



Recent Advancements in Commercial LIDAR Mapping and Imaging Systems

NPS Lidar Workshop
May 24, 2007

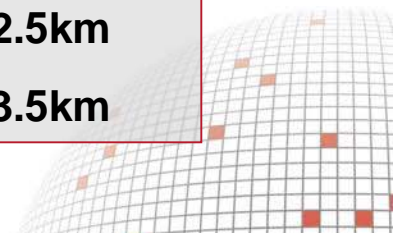
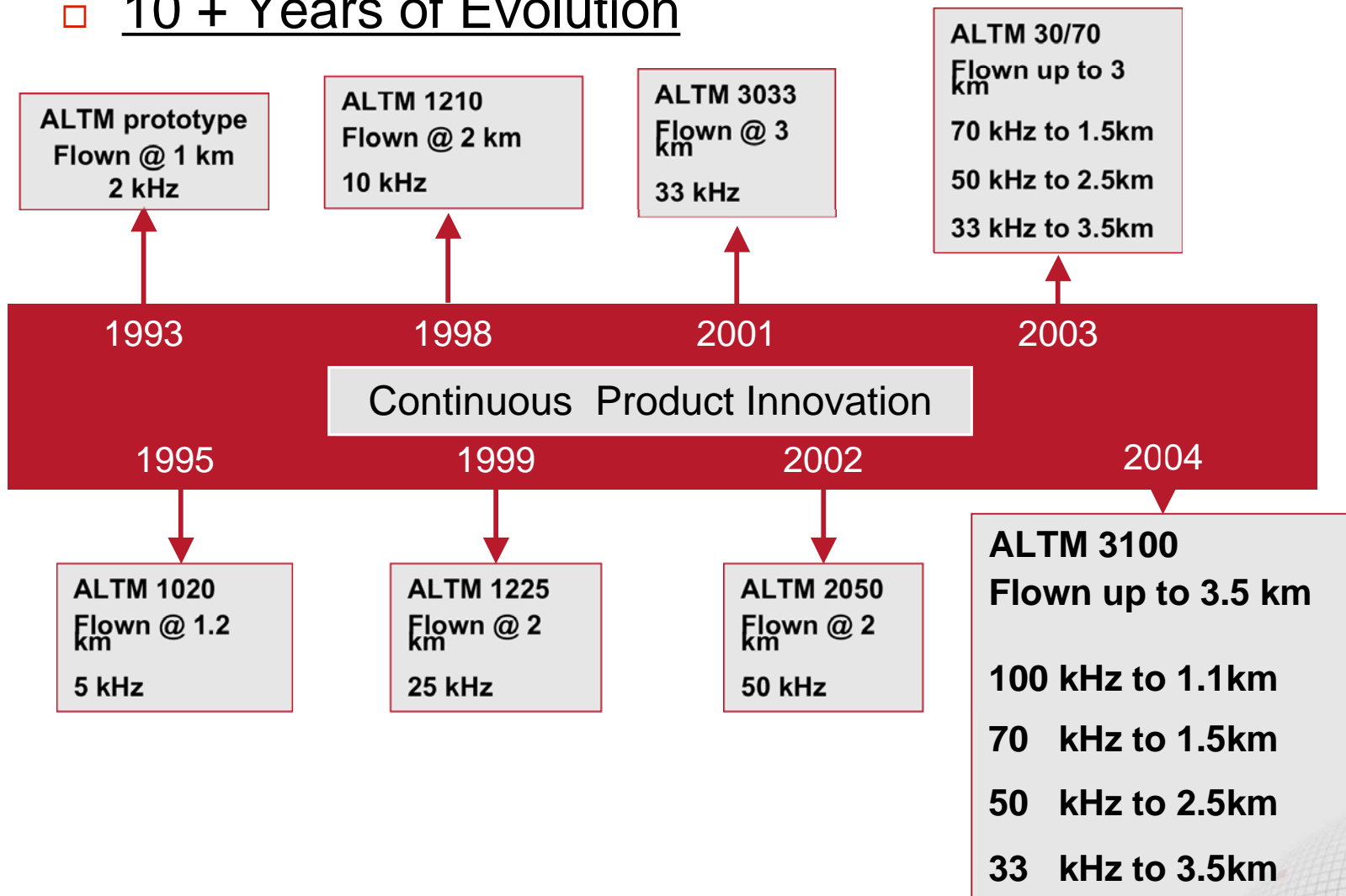
Joe Liadsky
Optech Incorporated



- Higher Laser Pulse Repetition Rates
- “Multipulse”
- Waveform Digitizer
- Sensor Fusion
- New Applications



□ 10 + Years of Evolution



□ Increased Performance

- Easy to use
- More data
- Higher Altitude

□ Increased Accuracy

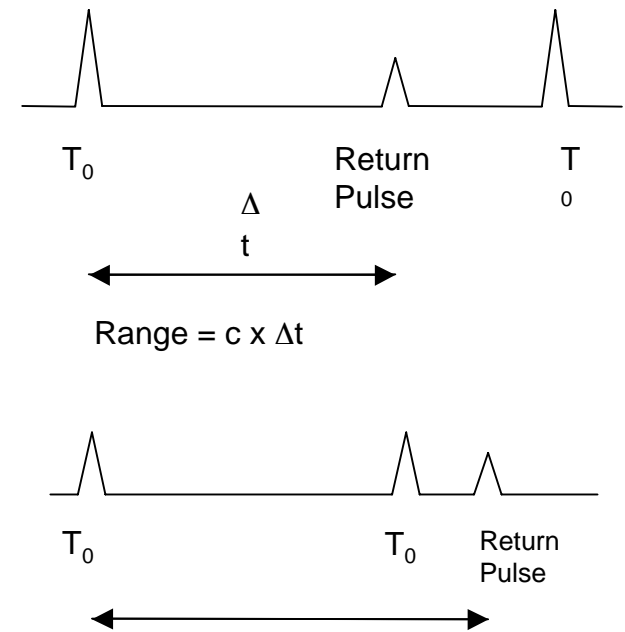
- Scanner
- Rangefinder
- IMU

□ Application specific features

- Capture of 4 returns incl. last
- intensity
- dual divergence
- waveform capture
- integration with other sensors

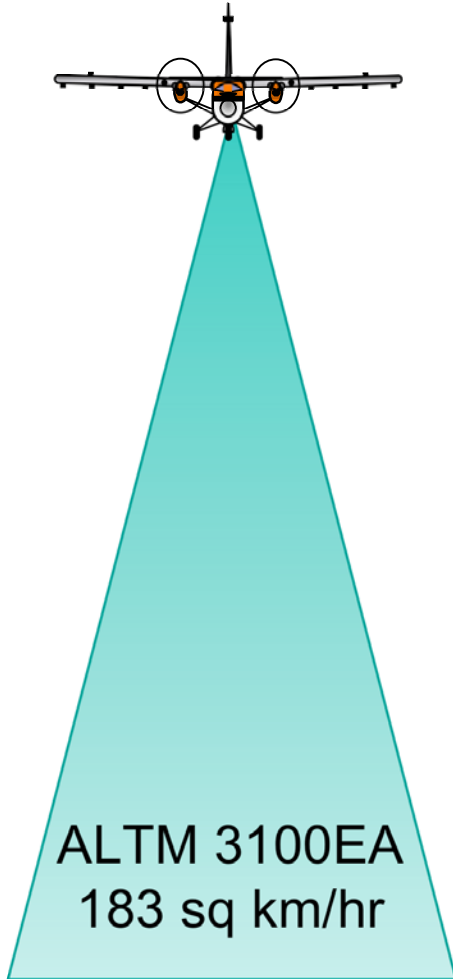


- Lidar traditionally limited in operational altitude by the inability to accommodate multiple laser pulses in the air simultaneously.
- Historically higher PRF (Pulse Repetition Frequency) did not translate to improved survey efficiency.
- The multi-pulse (MP) operation reflects the capability of a lidar system to handle more than one pulse in air;
- ALTM-GEMINI is not limited to a single pulse in the air at a time and can fly higher at maximum repetition rates



ALTM-GEMINI is the first commercially available lidar in the world that provides multipulse capability



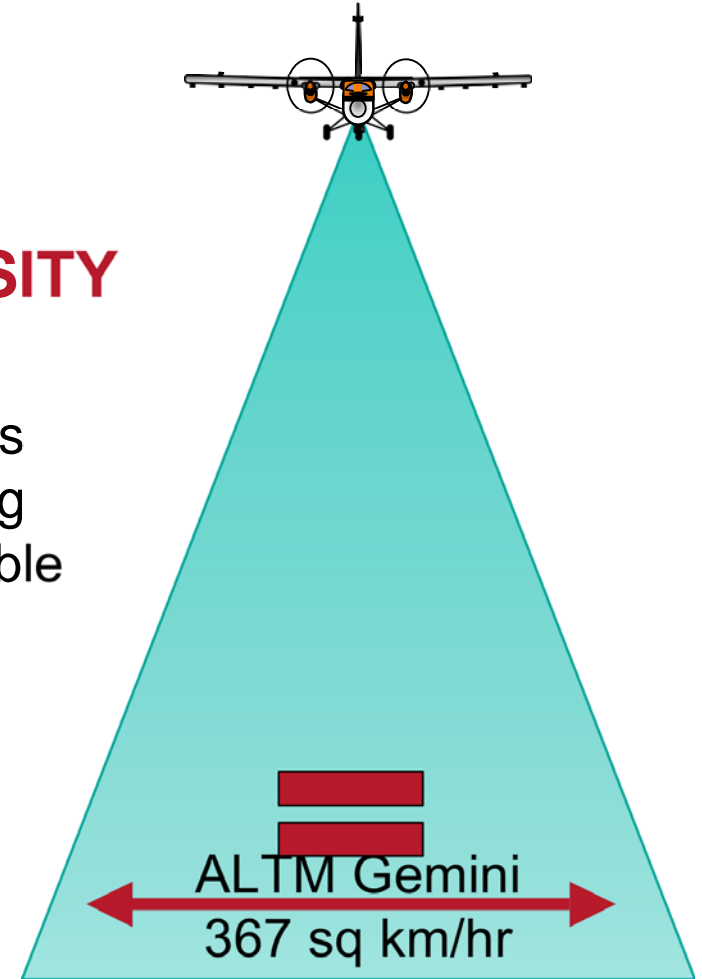


Most Efficient for data acquisition

COVERAGE vs. DENSITY

- Contract requirements
- 1 meter spot spacing
 - 2 km altitude desirable

Potential **50%** reduction in acquisition cost



□ Fast Lidar data processing package for X,Y,Z,
Intensity output

■ Key Features:

- 1:1 or better processing time
- 3-D Graphics Viewer
- User Friendly, single page GUI
- Windows Compliant (multiple sessions)
- Multiple, Selectable Output formats in ASCII & LAS
- Multiple Geoid & Ellipsoid Transformations
- Built-in Digitizer post processing software
- DLL & SDK available

DASHMAP: The next generation in lidar processing



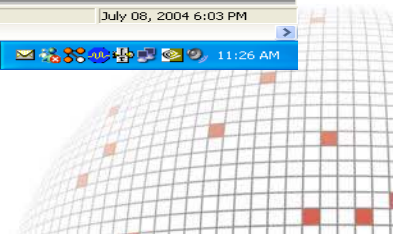
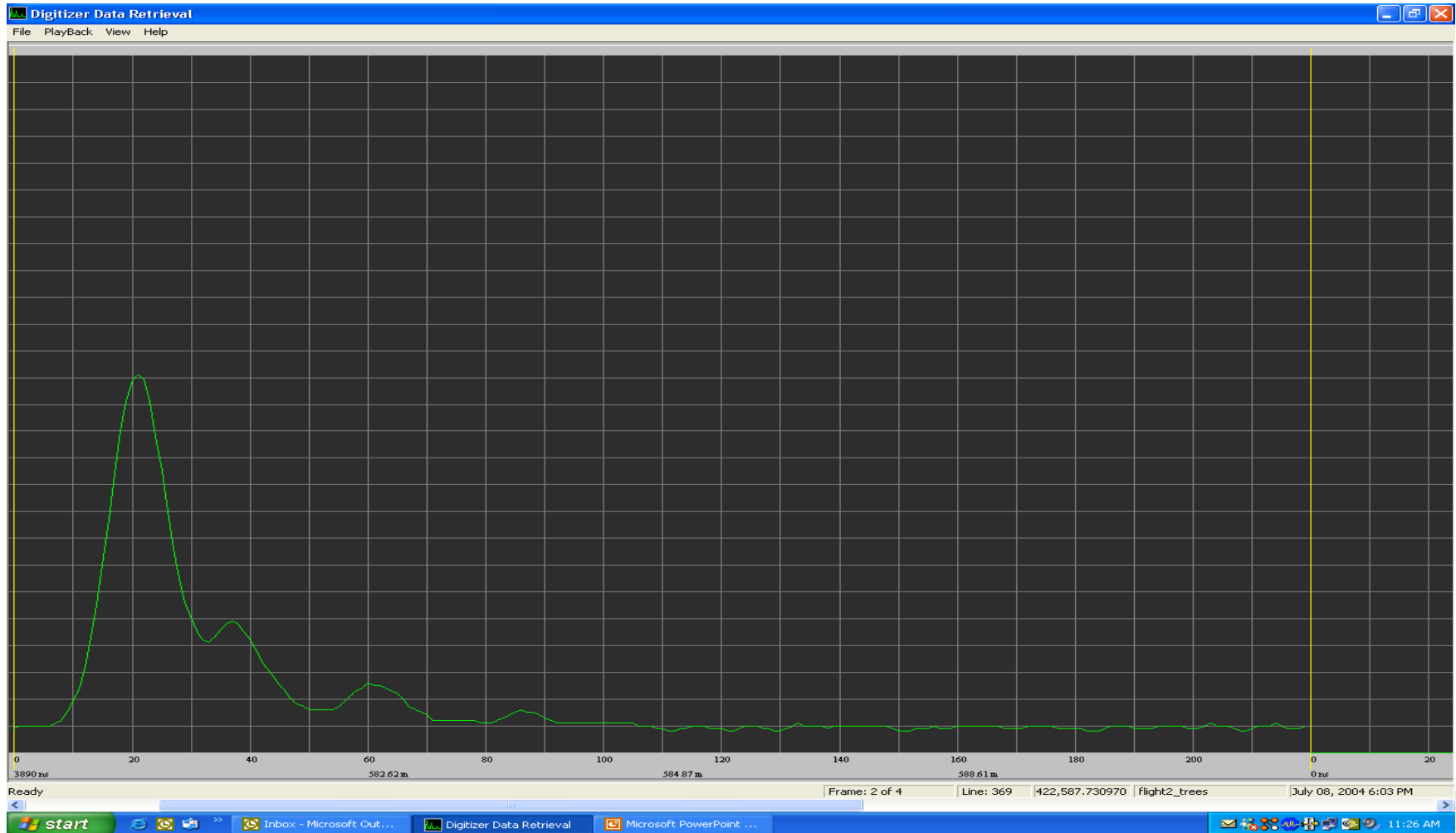
- ALTM hardware measures 4 ranges (and Intensities) for each laser shot provided the return pulses are separated in time.

- Waveform Digitizer allows analysis of complex returns using software-based algorithms
 - Captures whole waveform
 - Capable of recording 70,000 waveforms/second
 - Complex details of multiple pulses recorded
 - Possible to resolve closely-spaced targets
 - Shape of return pulse gives additional information about target
 - Aids in target classification



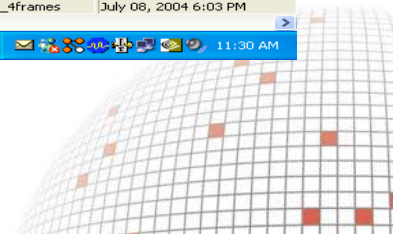
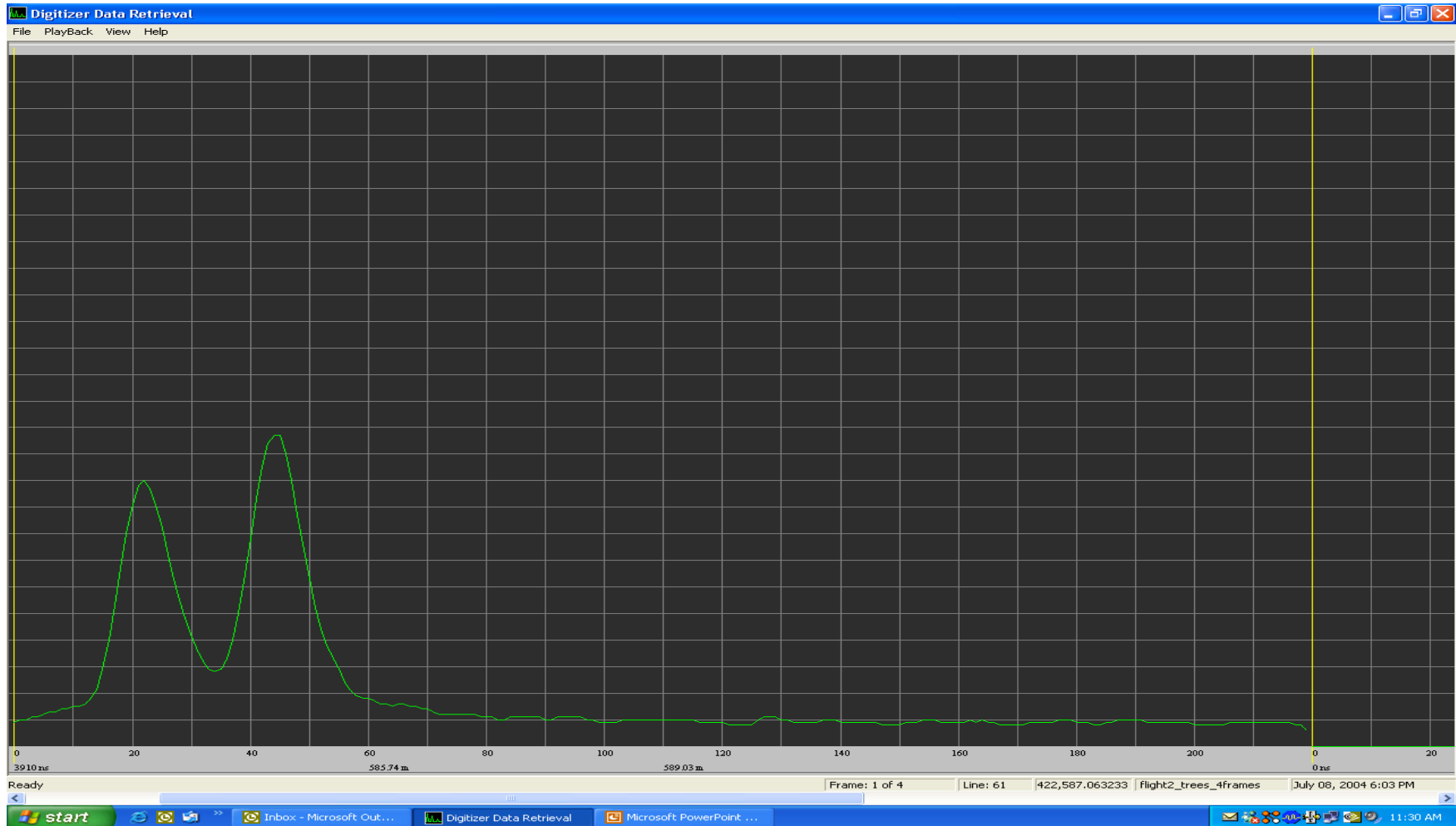


Digitized return waveform from trees



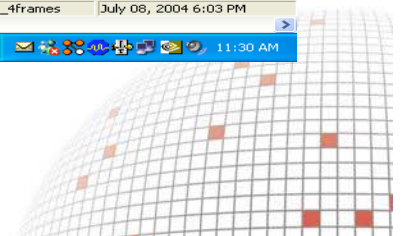
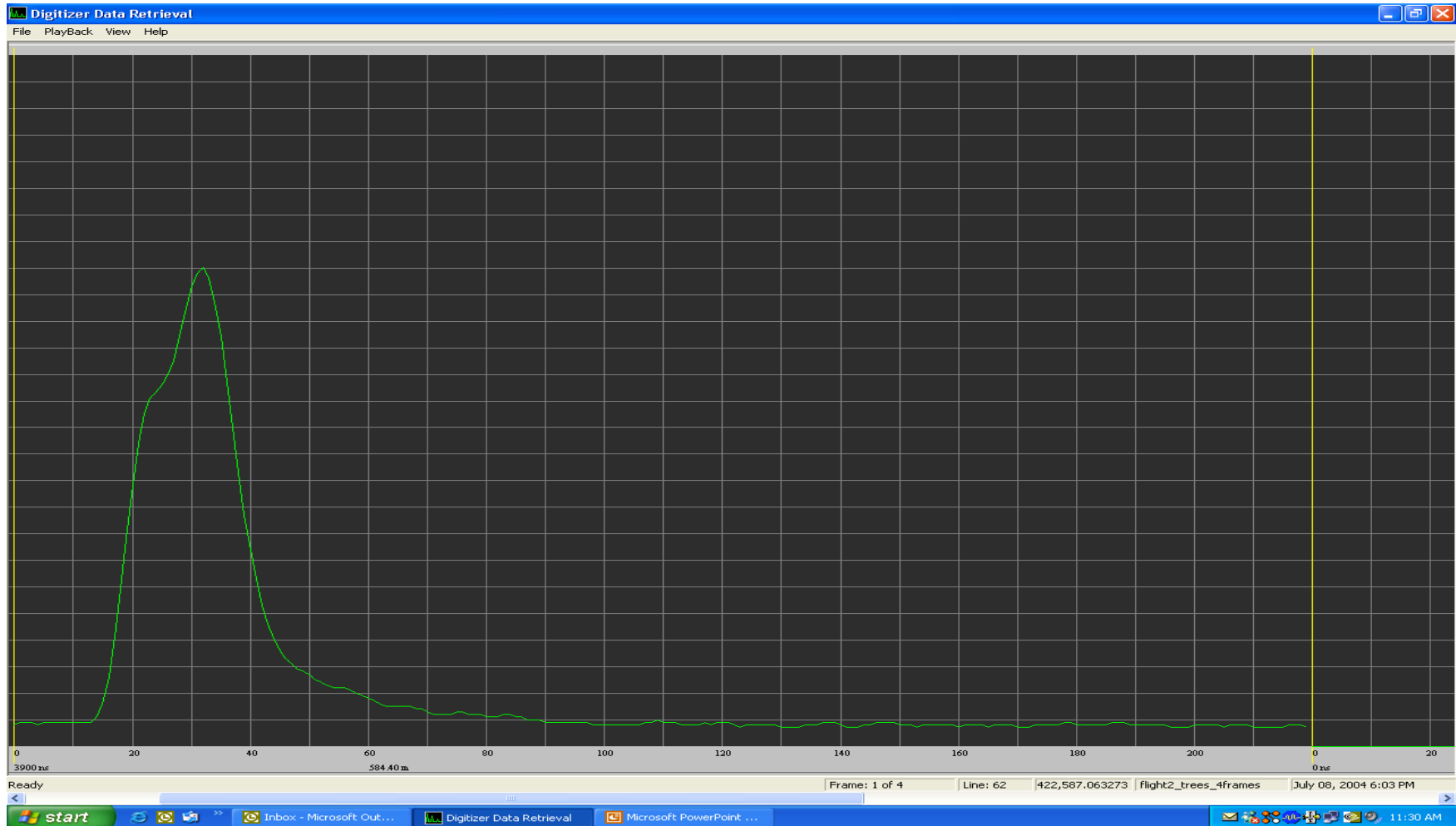


Digitized return waveform sequence 1 of 4



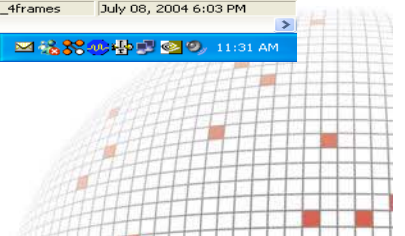
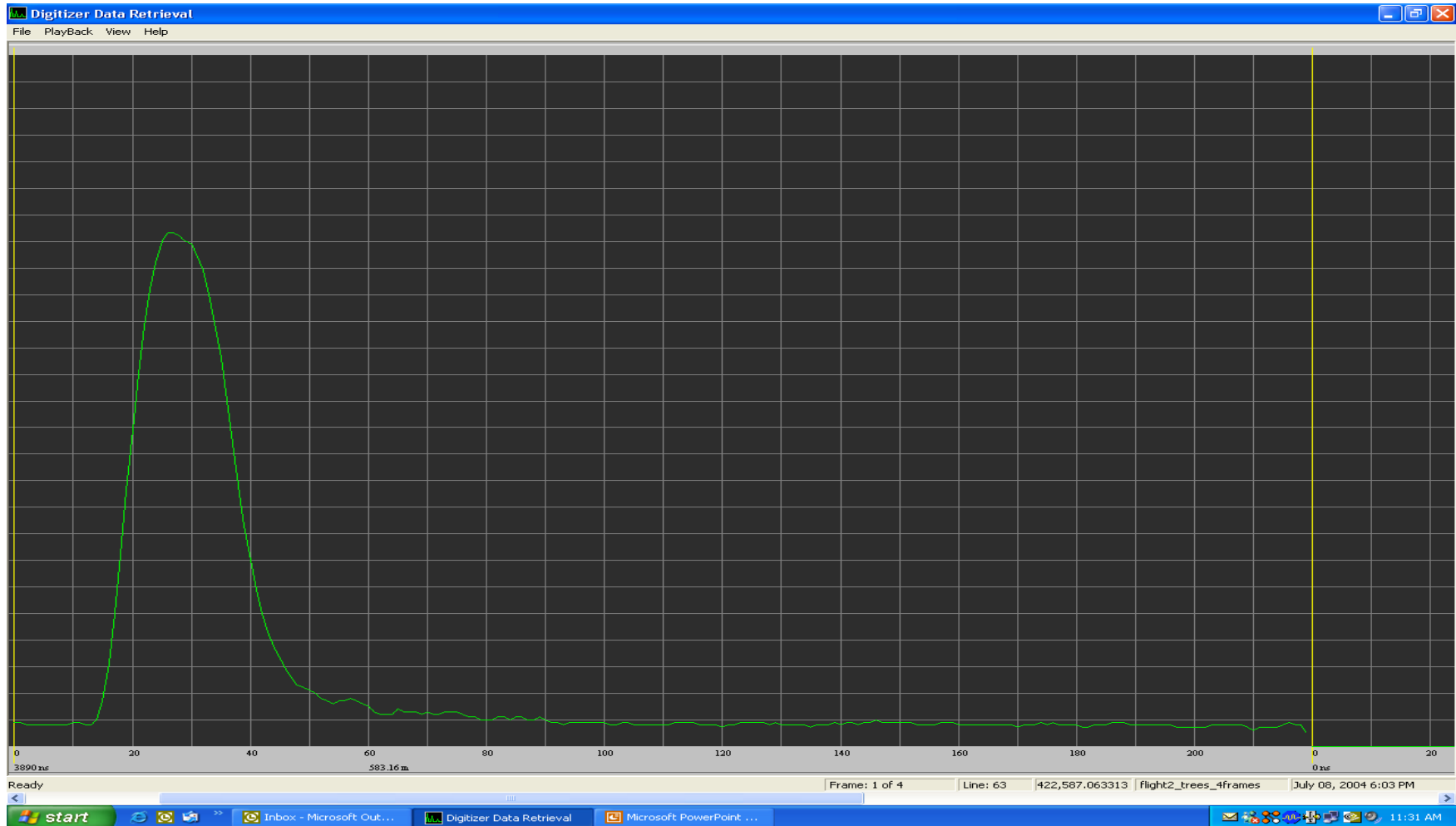


Digitized return waveform sequence 2 of 4



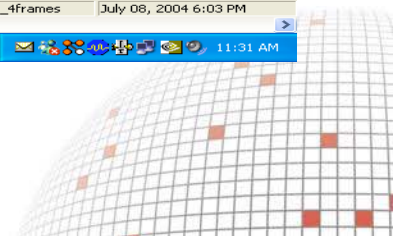
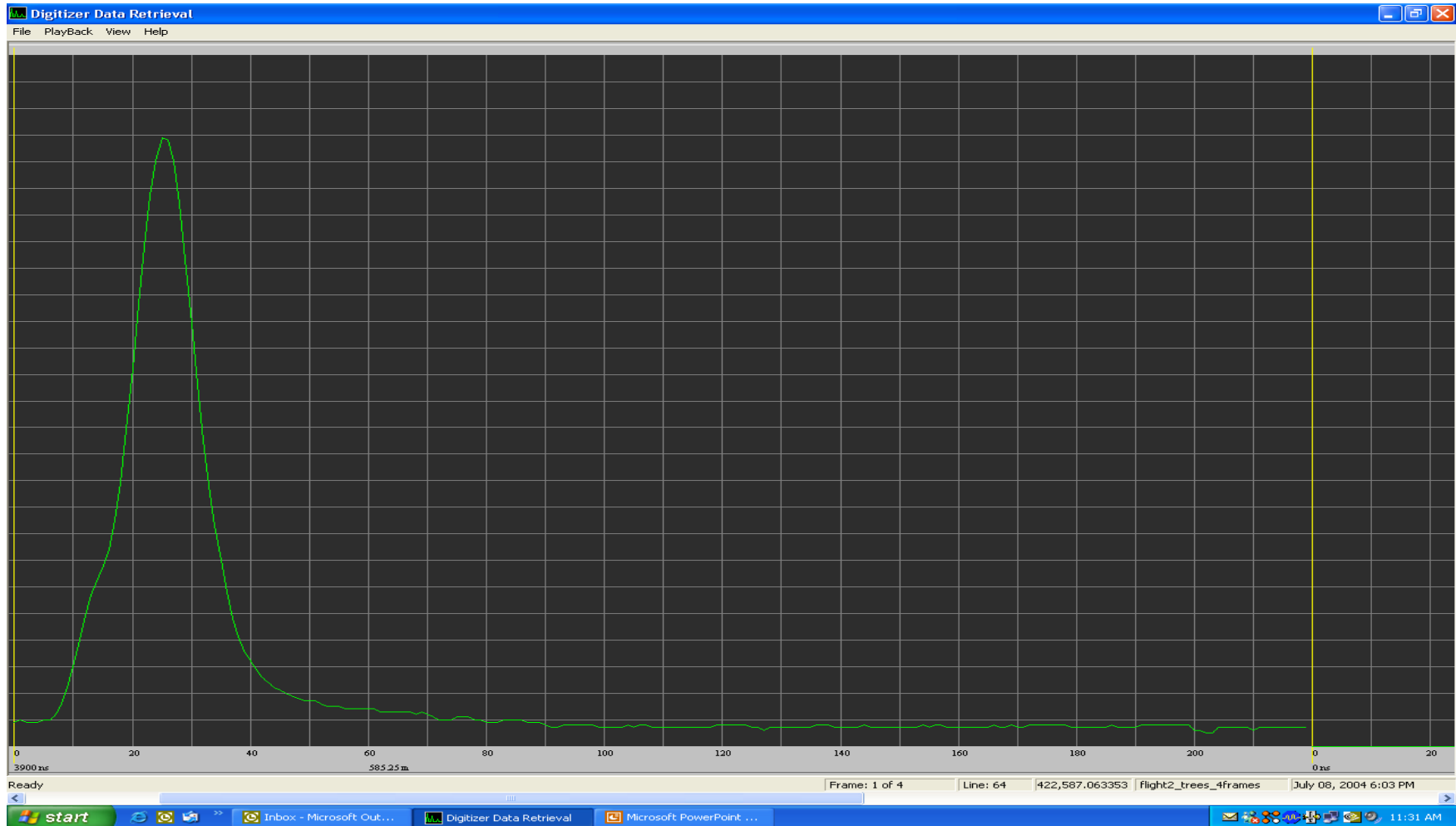


Digitized return waveform sequence 3 of 4





Digitized return waveform sequence 4 of 4



- Select the camera best for your application
 - Already Integrated:
 - Rollei AIC, 22 megapixel
 - Applanix DSS 322, 22.2 megapixel
 - Vexcel UltraCam
 - Intergraph DMC
 - Hyperspectral – Itres CASI 1500



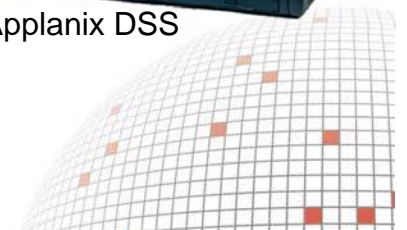
DSS Camera Control Rack

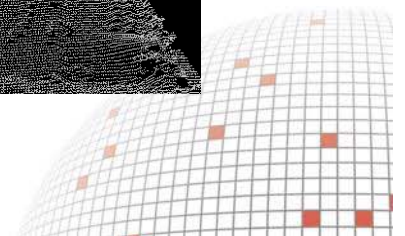
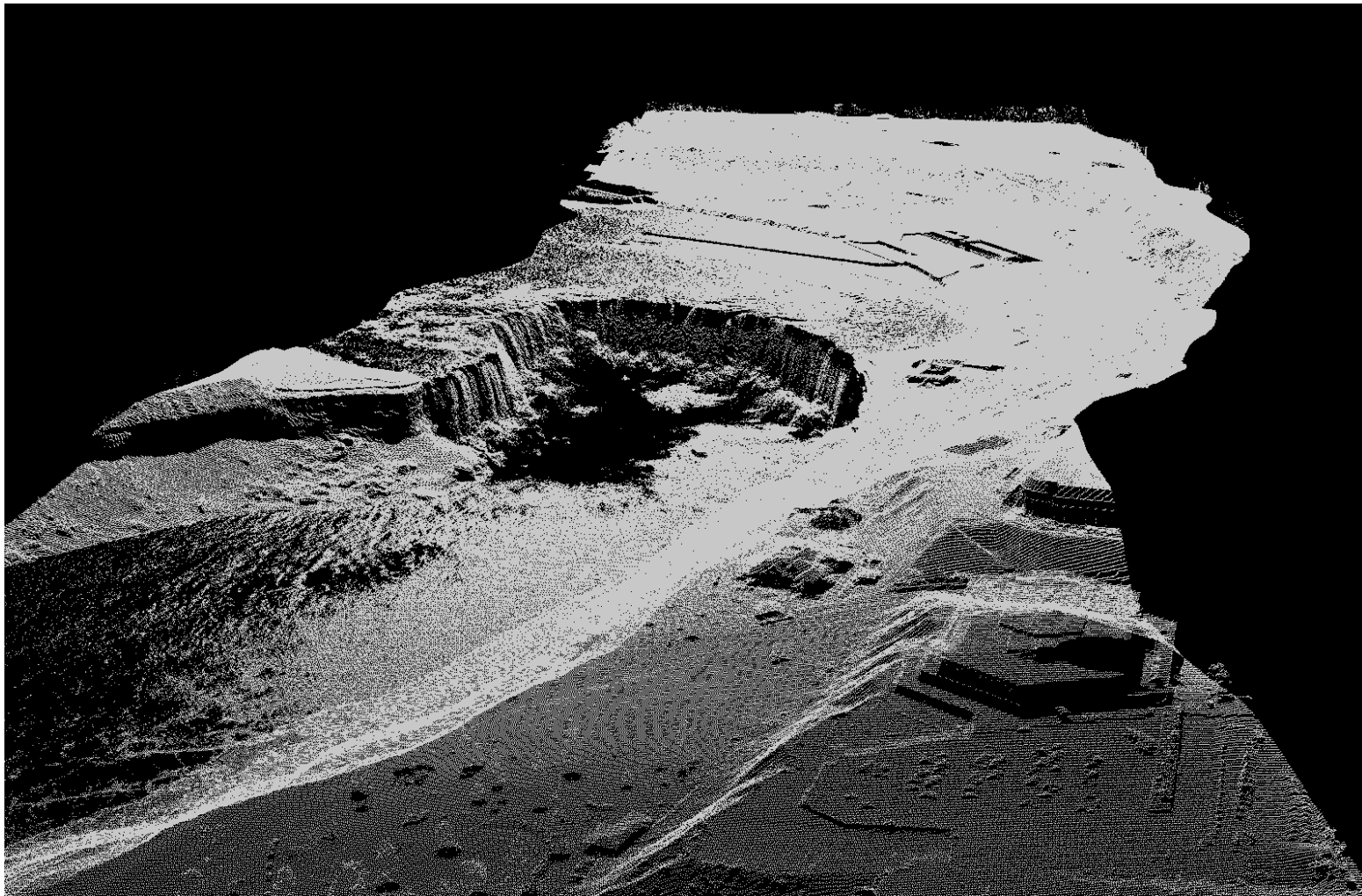
ALTM Control Rack

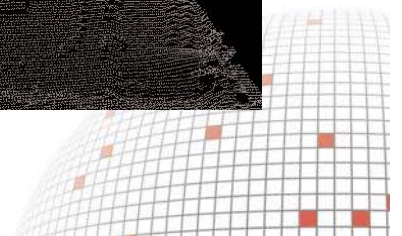
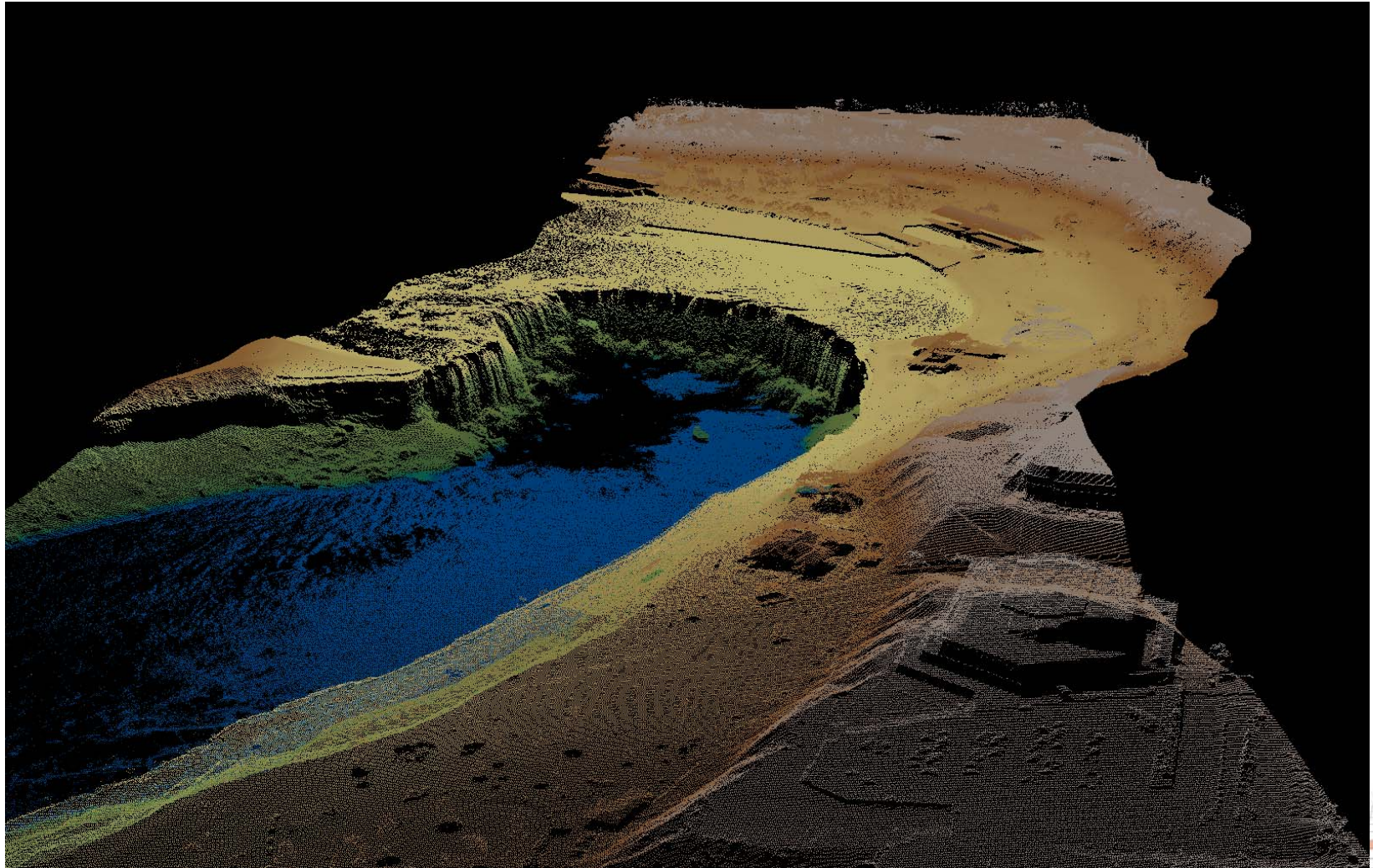
ALTM Sensor Head with DSS Camera

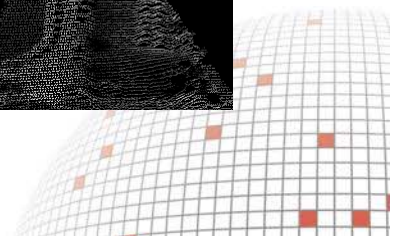
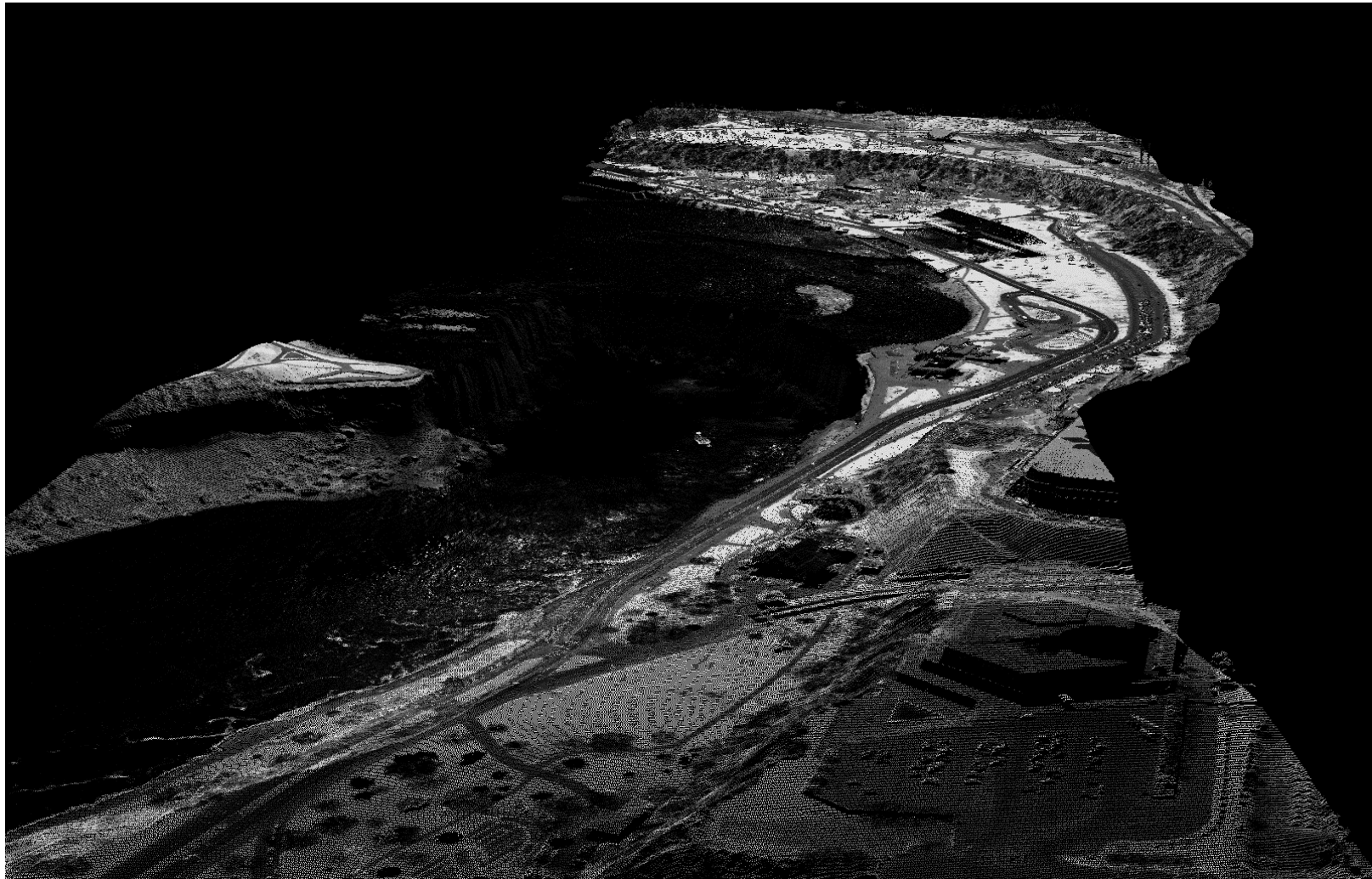


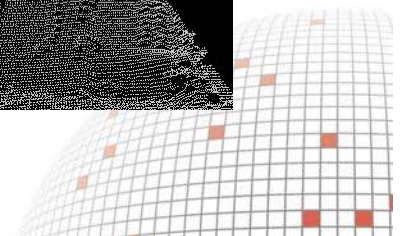
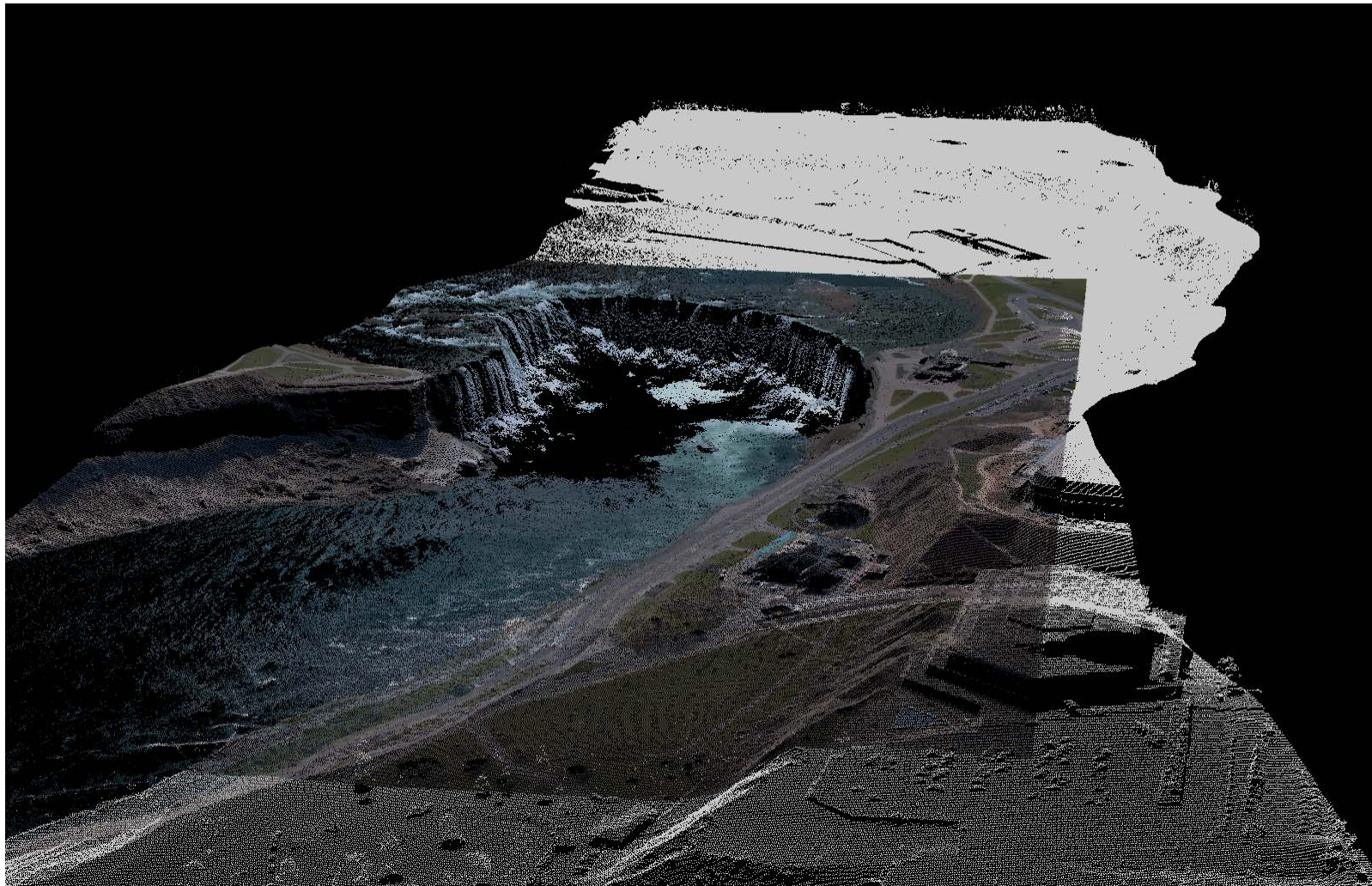
ALTM 3100 with Applanix DSS



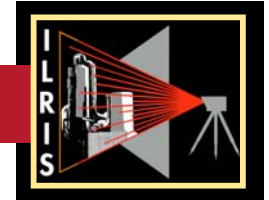








- Optech's ILRIS-3D is a complete, fully portable, laser-based imaging and digitizing system for the commercial survey and industrial market



ILRIS-3D



- 2500 Laser Points per Second
- FOV 40° x 40°, extends to 360°
- Measurement Ranges > 1,000m
- Embedded Digital Camera
- Completely Eyesafe
- Modular Design



□ ILRIS-3D caters to a diverse pool of applications due to its operational versatility

■ Forensics

- Crime Scene Investigation
- Accident Scene Reconstruction

■ Civil Engineering and Surveying

- Structural Surveying
- Topographical Surveying
- Large Infrastructure Documentation

■ Open Pit Mining & Geology

- Volume Rectification
- Slope Monitoring/Landslide Detection
- Geological Analysis

■ Miscellaneous

- Forestry
- Land Fills
- Archaeology
- Entertainment (movie industry/animation)
- Sensor Fusion
- (airborne, multi-spectral, thermal etc.)



- The Color option generates true color point clouds automatically from scan data
- A high resolution digital image is collected with every scan

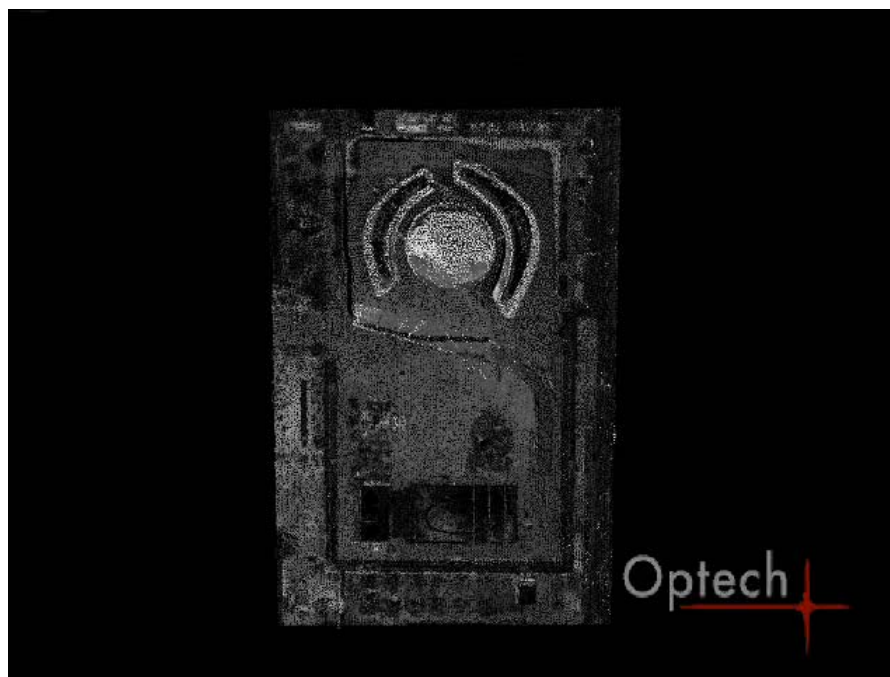




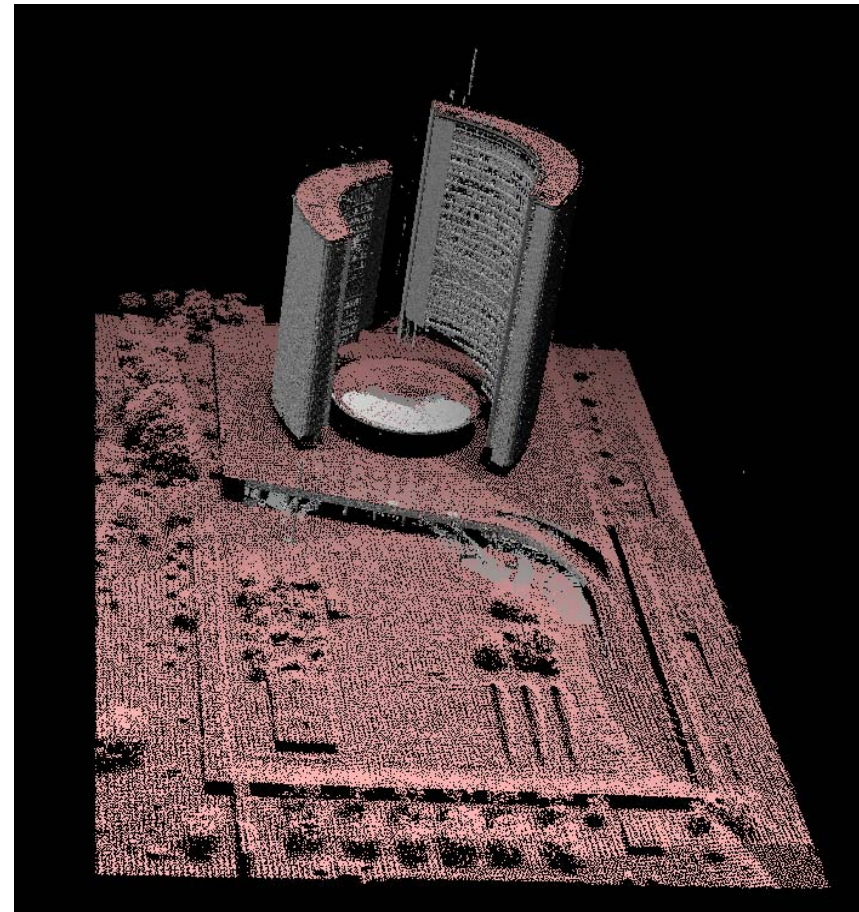
ILRIS-3D Imagery Complete with Color

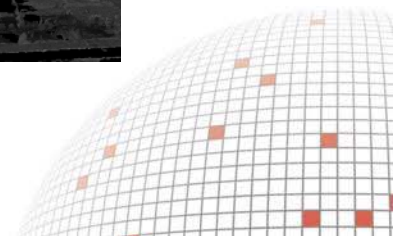
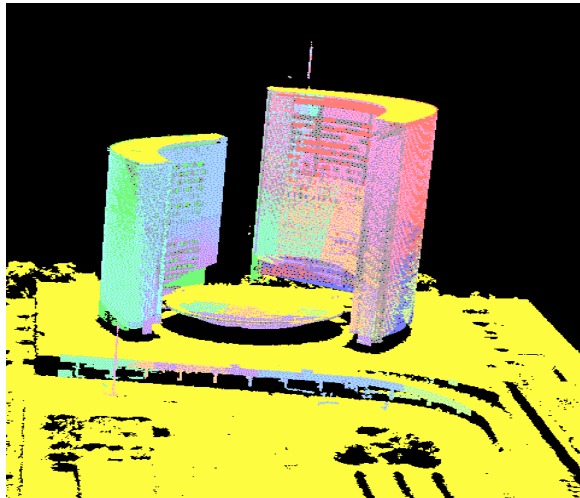
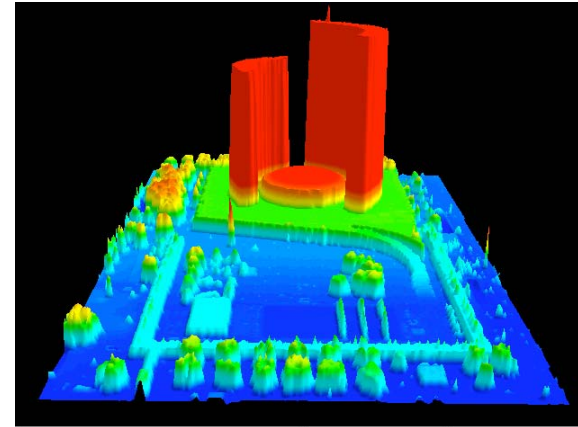


- Ground Based with Airborne using ALTM and ILRIS



- Common feature alignment used
- Corners of the building roofs and the top of the disc used as the control points
- Accuracy of the alignment ~0.017 m

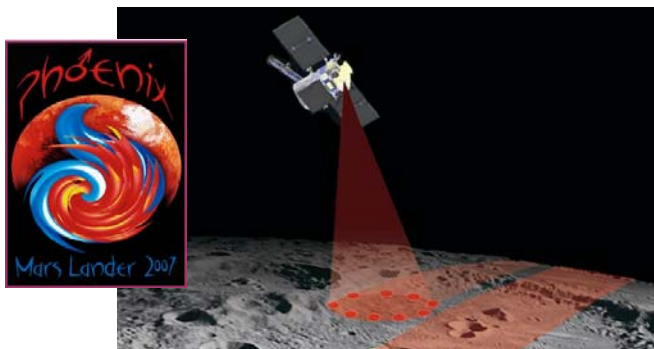




EXPLORATION.

Exploring new worlds

- Planetary Mapping
- Hazard Avoidance and Precision Landing
- Sample Return
- Altimetry
- Rover Navigation
- Virtual Geology
- Atmospheric Monitoring



OPERATION.

Operation and safety in space

- Spacecraft Imaging and Inspection
- Rendezvous and Docking
- Collision Avoidance
- On-Orbit Servicing
- Autonomous Robotics



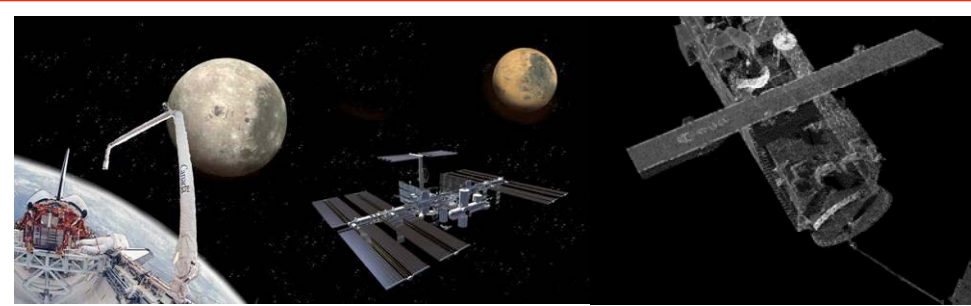
PRESERVATION.

Preserving planet Earth

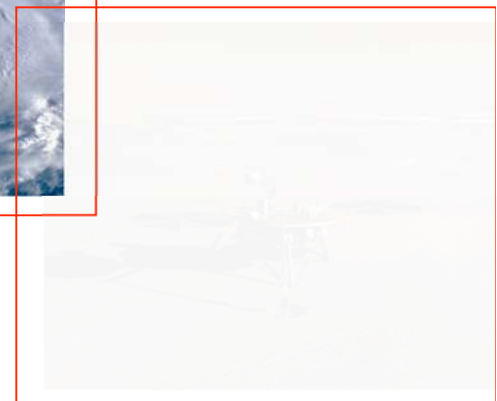
- Homeland Defense and Security
- Environmental Monitoring
- Meteorology
- Remote Sensing
- Cloud Height Measurement



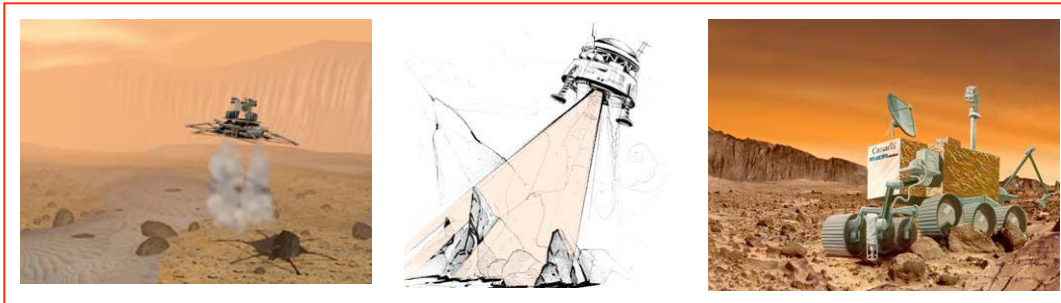
Rendezvous & Docking Systems



Planetary Science



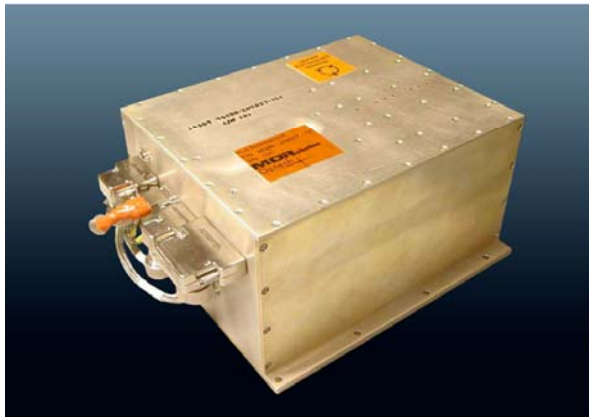
Smart Landers & Rovers



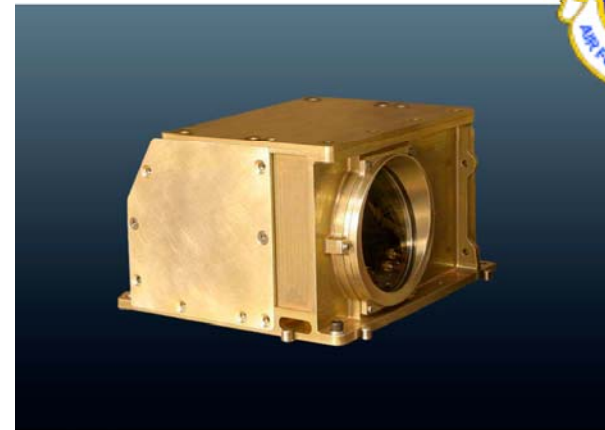
Inspection & Safety



□ Flight Hardware: Rendezvous Lidar Sensor (RLS)



RLS Avionics Unit



RLS Optical Head



□ Performance Highlights

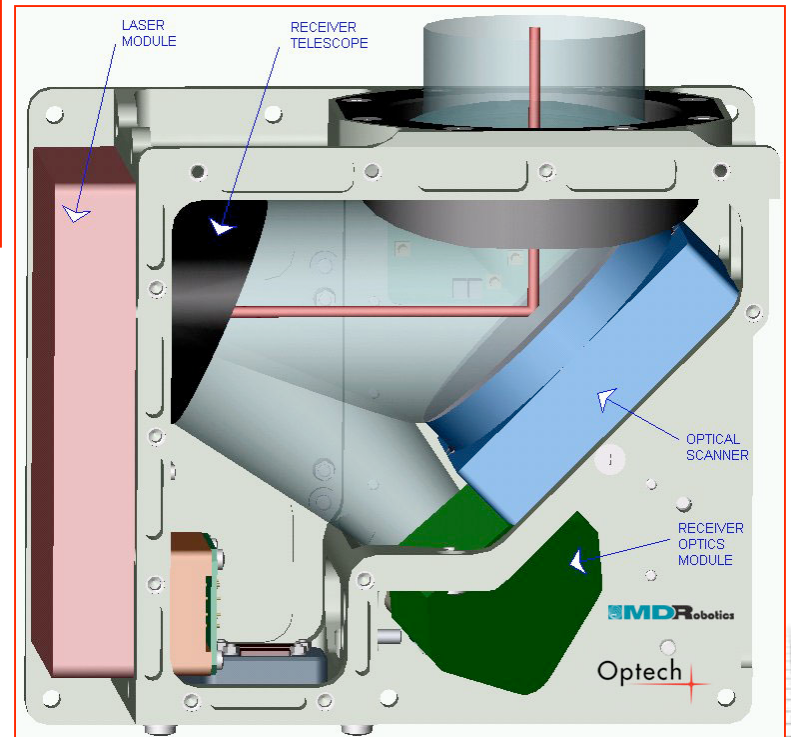
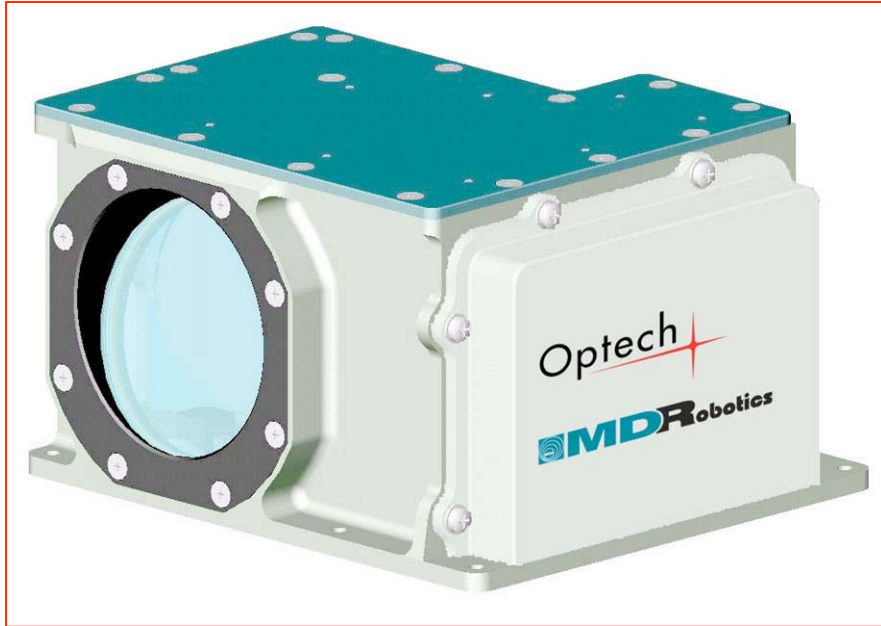
- Field of view +/- 10 degrees
- < 75 w & < 10 kg
- Range – 2 m to 3 km (1cm resolution)
- Short range accuracy – 5 cm and 3.5 mrad
- Returns raw data or centroids at 10 Hz
- Data points collected at 8-10 kHz (laser PFR)





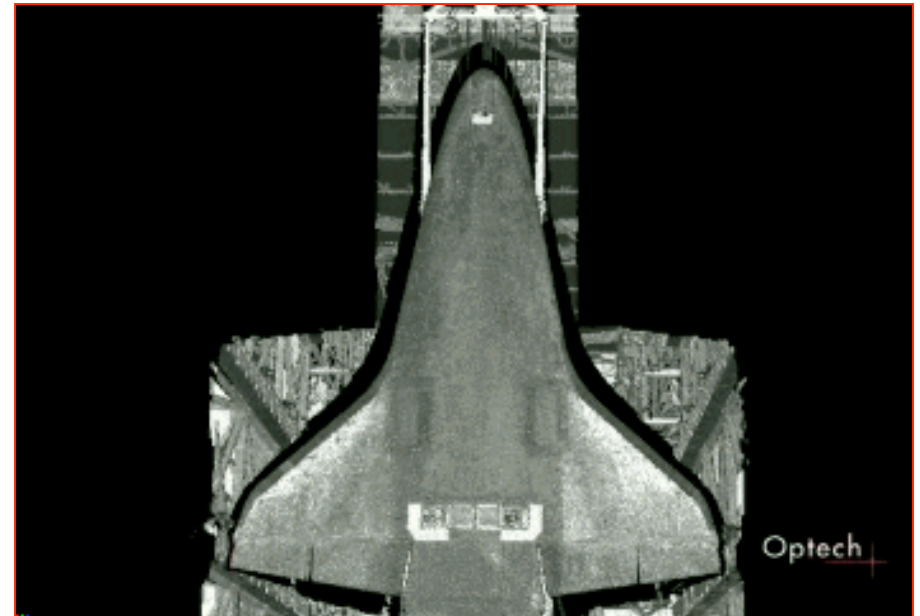
Optech/MDR Current Flight Program

(Rendezvous)

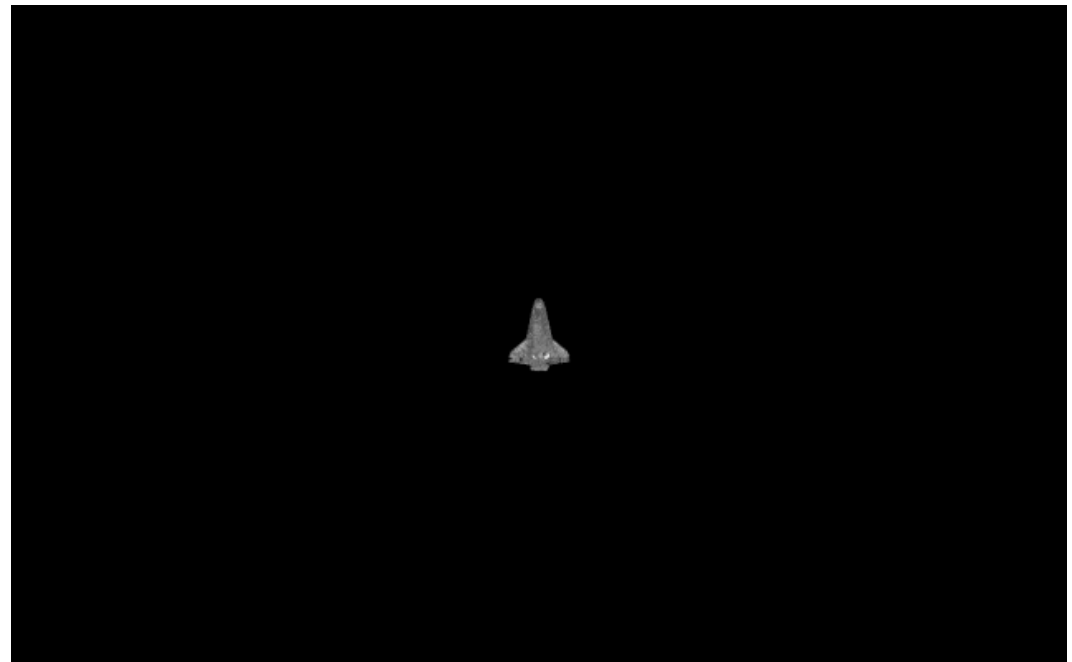


Shuttle Tile Inspection Test Results

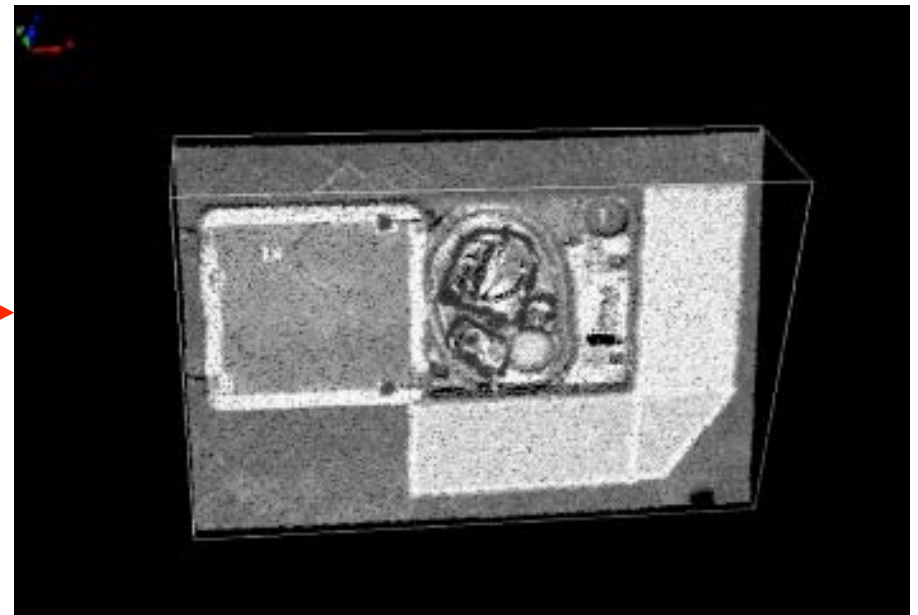
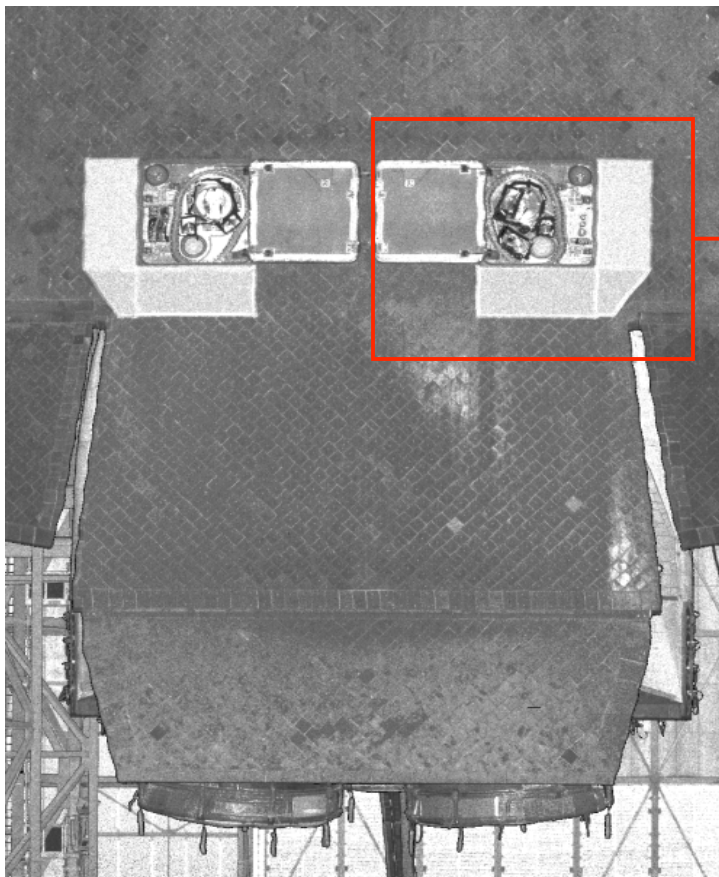
Full Orbiter from 75 m @ 10mm resolution



- RLS sensor demonstration for Shuttle Return to Flight



- Fuselage umbilical bay from 75 m @ 10mm resolution



- Underwater imaging
- Finding camouflaged targets
- Scene monitoring using change detection
- UAV systems (small size, real-time data output)
- High-speed mobile mapping of urban areas

