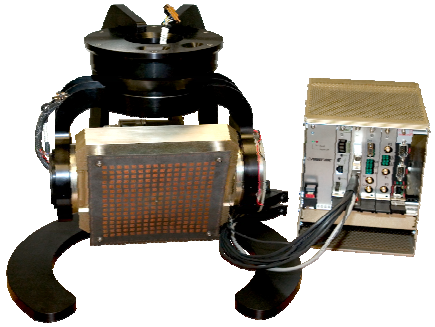
Edition 2005 /2nd Quarter

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Sandia Miniaturized SAR

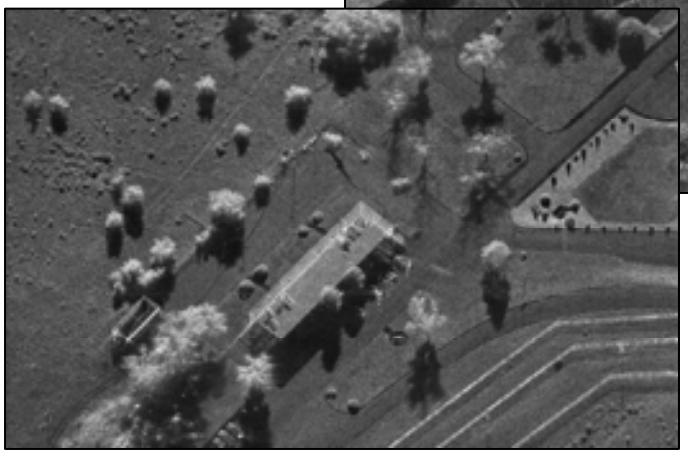
- ***Initial test flights successfully completed***
  - ***Real-time, on-board image formation***
- **MiniSAR program: reducing size, weight, and cost of high performance SAR by 5-10x without reducing resolution or quality.**
- **Facilitates new applications:**
  - **All weather intelligence, surveillance, and reconnaissance from small UAVs**
    - **such as AAI Corp. *Shadow 200***
  - **All weather, GPS-denied precision weapon guidance**



MiniSAR Antenna/Gimbal Assembly (AGA) and Radar Electronics Assembly (REA).

Real-time image of static aircraft display at 0.3 m resolution.

parameter	*value*	*notes*
Weight	25 lbs	under 20 lbs (early 06)
Size	7'' cube (REA) 11'' swept vol. (AGA)	(antenna size is adjustable)
Frequency	Ku-band (16.8 GHz)	Readily adaptable to X- or Ka-band
Resolution	4 inch	Real time, spotlight
Modes	Spotlight SAR (initially)	Stripmap, GMTI, CCD (soon)



Real-time image of NNSI facility at 0.1 m resolution.

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Image down-sampled and compressed for emailing

MiniSAR real-time image of Kirtland AFB golf course clubhouse,
Ku-band, 0.1 m resolution, 3.4 km range, 28° grazing angle.

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Image down-sampled and compressed for emailing

MiniSAR real-time image of Kirtland AFB Eubank gate,
Ku-band, 0.1 m resolution, 3.5 km range, 26° grazing angle.

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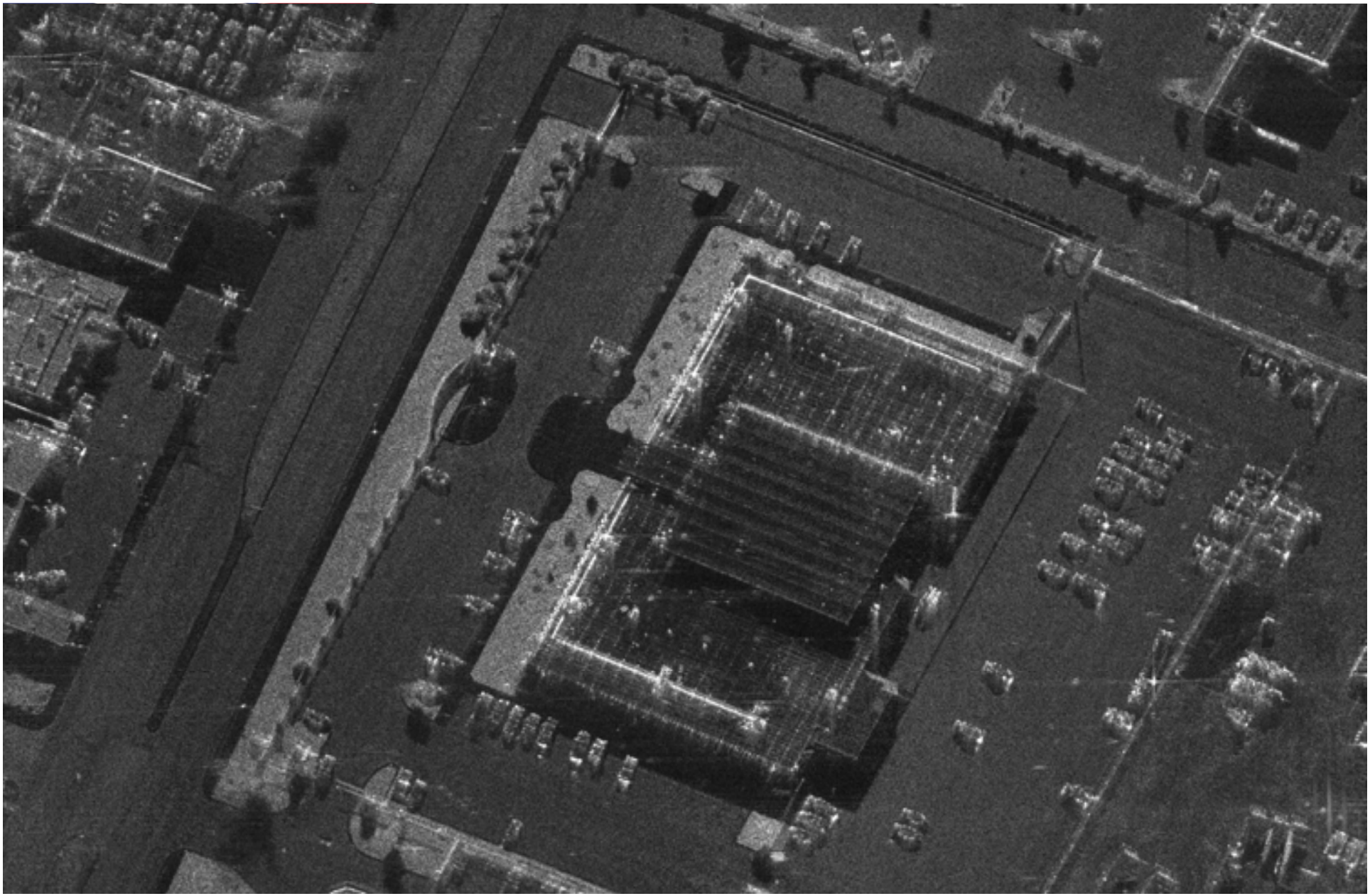

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MiniSAR real-time image of Army National Guard Armory in Albuquerque, NM, Ku-band, 0.1 m resolution, 3.3 km range, 29° grazing angle.

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Recent Accomplishments

- **Inertial Navigation Instruments:** We are investigating a small MEMS Inertial Measurement Unit (IMU) as a viable candidate for application to very small SARS (a future generation of Mini-SAR). These represent considerable size, weight, and cost savings over presently used instruments. Large quantities of test data have been generated which we are now studying. Results are promising.
- **GMTI:** We have defined the modifications that need to be made to the Sandia Ka-band UHRSAR system in order to accommodate GMTI and Vibrometry activities. We have started updating the system wiring diagrams and will start on the hardware modifications soon.
- **Image Enhancement:** We are continuing to investigate the use of multiple phase-centers for resolving IFSAR ambiguities and multiple point targets. We have shown that, by using only two pairs of phase-centers, it is possible to detect and correct for the presence of two point targets in a single resolution cell. This extends our earlier finding of a significant reduction in IFSAR ambiguity errors when the antenna phase-centers are increased from two pairs to three pairs of phase-centers.
- **Long-range Atmospheric Effects:** Our investigation of observed effects, attributed to the atmosphere continues. Models are continuing to be refined, with the latest being presented at the SPIE Defense & Security Symposium in Orlando, FL, at the end of March.
- **Image Quantization Effects:** We have processed over 600 Coherent Change Detection (CCD) image pairs with 30 different types of lossy compression and analyzed the results to determine just how many image magnitude and phase bits we need to keep to get good CCD results. We are now in the process of documenting the results.

Recent Publications/Patents

- A. Doerry, D. Dubbert, M. Thompson, V. Gutierrez, “A portfolio of fine resolution Ka-band SAR images: part I”, SPIE 2005 Defense & Security Symposium, Radar Sensor Technology X, Vol. 5788, Orlando FL, 28 March - 1 April 2005.
- A. Doerry, D. Dubbert, M. Thompson, V. Gutierrez, “A portfolio of fine resolution Ka-band SAR images: part II”, SPIE 2005 Defense & Security Symposium, Radar Sensor Technology X, Vol. 5788, Orlando FL, 28 March - 1 April 2005.
- A. Doerry, “Autofocus correction of SAR images exhibiting excessive residual migration”, SPIE 2005 Defense & Security Symposium, Radar Sensor Technology X, Vol. 5788, Orlando FL, 28 March - 1 April 2005.
- A. Muschinski, F. Dickey, A. Doerry, “Possible effects of clear-air refractive-index perturbations on SAR images”, SPIE 2005 Defense & Security Symposium, Radar Sensor Technology X, Vol. 5788, Orlando FL, 28 March - 1 April 2005.
- Dale F. Dubbert, Bert Tise, “Digital intermediate frequency receiver module for use in airborne SAR applications”, US Patent 6,864,827, March 8, 2005.
- Dale F. Dubbert, Peter A. Dudley, Armin W. Doerry, Bertice L. Tise, “Waveform synthesis for imaging and ranging applications”, US Patent 6,836,240, December 28, 2004.

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Additional Information

Visit the following link for additional information:

www.sandia.gov/radar/sar.html

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