JACIE 2013 CANDID SHOTS

Photos by various attendees

Welcome to the Joint Agency
Commercial
Imagery Evaluation Workshop
April 16, 2013
Mississippi River Delta

NASA Science Mission Directorate
Earth Science Division
Applied Sciences Program
WATER RESOURCES APPLICATION AREA
JACIE MEETING
16 April 2013
NASA

GoToMeeting Viewer

Now viewing Tom Holm's screen

Status: Landsat 5

- **Landsat 5 was officially "retired" when deorbiting and decommissioning began on January 15, 2013**
  - Launched in 1984, Landsat 5 exceeded its 3 year design life by 25 years.
  - Four Decommission Phases
    - Phase 1 – Initial 705Km orbit lowering – complete!
    - Phase 2 – Lowering perigee to minimize time of reentry
      - Begins April 17th and will extend until A) out of fuel or B) no additional benefit to burns
      - Planned completion no later than 6/30
    - Phase 3 – Render the spacecraft passive
    - Phase 4 – Closeout the Mission Operations Center (MOC)
      - Completed before the end of the fiscal year

USGS

citrix

10:34 AM
4/16/2013

Roberta
"Bobbi"
Lenczewski

Daniel Williams

arrel Williams
SPEAKER

Paul Stephens

EXIT
WorldView-3
DigitalGlobe
SOLAR RADIATION
CUSTOMER APPLICATIONS

DigitalGlobe
Fire Damage

Philip C. Abbo

Value of Satellite Imagery
for Agriculture
Abbott, David Boussios
less Lowenberg-DeBoer
Economics, Purdue University
Department of Agricultural Economics
Purdue University

Drew Hopwood
SPEAKER

Andreas Brunn
RapidEye AG
SPEAKER

Karen Hasselle
Bill Hughes

SMALLSATS SOLUTIONS CAN YIELD BIG RESULTS

USGS
Overview of the Land Product Validation System (LPVS) for Enhanced Data Access, Retrieval, and Analysis of Satellite Data
Kevin Gallo[1], Calli Jenkerson[2], Greg Stensaas[3], Gyanesh Chander[3], John Dwyer[1], and Ryan Longhery[1]

Deimos-2 Pre and Post-launch Calibration & Validation

Jorge Gil, Alfredo Romo, Cristina Moclan, Fabrizio Pirondini (Elecnor Deimos Imaging);
Diego Lozano (Elecnor Deimos Space); Enrique Gonzalez, Jesus Quirce (Elecnor Deimos Satellite Systems)

elecnor deimos

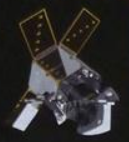
The Deimos-2 Mission Concept

- The Deimos-2 end-to-end system has been designed to provide a **cost-effective** and **highly responsive** service to cope with the increasing need of fast access to very-high resolution imagery
- It **expands Elecnor Deimos Imaging portfolio**, complementing DEIMOS-1 with VHR multispectral imagery (**75 cm Pan-sharpened**)
- The combined use of DEIMOS-1 (22 m) and Deimos-2 (75 cm) will provide a wide range of capabilities for the generation of products in all optical Earth Observation market segments

- With Deimos-2, Elecnor Deimos expands its capabilities into satellite integration with the creation of a new subsidiary: **Elecnor Deimos Satellite Systems**
- Its **brand new facilities**, built in Puertollano (Spain) in 2012, include more than 4,000 m² office space, a 430-m² **clean room** and a complete **control centre** with a 10-m X-band antenna

The Satellite

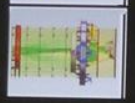
- The satellite is being developed together with **Satrec Initiative** (South Korea)
- Based on SpaceEye-1 concept (heritage from DubaiSat-1 and -2)
- It will be **integrated and tested in Elecnor Deimos Satellite Systems** premises in Spain in Q2 2013
- **Launch foreseen for early 2014**



- Mass: 300 kg
- Size: Ø 1.5 m x 2.0 m
- Agile platform (±45º across-track)
- High-performance AOCS for pointing accuracy & stability
- Dual redundancy in all critical systems
- Xenon gas thrusters (HEPS) for orbit control
- X-band antenna for 160 Mbps data transmission
- S-band antenna for telemetry & telecommand

The Payload

- EOS-2 pushbroom camera with multi-linear TDI sensor
- 40-cm Korsch telescope (5.75 m focal length, 1.2º FoV)
- Ground spatial resolution of 1m Pan, 4m MS
- **75 cm GSD pan-sharpened products**
- **Swath >12 km** (24 km in wide-area mode)
- **Pan** (450-900 nm) **+ 4 bands** (R,G,B, NIR)
- Radiometric resolution **10 bits**
- Images are stored on a high-capacity solid-state recorder
- During transmission of the stored image data via X-band, **data are compressed, encrypted and encoded in real time**

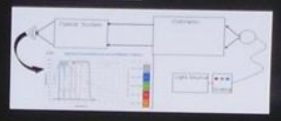


Pre-launch Geometric Cal

- The geometric calibration of D-2 payload is to **qualify** the system and to obtain a **rigorous sensor model** parameterization
- The main parameters include:
  - Effective Focal Length (EFL)
  - FOV and IFOV
  - Pixel Line of Sight (LOS)
  - Band-to-band registration of CCD arrays
  - Distortion map of CCD arrays
  - Knowledge of the camera optical axis

Pre-launch Spectral Cal

- The purpose of this measurement is to characterize the spectral transmissivity profile of each band and the response of the CCD arrays



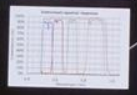
Pre-launch Radiometric Cal

- The aim of this calibration is to **characterize the optical sensor** in order to obtain absolute physical measurements:
  - Response Linearity
  - Dark Signal and Non-uniformity
  - Pixel Response and Non-uniformity
  - Signal-to-Noise Ratio (SNR)
  - Pixel Saturation
  - Absolute calibration

Linearity

- **Dark Signal** (DS) behavior is characterized pre-launch
- Blind pixels will provide DS information for each line

- By manufacturing, each detector has different response to equal illumination conditions: **Pixel Response Non Uniformity** (PRNU)
- To equalize the detectors, their response to an uniform light source shall be characterized



- PRNU
- DS

Absolute Calibration

- Camera parametrization:
  - TDI mode
  - Gain
  - Line rate

SNR measurement

- Illumination output levels are adjusted to simulate the spectral radiance of a given reference ground target
- Requirement is SNR >= 90

MTF measurement

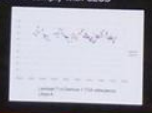
- Knife-edge method
- Requirements are:
  - PAN MTF @ Nyqyist >= 9% [illegible] FOV
  - MS MTF @ Nyqyist >= 18% [illegible] FOV

Post-launch Geometric Cal/Val

- Launch vibrations and other effects can affect the payload
- Ground-based location accuracy targets such as modern highways and railways in Spain can be used

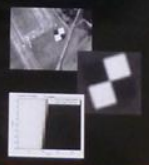
Post-launch Radiometric Cal/Val

- Closely follow **CEOS** Cal/Val recommendations and **sites**
- PRNU measurements using uniform and high reflectivity Land Non Equipped Sites (**LNES**)
- Dark signal measurements using night images over the ocean
- Libya-4 LNES (pseudo-invariant) for sensor trending
- Vicarious measurements for **absolute** Cal/Val using CEOS Land Equipped Sites (**LES**) and
- **CIBA** (low atmosphere research center)
  - Managed by the University of Valladolid (Spain)
  - Planned to enhance instrumentation to comply with CEOS LES sites



Post-launch MTF Estimation

- Will be performed using the **slanted edge methodology**
- Same as Deimos-1 but using artificial targets instead of field transitions



calval4EO

- Part of the g4EO suite
- Fully developed in-house
- Systematic extraction of calibration data
- Systematic generation of calibration reports
- Interactive
- Calibration database

elecnor

4

DigitalGlobe
Analysis
CALCULATE IN BAND RADIANCE (2A)
• G&S data reduction process (*J.E. Gunn and L.L. Stryker, 1983)
- (1)De-redden measured spectral irradiance, (2)convert to AB magnitude, and (3)normalize
• Convert G&S catalog data to measured spectral radiance by reversing process (F(ν) → f(ν))
1. $f_{de-red}(\nu) = (10^{[(A\lambda+Av-A\lambda)]}) \times f(\nu)$
$f(\nu)$ ≡ measured spectral irradiance
$f_{de-red}(\nu)$ ≡ de-reddened spectral irradiance
Av ≡ visual absorption constant
$A\lambda$ ≡ wavelength dependent reddening constant
2. $AB(\nu) \equiv -2.5 \times \log_{10} f_{de-red}(\nu) - 48.6$
AB≡ monochromatic magnitude defined such that the zero point corresponds to 3631 Janskys
3. $F(\nu) = 10^{[-A\times(AB-V)]}$
V≡ apparent visual magnitude
F(ν)≡ normalized G&S catalog data

DigitalGlobe
ctral Response
Panchromatic
Blue
Green
Red
Near IR
800
900
1000
(nm)

David Mulewa

Greg Stensaas
MODERATOR

WHEELCHAIR
SECUREMENT
LOCATION

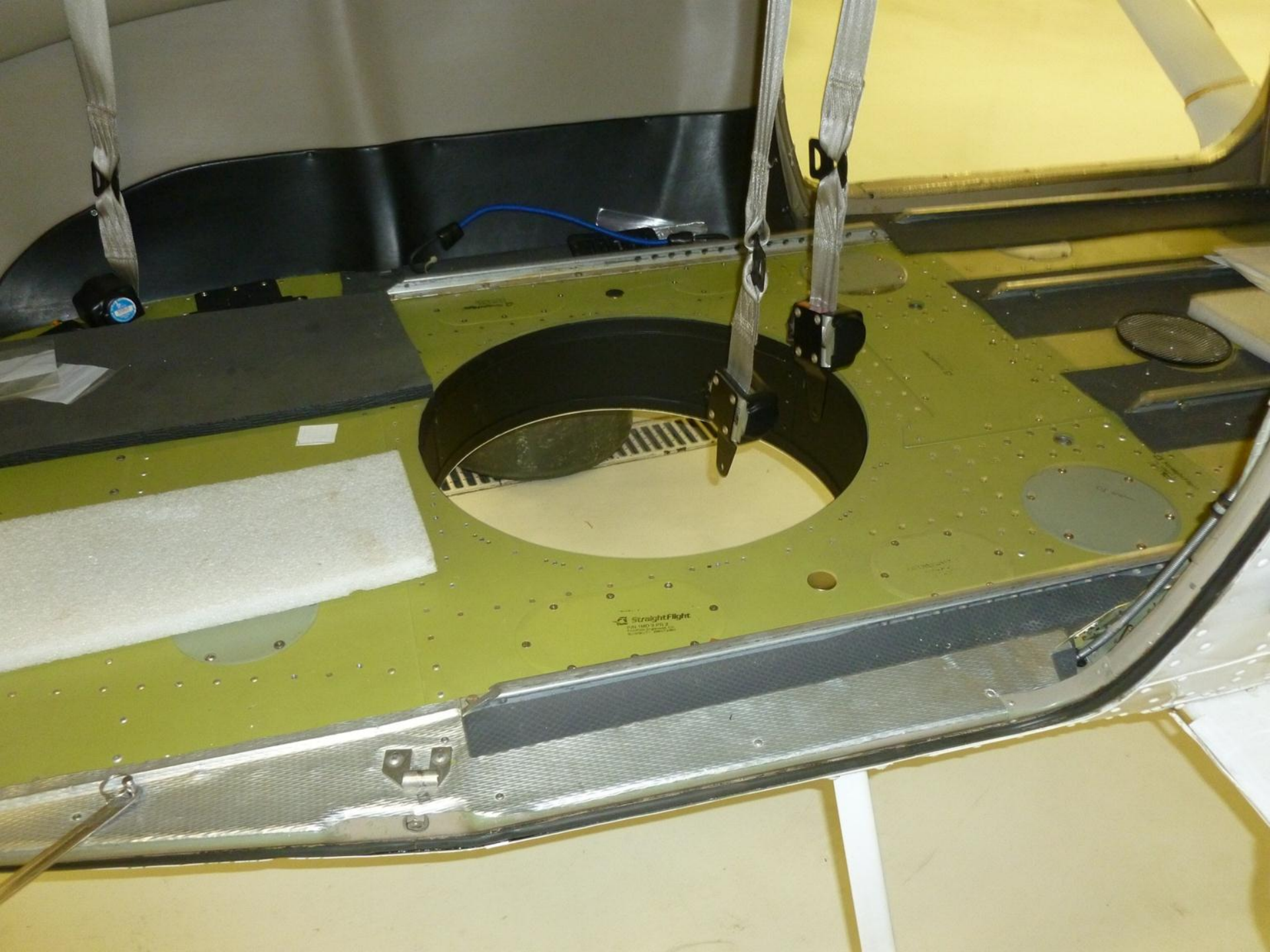
35

SURDEX
CORPORATION
N414EH
Jetprop

DMC
Digital Mapping Camera
A Product of Z/I Imaging
Optics by
Carl Zeiss

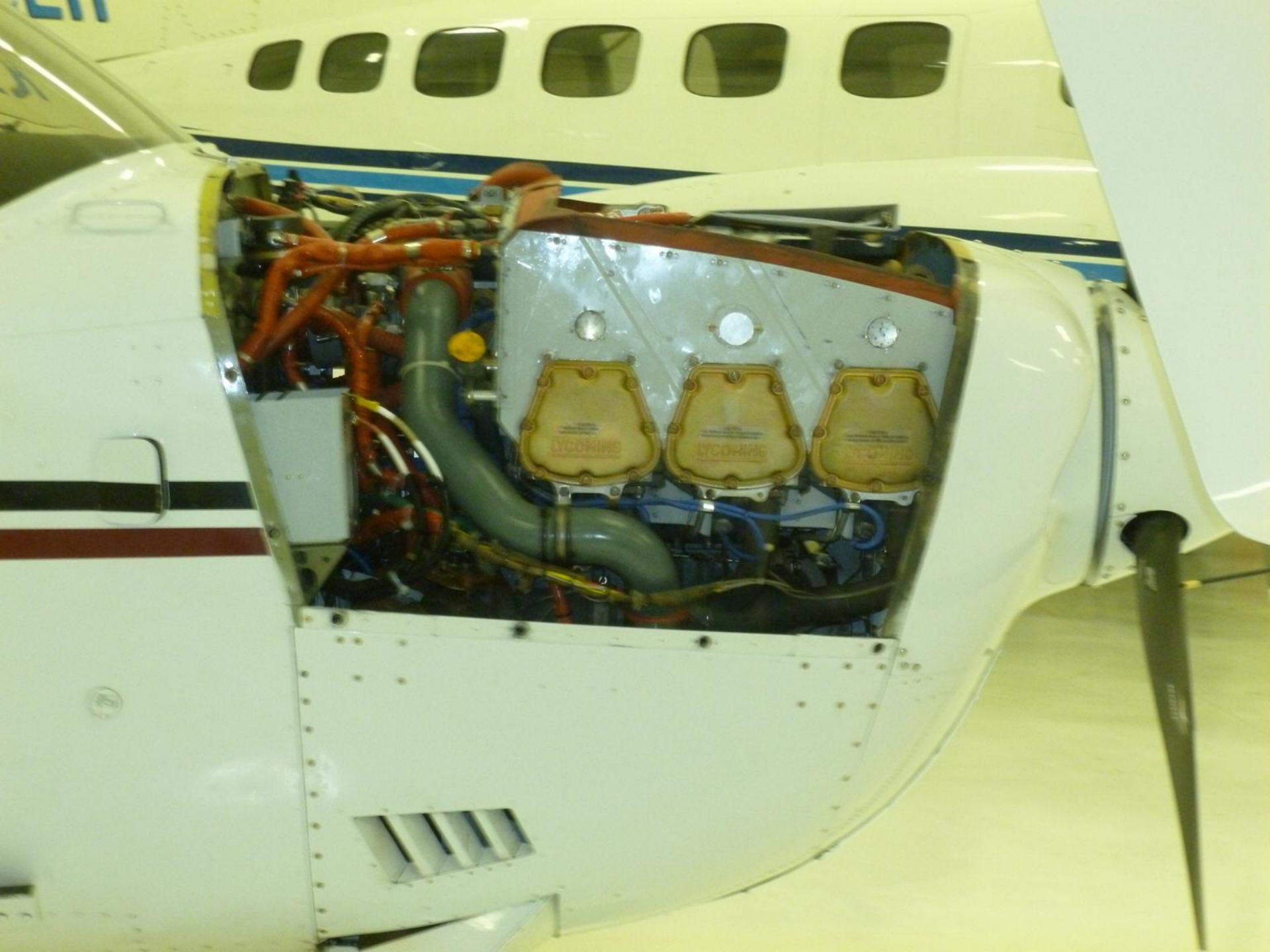
PD
POS
AUX
IN1
IN2
AUX

DMC
Digital Mapping Camera
A Product of Z/I Imaging
DMC 148
Optics by
Carl Zeiss


StraightFlight

ULTRACAM
Microsoft

ULTRACAM
Microsoft


LYCOMING
LYCOMING

ADIS
SHS2
Sensor Head

ADS 80
CU80
Control
Leica

N441EH
Jetprop Conquest II

SURL
CORPORA

N82JM

Automated methods for the quality control of data from the DMCii satellite constellation.
Steve Mackin, Laura Brindle and Paul Stephens
DMC International Imaging Ltd

dmc
International Imaging
Small Satellites
• Current satellites about 100 kg up to 300 kg
• No onboard calibration equipment
• So how can we monitor the calibration and data quality?
NigeriaSat-2 Satellite

Current satellites about 100 kg up to 300 kg
No onboard calibration equipment
So how can we monitor the calibration and data quality?
NigeriaSat-2 Satellite

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HEXAGON
USGS

IONS MADE EASY
ics System (IDEAS™)
Patent Pending