FARAD: Facility for Advanced RF and Algorithmic Development

Exploratory Radar Systems Capabilities Overview

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The Purpose of FARAD

■ **To develop and maintain an in-house, high-performance, multi-mode airborne radar capability for the continued advancement of Sandia's ISR capabilities.**

■ **FARAD works in accord with R&D efforts, both internal and external, to provide advanced radar airborne data collection and exploitation assets to facilitate specific research goals.**

■ **FARAD provides a "testbed laboratory"/research tool set that can be widely utilized in support of internal R&D, new program development, and collection of customer requested data products.**


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

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FARAD Common Architecture

- **FARAD complies with Sandia Common Architecture Program (CAP)**

- **Subsystems common to all FARAD radars:**
  - Modular phase history generator (PHG)
  - GPU-Based phase history processor(s) (PHP)
  - Claw® based radar operator computer and console
  - CAP multi-mode radar software
  - 3-Axis antenna positioner
- **Frequency dependent subsystems:**
  - Antenna
  - RF front end
  - Frequency translation (Ka-Band)
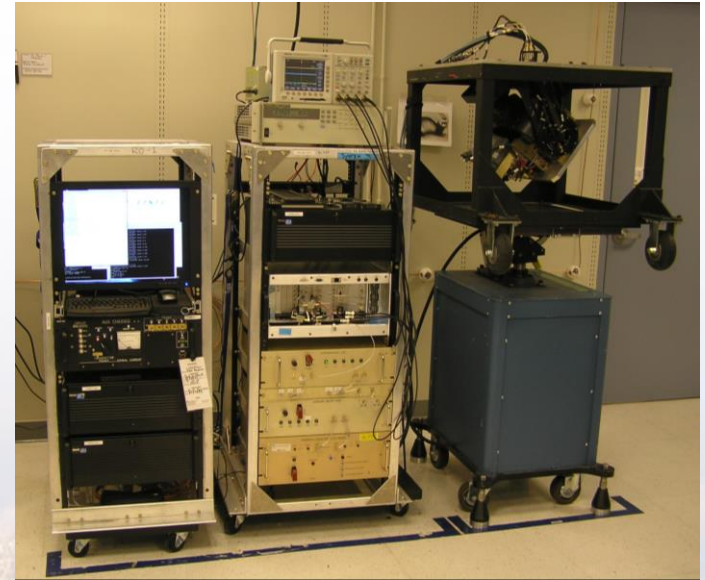
®*Claw: Integrated payload control and analysis software, General Atomics Aeronautical.*

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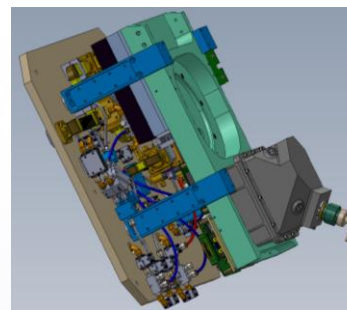
FARAD Radar Configurations

- **PhoeniX**
  - X-Band (9.6 GHz)
  - Fully polarimetric
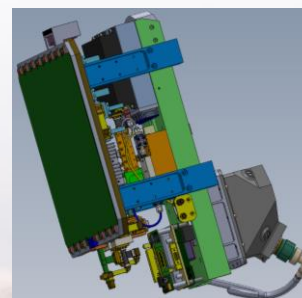 - Fully integrated dual-channel front end

- **Ku-Band**
  - Ku-Band (16.8 GHz)
  - Quad-phase-center antenna
  - CAP PHG/PHP/Claw and Ku-Band MFE/AGA*
  - 4-channel front end, dual RX channel PHG**

- **Ka-Band**
  - Ka-Band (35 GHz), ultra-fine resolution
  - Azimuth monopulse antenna (low-MDV GMTI, VICTR***)
  - All Ka-Band RF, including MPM, integrated on gimbal center axis

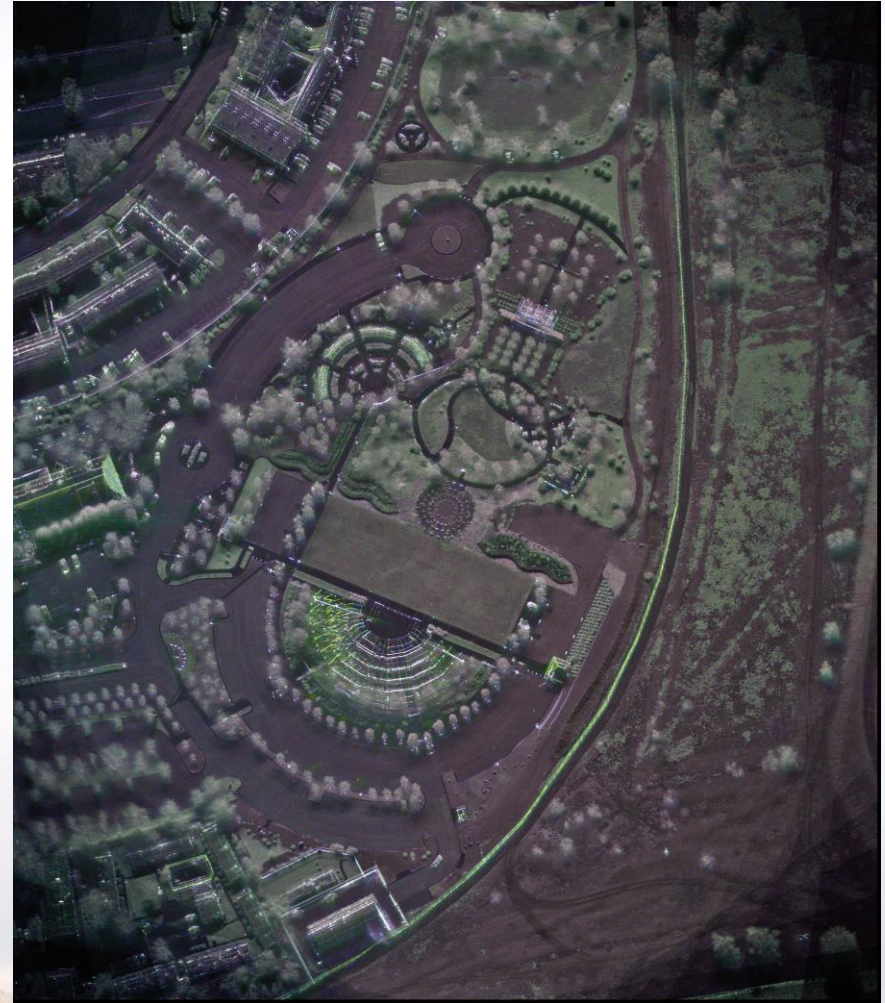*Modular Front End / Antenna Gimbal Assembly*
**Phase History Generator
***Velocity Independent Continuous Tracking Radar

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PhoeniX

- **9.6 GHz center frequency**
- **3 GHz RF bandwidth**
- **4-inch resolution (spot mode)**
- **1-foot resolution (contiguous stripmap)**
- **300 Watt TWTA**
- **Single hardware RX channel**
- **Fully polarimetric (4:1 multiplex)**
- **12 km single-pol, 8 km full pol max range at finest resolution***
- **Real-time image formation on single polarization**
- **Operating modes:**
  - SAR (spot circle, straight-line spot, stripmap)
  - VideoSAR
  - Exoclutter GMTI
  - Single or quad-polarization on all modes
  - Bistatic modes with ground-based RX/acquisition system
- **Fully operational: First collect was 6/19-8/1/2013.**

*Assumes < -25 dB noise reflectivity maintained at far corners of image with max image size (4k pixels range, 3 dB beamwidth azimuth)

Multi-look X-Band Polarimetric SAR, Yamaguchi decomposition, New Mexico Veterans Memorial

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Ku-Band

- **16.8 GHz center frequency**
- **3 GHz RF bandwidth**
- **70 Watt MPM***
- **4-inch resolution (spot mode and contiguous stripmap)**
- **Dual hardware RX channels**
- **2:1 multiplexing each channel (4 data channels)**
- **Quad phase center antenna**
- **8 km max range at finest resolution**
- **Real-time image formation on two channels**
- **Operating modes:**
  - SAR (spot circle, straight-line spot, stripmap)
  - VideoSAR
  - Endoclutter GMTI
- **Fully operational: First collect was 7/11-8/13/2014**

*L-3 Comm Microwave Power Module

Ku-Band 4-inch resolution SAR image, Tijeras Arroyo Golf Course, KAFB, New Mexico

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Ka-Band

- **35.6 GHz center frequency**
- **5 GHz RF bandwidth**
- **Ultra-fine spot-mode resolution**
- **1-foot resolution (contiguous stripmap)**
- **50W NanoMPM®**
- **Single hardware RX channel**
- **Azimuth monopulse antenna**
- **2:1 multiplex (Σ/Δ)**
- **6 km max range at finest resolution**
- **Real-time image formation on single channel**
- **Operating modes:**
  - SAR (spot circle, straight-line spot, stripmap)
  - VideoSAR
  - Endoclutter GMTI
  - VICTR
- **Fully operational: First collect in June, 2015.**

Ka-Band 4-inch resolution SAR interleaved stripmap, UNM Golf Course, overlay on Google-Earth.

® L-3 Communications, Electron Devices Division

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