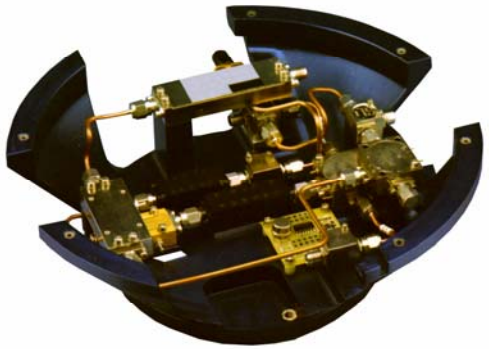
Sandia Remote Sensing E-Magazine

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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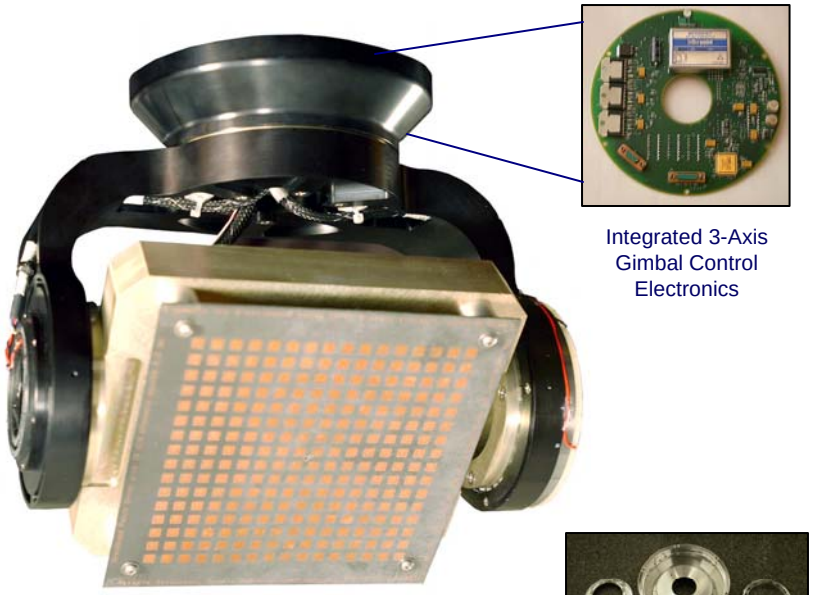
MiniSAR Gimbal Assembly

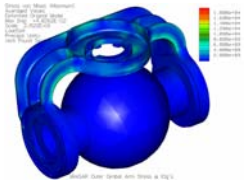
- **Extremely well suited for both airborne and ground-based applications.**
- **A perfect match for small, tactical UAV's.**
- **Clearance through each axis for cables, slip-rings, rotary joints, optical paths, etc.**
- **Easily modified for various payloads and configurations including 3 axes if required.**
- **Based on over 20 years of gimbal design experience for airborne and ground-based applications.**

Gimbal Features

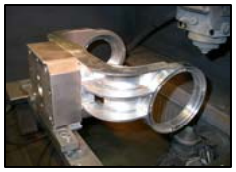
- **Minimum 15 pound payload capacity**
- **Small Size and Weight**
  - **~12" Swept Diameter - 9.5" Tall**
  - **7 lbs with Aluminum Structural Components**
  - **6 lbs. with Magnesium Structural Components**
- **2 Axis Design, 3rd Axis Could Be Added**
- **Direct Drive DC Torque Motors - 325oz-in per axis**
- **Low Torque ABEC 5 Precision Bearings**
- **Pancake-Style Resolvers w/16Bit R/D's**
- **Integrated 3-Axis Gimbal Control Electronics**
  - **RS-422 Communications, Control and Feedback**
  - **Resolver Drive and Decode Circuitry**
  - **PWM, H-Bridge Drive Off 28VDC Single Supply**
- **Gimbal Freedoms**
  - **Outer ±175°**
  - **Inner ± 45°**
- **2.5grms Vibration Minimum**
- **10g Sustained with Balanced Payload**
- **Pointing Stability**
  - **~ 200µrad with LN-200 IMU**



Integrated 3-Axis Gimbal Control Electronics



Iterative Structural Analysis to Optimize Design



Low-Stress Manufacturing Methodologies

Light Weighted Structural Components

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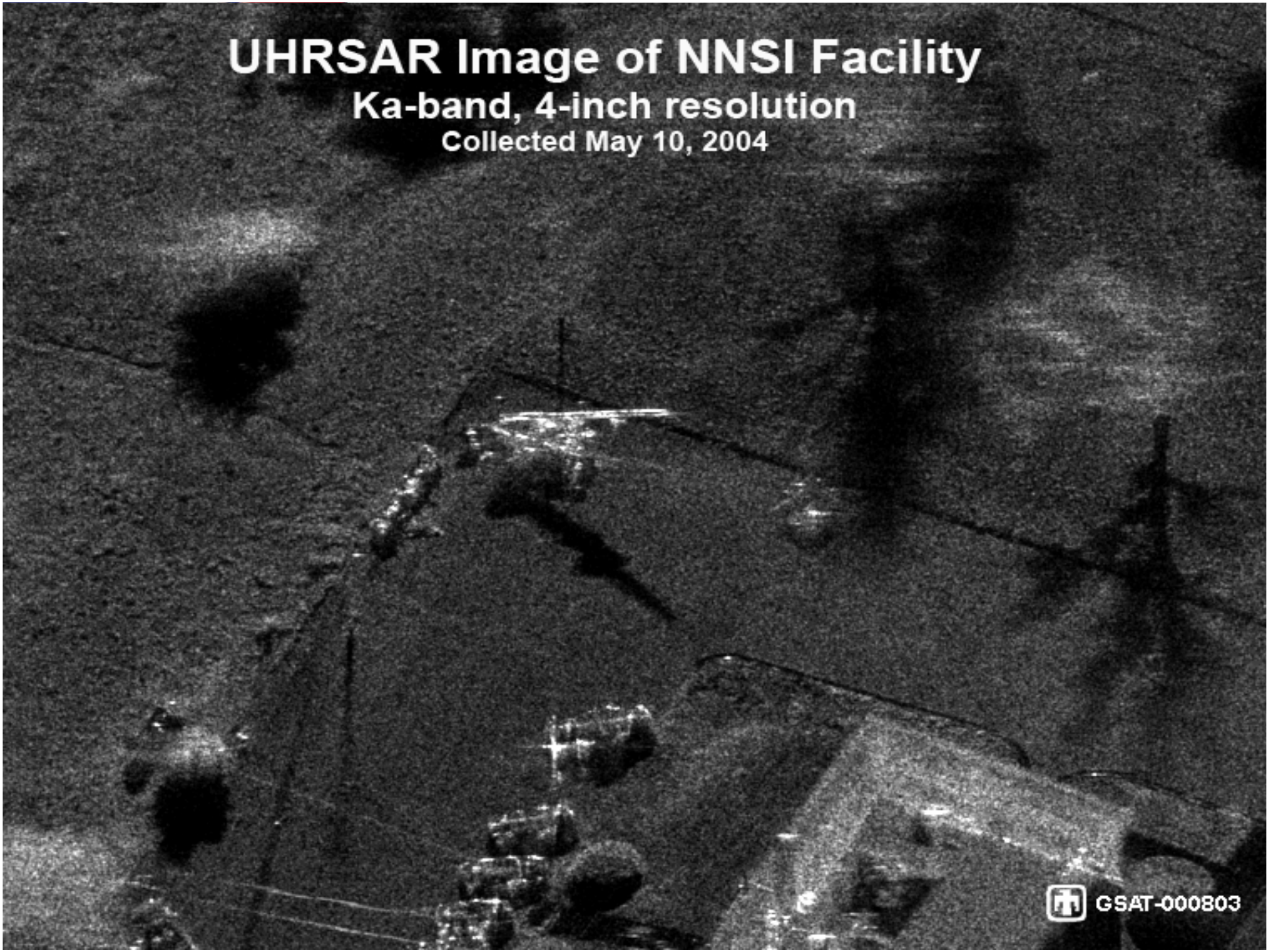
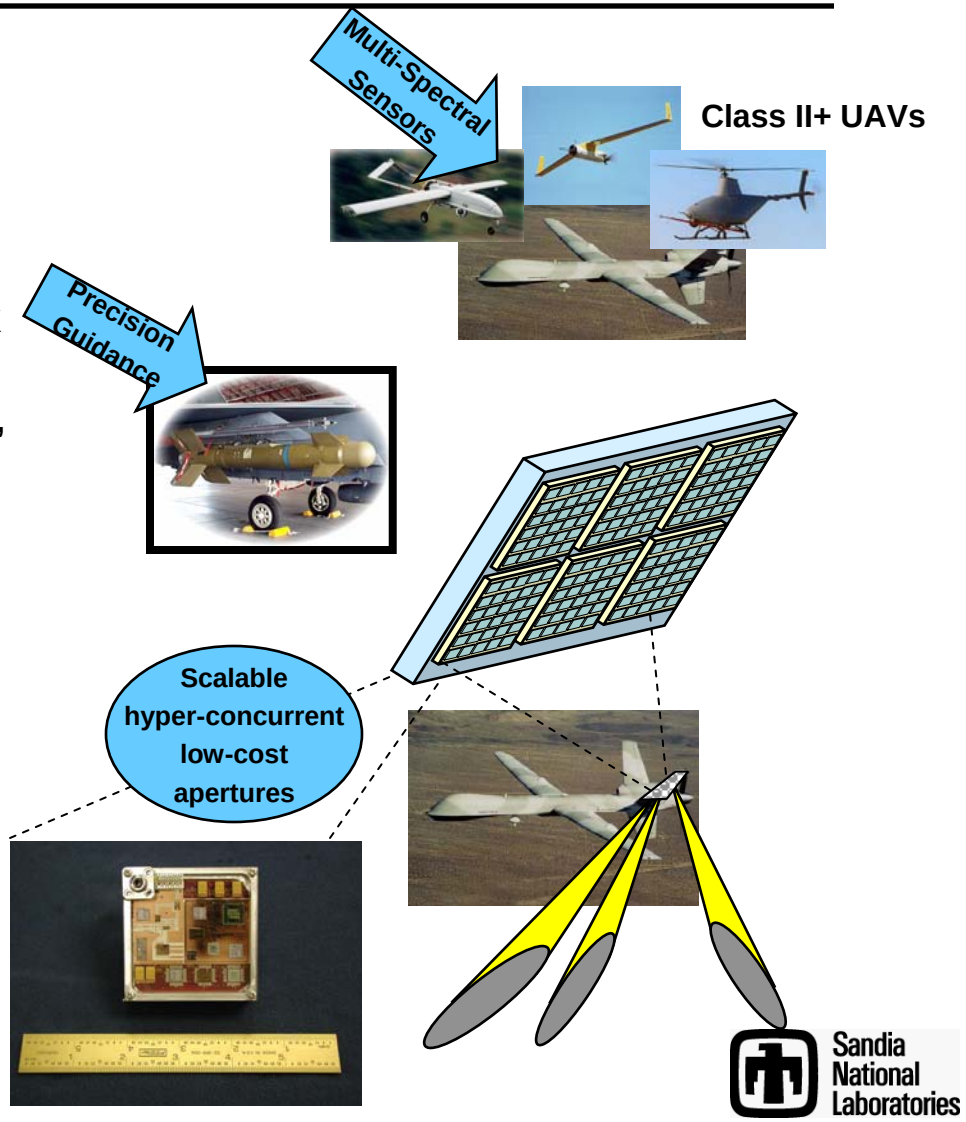

UHRSAR Image of NNSI Facility
Ka-band, 4-inch resolution
Collected May 10, 2004
GSAT-000803

MESA SAR: generation-after-next ultra-miniature SAR

- Facilitated by Sandia's Microsystems (MESA) programs: beginning 4 year effort
- FIRE Module Technology: Fully Integrated Radar Element
  - **Full exciter/receiver (from DWS to DRx, 2 x 2 x 1 inch module, true independent radar phase center)**
  - **Scalable Architecture:**
    - **1-2 modules: 5 to 10 lb SAR (, $25K SAR with passive ESA (RF MEMs) (4" res.)**
      - **Class II UAVs, sensor fusion, precision munitions**
    - **4-8 modules: 10-15 lb SAR with multi-phase center capability (endoclutter GMTI, etc.)**
      - **Class II/III UAVs, sensor fusion, advanced GMTI**
    - **10's to 100's of modules: scalable tile ESAs with multi-mode, multi-beam capability (hyper-concurrency)**
      - **Class IV UAVs, manned aircraft**
- Near term tasks (demonstrated as spiral enhancements to current miniSAR)
  - **Quadrature DWS SiGe ASIC**
  - **Stalo MCM (SiGe ASIC with custom SAW filters)**
  - **GaN SSPA MMIC**



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Recent Accomplishments

- **MiniSAR Hardware System Integration: Integration of the prototype MiniSAR system continues to progress at a steady pace in preparation for the April-May 2005 inaugural flights on the DOE Twin Otter. Full receiver/exciter radar loop tests using a standard optical delay line have proven very successful, with the performance of the Quadrature Digital Waveform Synthesizer (QDWS), the Digital Receiver (DRX), and the ultra-miniature analog RF assembly meeting or exceeding expectations. Current activities focus on the completion of the gimbal inner axis components, software integration with the radar electronics, and system calibration.**
- **MiniSAR Gimbal: The Mg-based MiniSAR gimbal iteration has been fabricated, and is currently undergoing evaluation. This design will provide a 1 lb weight savings over the original Al design, as well as provide a second gimbal. A composite gimbal arm has also been fabricated and is undergoing evaluation.**
- **Image Enhancement: We are continuing to investigate multiple baseline/frequency methods for resolving IFSAR ambiguities. We have shown that, by increasing the number of phase center pairs to three pairs of phase centers, the probability of observing an IFSAR ambiguity error decreases approximately as the square of the probability of an ambiguity error for just two pairs of phase centers (if the probability of an ambiguity error for two pairs is approximately 10e-5, the error probability for three pairs of phase centers is only about 10e-10). Also, we believe that it is possible to extend the work on three pairs of phase centers to include the ability to detect and correct for the presence of two reflectors in a single resolution cell.**

Recent Publications/Patents

- **Armin W. Doerry, Fred M. Dickey, “Synthetic Aperture Radar”, Optics & Photonics News (OPN), November, 2004.**

- **Peter A. Dudley, Armin W. Doerry, Dale F. Dubbert, Bertice L. Tise, “Waveform synthesis for imaging and ranging applications”, US Patent 6,825,800, November 30, 2004.**
- **Armin W. Doerry, Peter A. Dudley, Dale F. Dubbert, Bertice L. Tise, “Waveform synthesis for imaging and ranging applications”, US Patent 6,828,933, December 7, 2004.**
- **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.**

Additional Information

Visit the following link for additional information:

www.sandia.gov/radar/sar.html