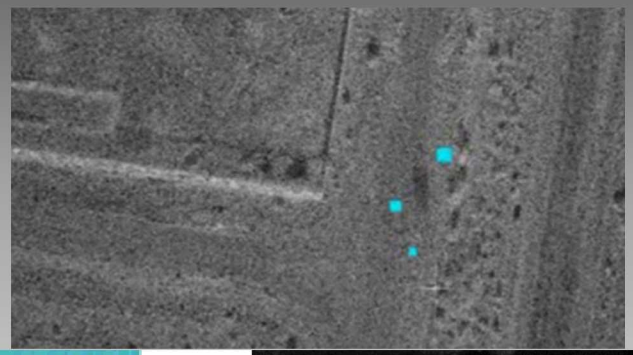
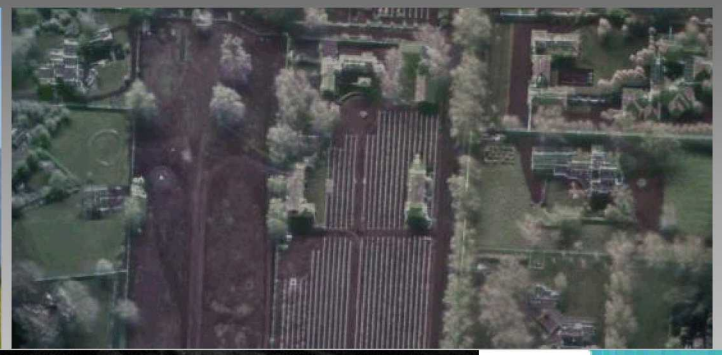
SAND2018-11875C

Sandia.gov/radar





Radar ISR Overview

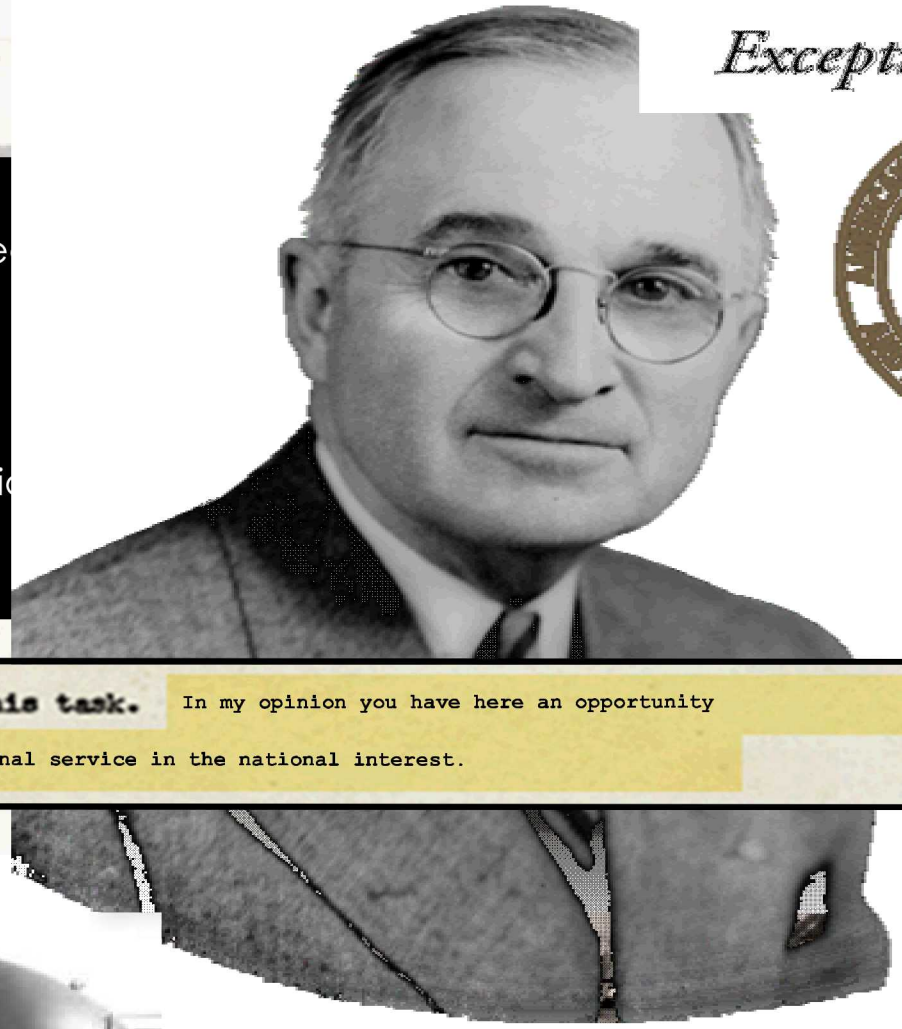
Dr. Steven Castillo, Sr. Manager, Radar ISR
Sandia National Lab
spcasti@sandia.gov, (505) 2

Sandia Radar ISR: www.sandia.gov/radar/

Sandia National Laboratories is a multimission laboratory managed and operated by National Technology and Engineering Solutions of Sandia, LLC., a wholly owned subsidiary of Honeywell International, Inc., for the U
of Energy's National Nuclear Security Administration under contract D

Exceptional service in the national interest

- July 1945: Los Alamos cre
  Division
- Nonnuclear component
  engineering
- November 1, 1949: Sandi
  Laboratory established



to undertake this task. In my opinion you have here an opportunity to render an exceptional service in the national interest.

May 13, 1949

Wilson:

I am informed that the Atomic Energy Commission intends that the Bell Telephone Laboratories accept under contract ...tion of the Sandia Laboratory at Albuquerque, New Mexico. This operation, which is a vital segment of the atomic ...program, is of extreme importance and urgency in the na- ...fense, and should have the best possible technical direc-

I hope that after you have heard more in detail from the ...ergy Commission, your organization will find it possible to undertake this task. In my opinion you have here an opportunity to render an exceptional service in the national interest.

I am writing a similar note direct to Dr. O. E. Buckley.

Very sincerely yours,

Harry Truman

Mr. Leroy A. Wilson,
President,
American Telephone and Telegraph Company,
195 Broadway,
New York 7, N. Y.

Governance of Sandia Laboratories

National Technology and Engineering Solutions of Sandia (NTESS) Corporation

- AT&T: 1949–1993
- Martin Marietta: 1993–1995
- Lockheed Martin: 1995–2017
- Honeywell: 2017- present
- Government owned, contractor operated

Federally Funded Research and Development Center (FFRDC) Unique nonprofit entities sponsored and funded by the U.S. government to meet some special long-term research or development need

Sandia is 1 of 39 recognized FFRDCs

RADAR ISR 5340

- **Missio**
  We de deliver and support advanced, high performance RF imaging tions for the most challenging and urgent national securi problem
- **Vision:**
  Be recog d as the leader of innovative RF imaging solutions that support S lia's national security mission and solve extreme national security c enges through a flexible, world class workforce, broad, robust pr ammatic engagement, and relevant, cutting edge technol .
- **Workfo**
  - 89 Engineers, Technologists, and support staff.
    - nts issued since 2012.

Sandia National Laboratories

Radar ISR Solutions

3+ deca… pathfinde… and urgen… (FFRDC)

…experience delivering …olutions for complex, critical …ional security problems

- All Weather, … or Night
- High Resoluti… Optical-like
- On-board ar… eal-time Processing
- Flexible platf… and TPED configuration

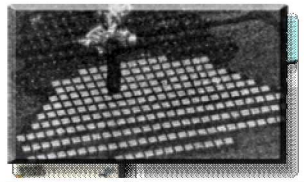
High Resolution SAR/VideoSAR

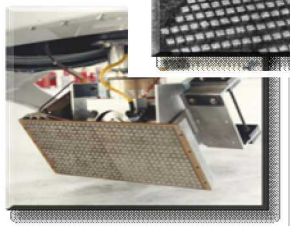
High Resolution CCD/VideoCCD

Sandia National Laboratories

Sar... r Evolution

1987

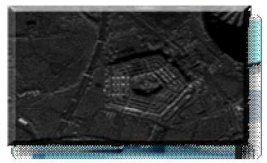


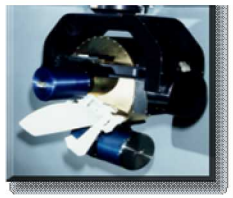


500 lbs

Terminal Fix System (TFS) SAR

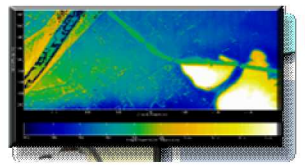
1991

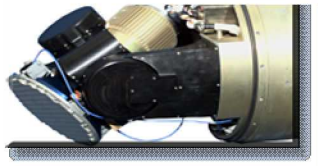




SAR Target Recognition &

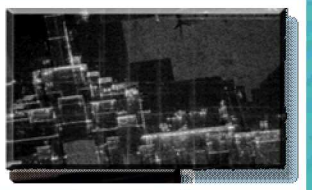
1997





Inertial Terrain Aided Guidance (ITAG)

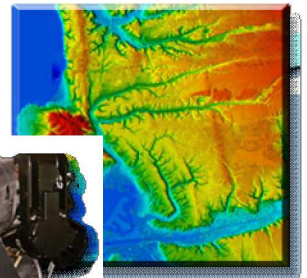
1998



120 lbs

Lynx Multi-Mode Radar CCD & GMTI

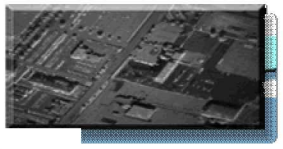
2001

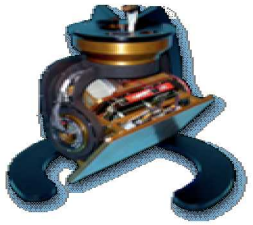


664 lbs

Rapid Terrain Visualization (RTV)

2004



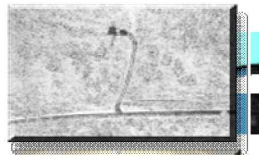


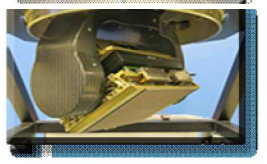
Developed for a Class III UAV

27 lbs

MiniSAR

2008



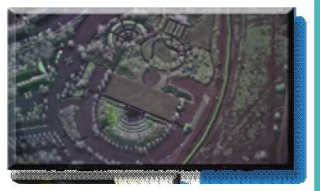


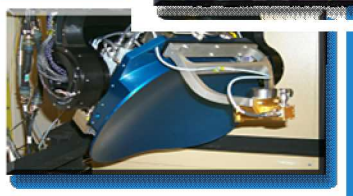
IED Detection

65 lbs

Copperhead

2010





FARAD

Multi-mode

Variable Resolution & SWAP

Improving radar performance & reducing SWAP for three decades

e Mission Solutions

- Provia
  and inf
  - **Missio**
    - Pre
    - High
    - Cont
    - Analy
  - **Real-time**
    - Real-t
    - Image
    - Chan
    - Trans
  - **Advanc**
    - Pre
    - H
    -
  - **A**

-end solutions that leverage physics, engineering, and data cience to support national security decision making

ering

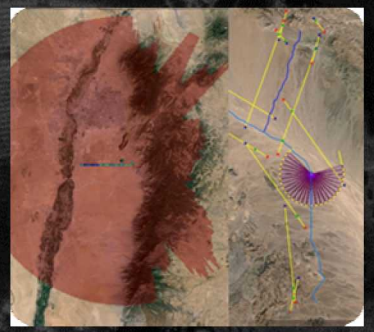
- nalysis & Flight Planning
- mized TTPs and CONOPs
- performance assessments
- ing in SAR phenomenology

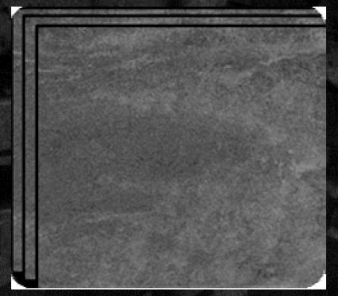
essing

- elivery of Multiple Image Products to Analysts
- ation
- rection Products
- of Real-time Products

sor Exploitation

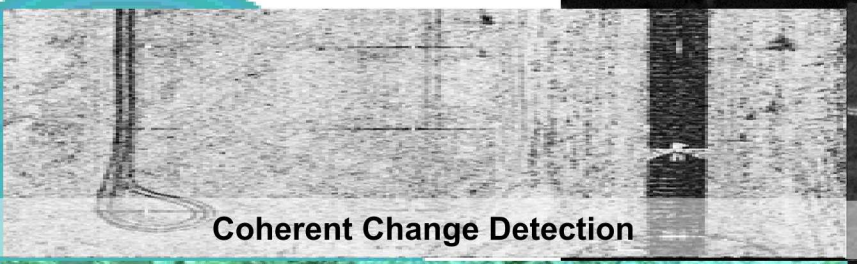
- telligence
- ors
- xploitation Techniques

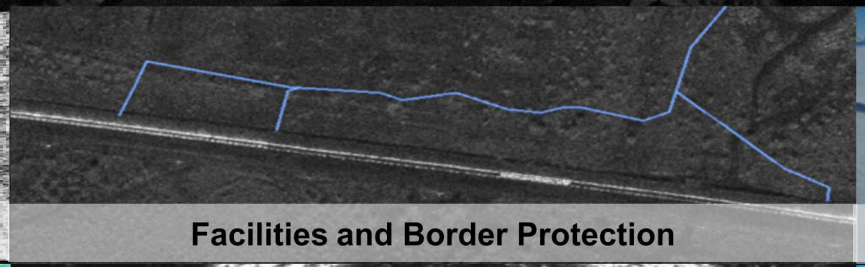





ery integration into PED cycle is difficult at best.

d Applications

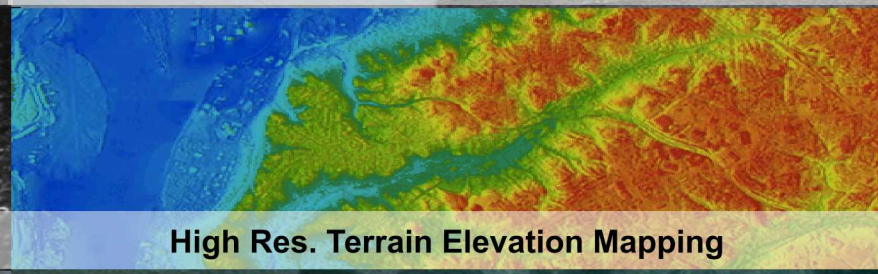

Coherent Change Detection

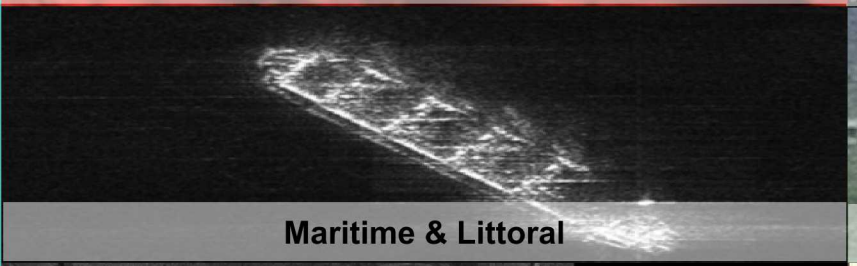

Facilities and Border Protection


Crevasse Detection

Environmental Monitoring

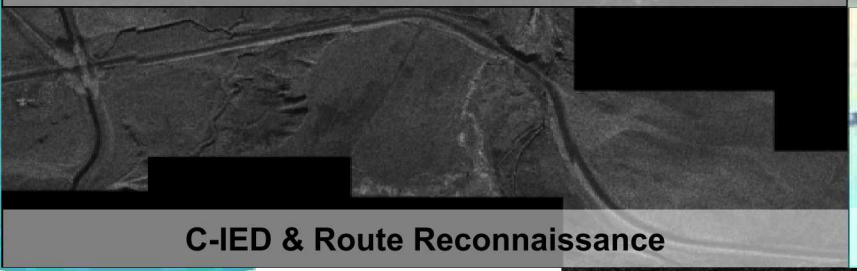

Space Missions

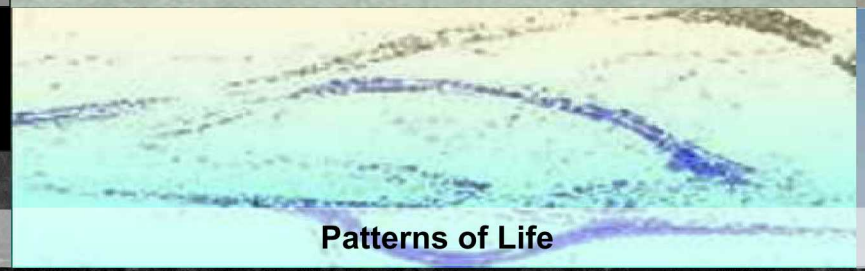

High Res. Terrain Elevation Mapping


Maritime & Littoral


Vehicle and Dismount Tracking


S&R and Targeting


C-IED & Route Reconnaissance

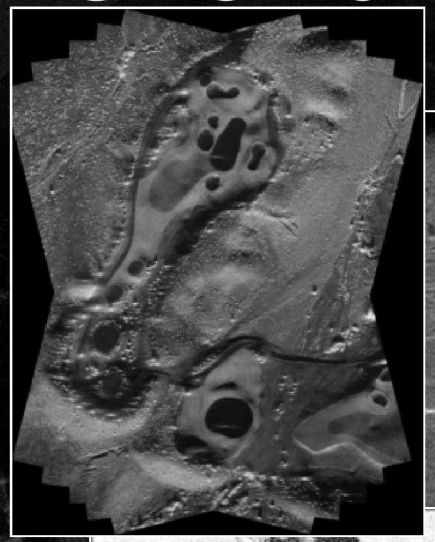

Patterns of Life

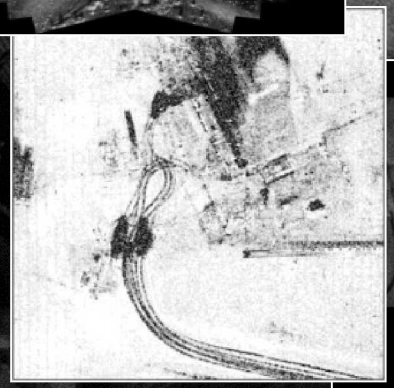

Precision Guidance

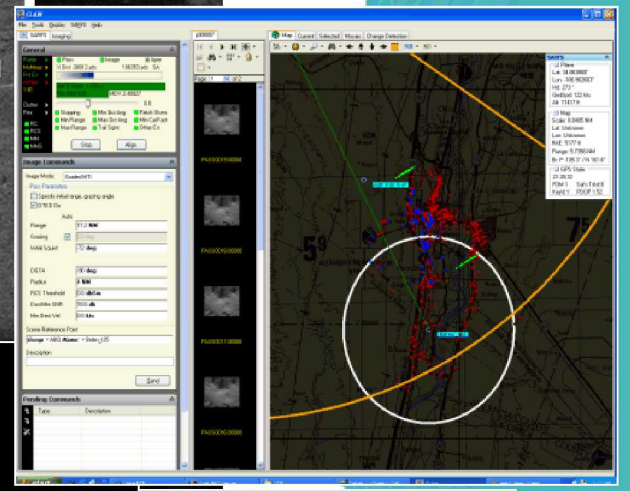
ce ‘97, Sandia radars have operated in all geographic COCOMS

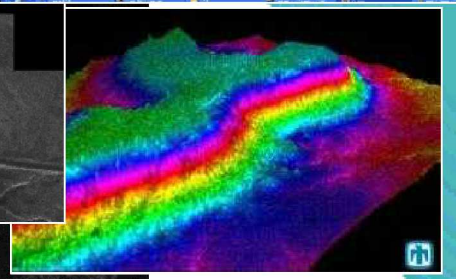
M ode Functionality

- Spotlig
- SpotDw
- Circle
- Stripmap
- Arbitrary S nap
- CCD/NCP
- IFSAR
- VideoSAR TR
- GMTI/D
- Wide A arch
- High esolution







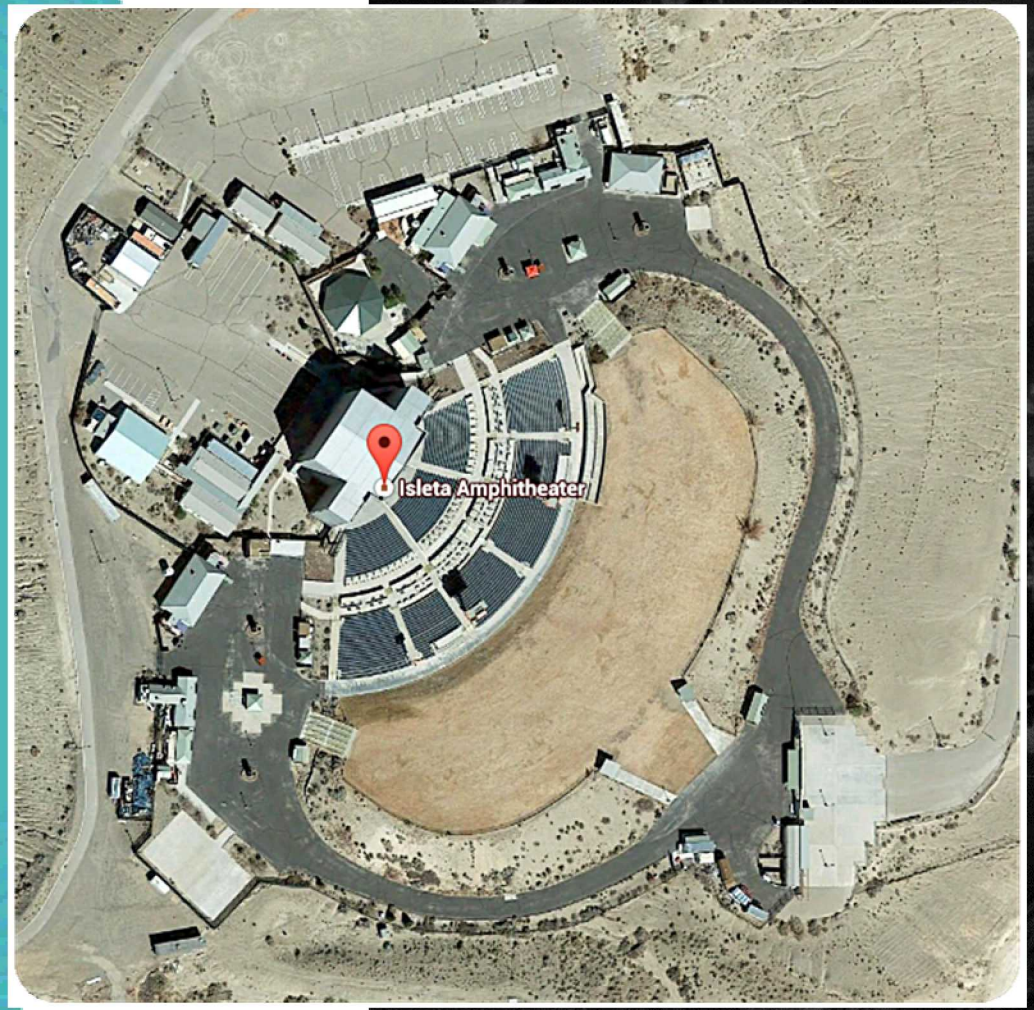


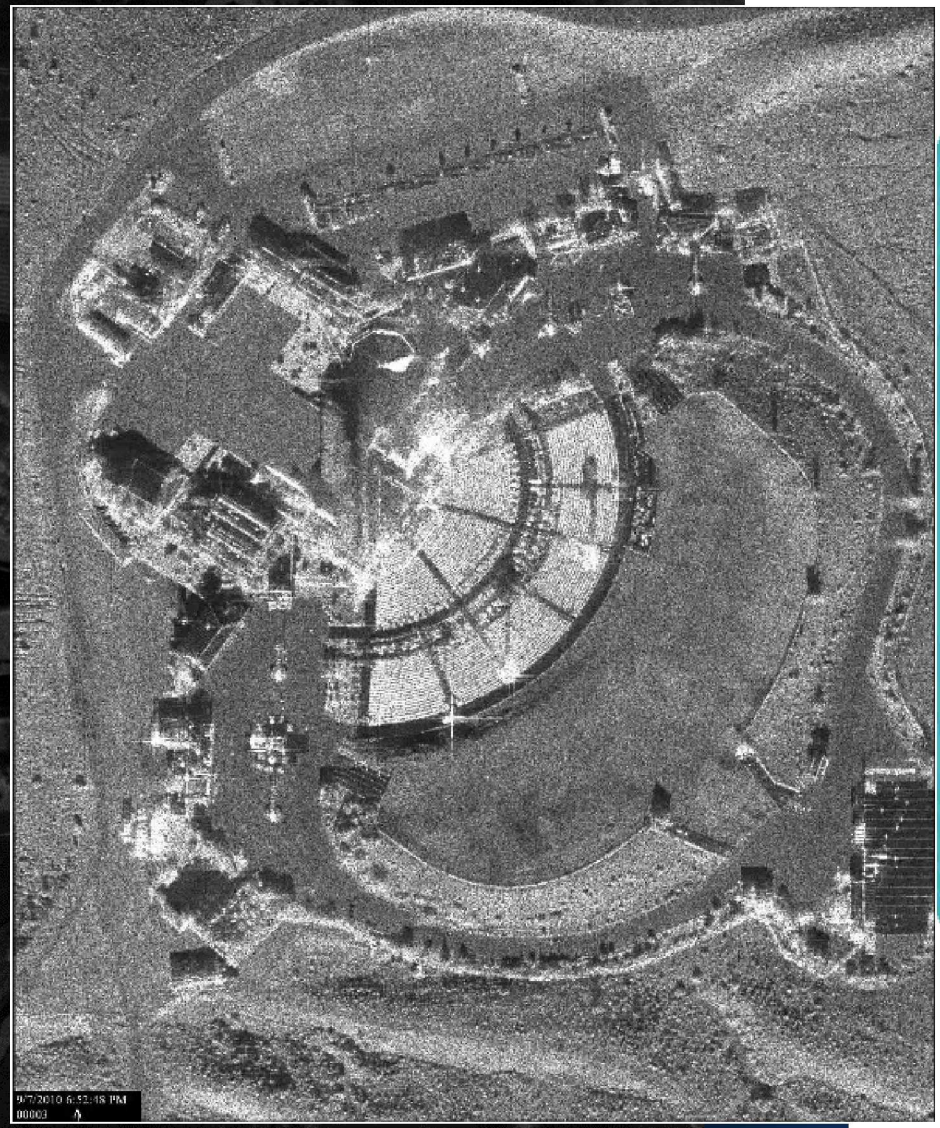
radar modes are developed they can be integrated into existing San
uring product improvement phases without redeveloping the entire syste

VideoSAR Vehicles Example

- This is VideoSAR foota
  a gate at a facility. Th
  video shows vehicle t
  moving through the g
  As the vehicles are in
  motion their location
  indicated by a shado
  the vehicles stop the
  reflected energy of th
  vehicles fall on top of
  shadow. Once the ve
  continues in motion t
  shadow is again visib
  lines moving across th
  screen are Doppler sh
  caused by the movin
  vehicles.

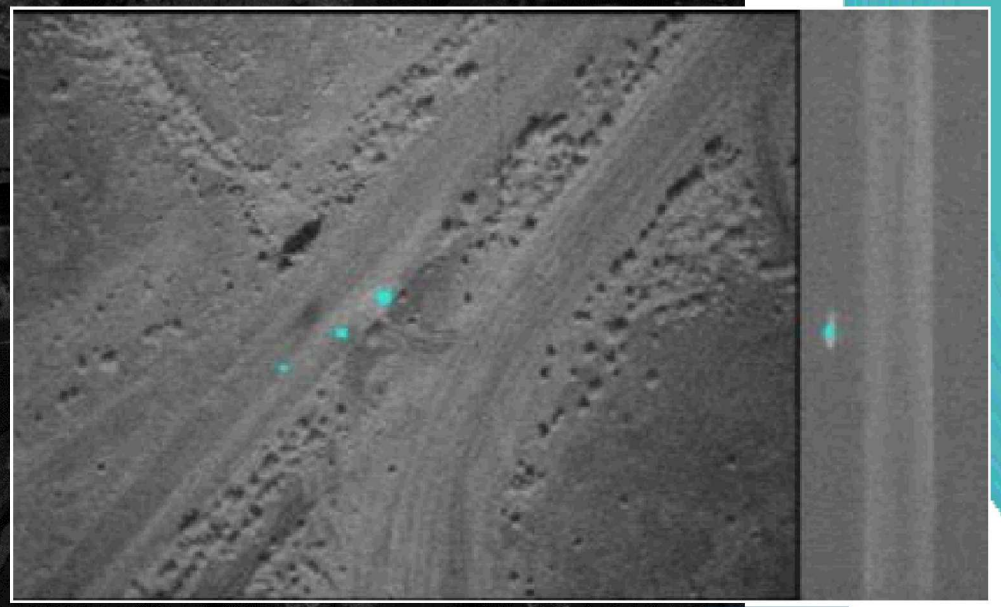
Facility Example





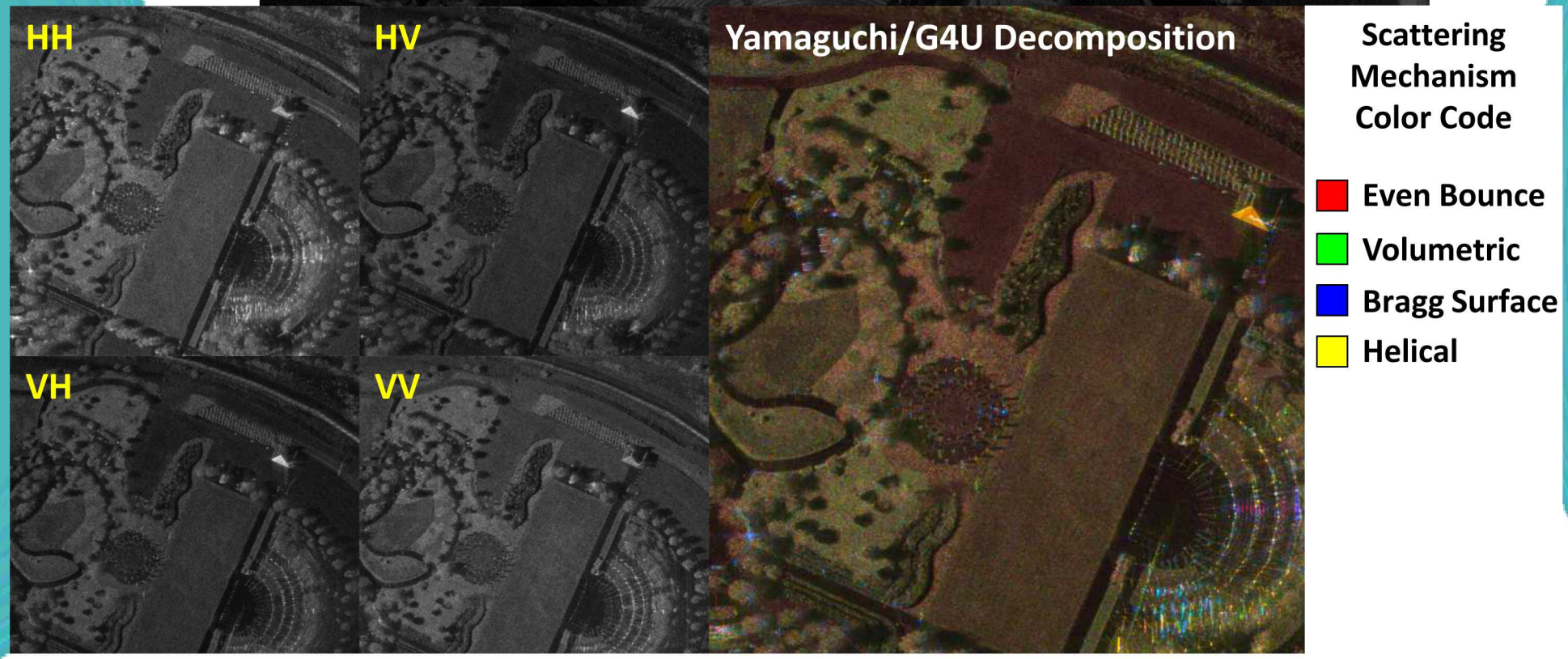
A ced Capabilities

- Multip nnels with the same instantaneous bandwidth.
- Multiple se centers – sum and difference yield clutter suppression and incr ed ability to track targets.
- Polarime HH, VV, HV, VH) yields additional information around scatterin henomena.



olution Polarimetric SAR

- Valu metric SAR is not in visual comparison of individual channel (HH VV, HV catter intensity maps, but rather in the inference of underlying scatteri chanisms from these independent phase coherent measures



SNL FARAD, X Band, 0.2m Full-Pol Imagery of New Mexico Veterans Memorial, Model Based Decomposition Example

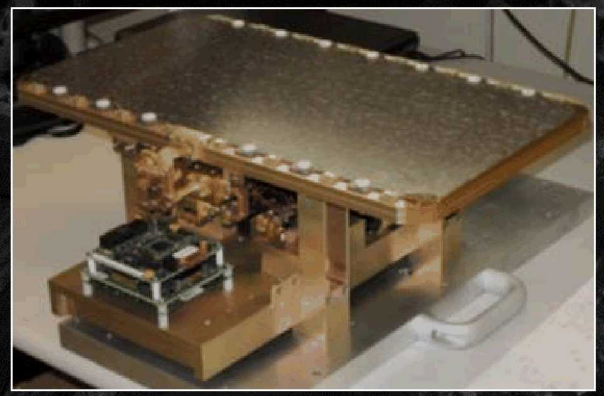
Purpose of FARAD

- An in… high-performance, multi-mode airborne radar capability for the… ed advancement of SAR ISR capabilities
- FARAD … accord with R&D efforts, both internal and external, to provide … nced radar airborne data collection and exploitation assets to … ate specific research goals
- FARAD pro… es a "testbed laboratory"/research tool set that can be widely utili… in support of internal R&D, new program developm… t, and collection of customer requested data products

DeHavilland DHC-6 "Twin Otter" research aircraft operated for Sandia by Twin Otter International

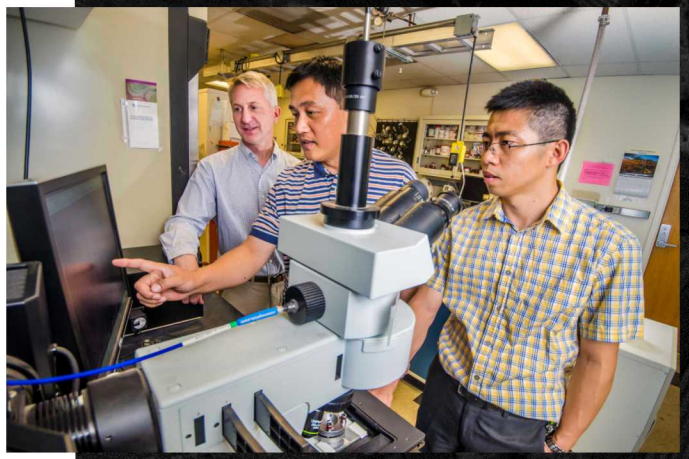
AR R&D Testbed

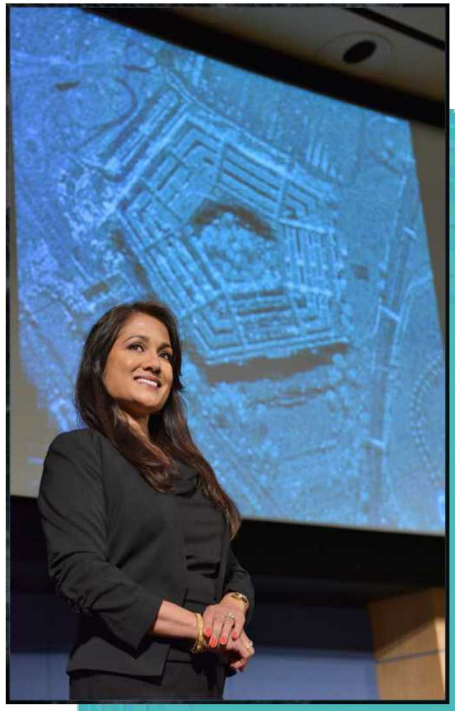
- F
  - F armetric
- Ku-Ba
  - Qu hase center planar antenna
- Ka-Bar
  - Du ase center planar antenna



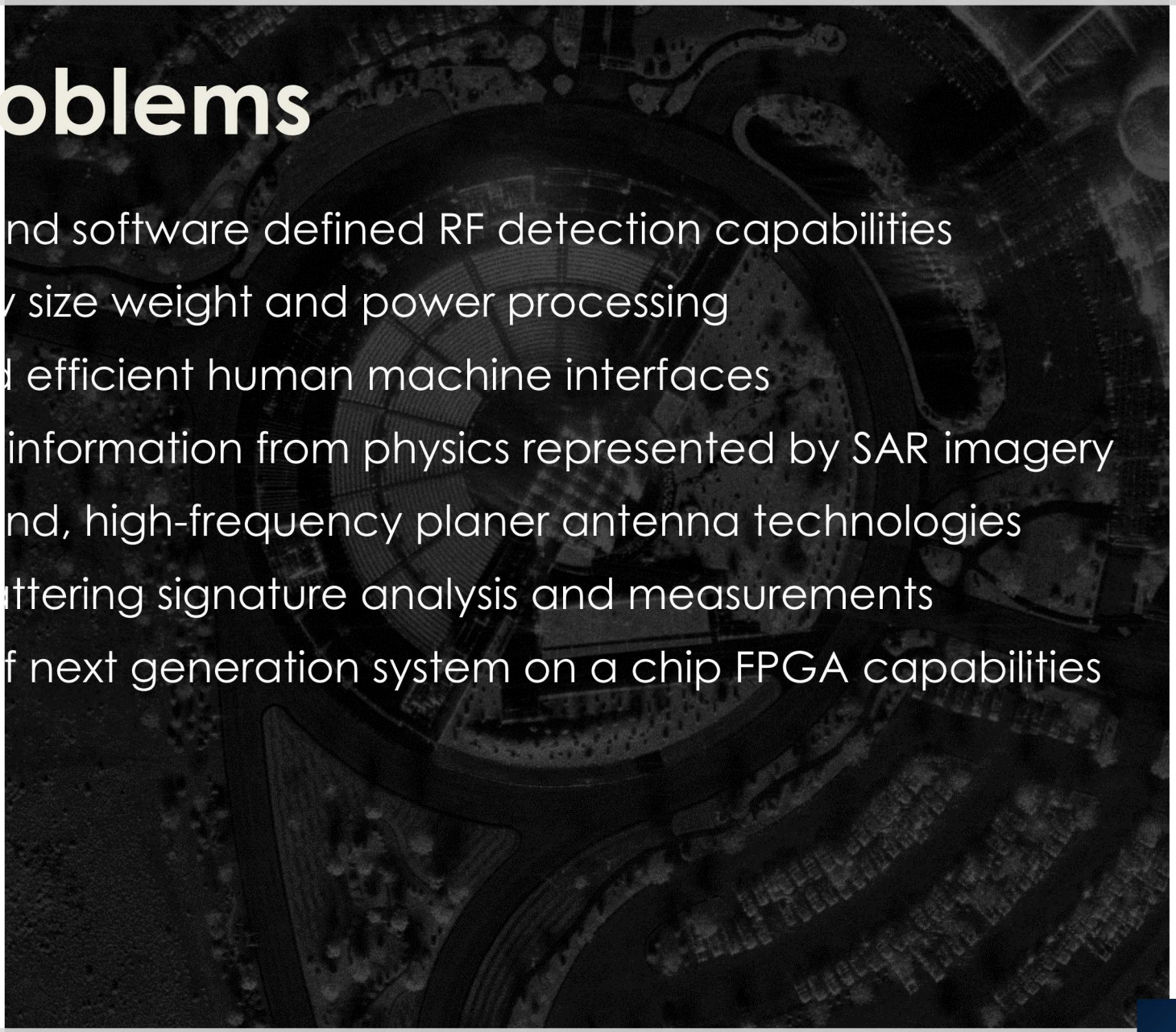
Ideal Prospective Employees

- Must to obtain a security clearance.
- Proficie echnical areas: signal processing, RF, electromagnetic scatteri natures, antenna design, FPGA implementation, and Human hine Interface.
- Self moti d and innovative
- Ability to k well on inter-disciplinary teams
- Strong p n to see work come "alive" as solutions to national secu problem





Hard Problems



- Ultra-w nd software defined RF detection capabilities
- Real tim y size weight and power processing
- Effective d efficient human machine interfaces
- Extractio information from physics represented by SAR imagery
- Ultrawide nd, high-frequency planer antenna technologies
- Complex ttering signature analysis and measurements
- Integrati f next generation system on a chip FPGA capabilities

Ideal Collaboration Opportunities

- Strong boration between Sandia staff member(s) and university profess n a graduate student working on MS or PHD thesis
- Hard pro ns of interest
- Technolo olution can be published
- $ to fund collaboration
- Desired: S ents that are US citizens