ASC 3D

Bringing 3D Alive!

3D Flash LIDAR Cameras™

For OOS Applications March 26, 2010

www.asc3d.com

Advanced Scientific Concepts Inc.

AGENDA

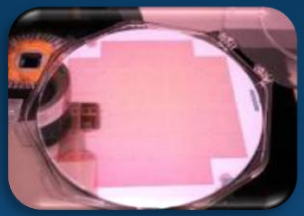
- Introduction to ASC
- Description of 3D Flash LIDAR Cameras (3DFLC)
- Potential OOS Applications of 3DFLC
- Current NASA Related Programs at ASC
- ASC STS Flight Qualified 3DFLC

ASC 3D

3D Flash LIDAR Technology

(everything below represents original ASC IP)

Chips (GaAs and CMOS)

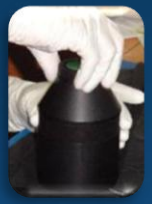


Non-CCD/CMOS hybrid sensors

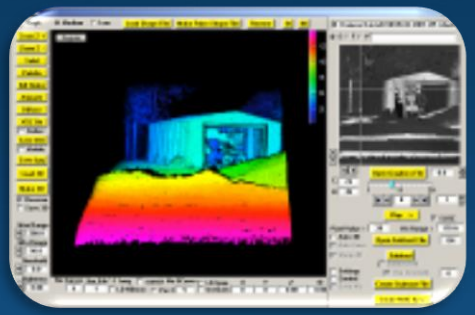
Lasers

Diode or “pumped” depending on application

Optics



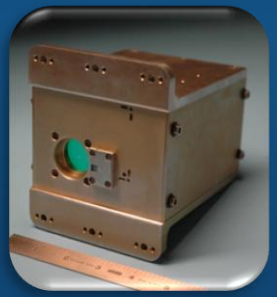
TigerView Software



Electronics & Custom Cameras

Portable 3D FLC Evaluation Kit™

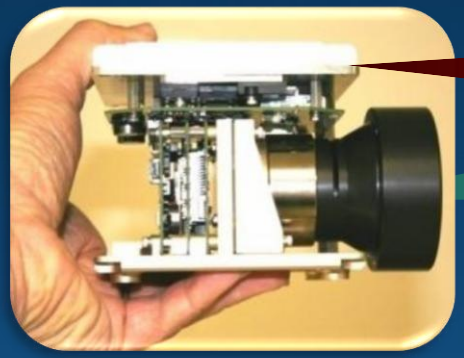
TigerEye 3D Camera™ (9º)



DragonEye
3D FLC for Space
(45º)

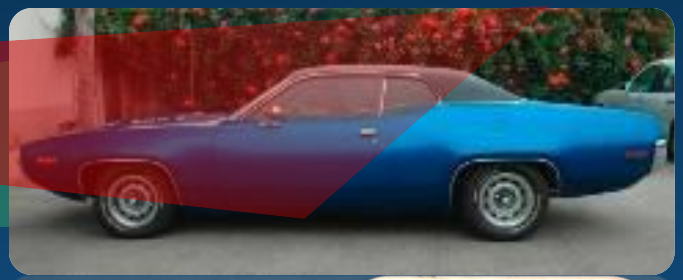
CatEye 3D Camera™

ASC's 3D Flash LIDAR Camera™
(3D FLC)



Eyesafe laser illumination

Return



ASC's 3D FLC illuminates the scene, records time-of-flight laser pulse data onto a detector array and generates precise "point cloud" data on a per frame basis

Raw data (2005)

- The TigerEye 3D FLC captures 128x128 pixels
  - Each pixel is "triggered" independently, allowing capture of 16,384 range data points to generate the 3D point cloud image
  - Up to 30 pulses (frames) per second
- 3D FLC is a non-mechanical, solid state system
- Using eye-safe laser

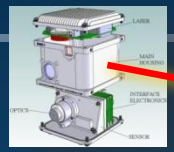
ASC 3DFLCs Applications to OOS

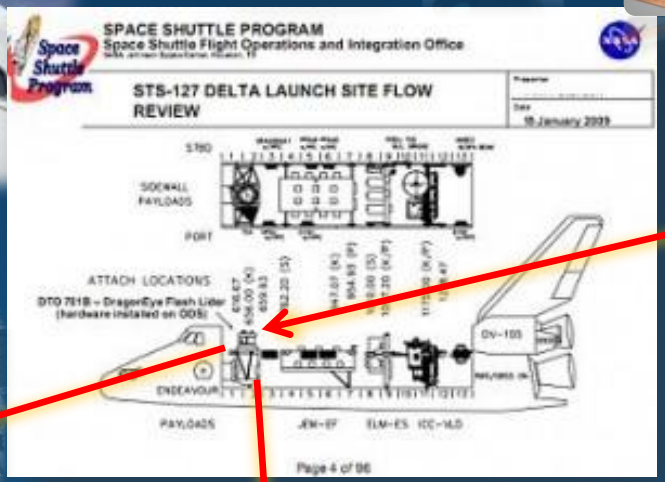
- Rendezvous and Docking – Successful ISS DTO on STS-127
- Navigation, Station Keeping, Circumnavigation, Close –Proximity Operations
  - 3DFLC = Real time 3D video camera = real time 3D positioning, with no motion distortion
- Inspection and Defect Detection
  - 3DFLC = Real time 3D video camera = accurate real time 3D modeling
    - Spatial Resolution determined by focal length and pixel size
      - Can be zoomed for higher resolution
    - Range Resolution determined by SNR (cm to mm; sub mm possible)
    - Can be overlaid with co-aligned 2D imagery (IR, high resolution visible)
- Very small SWAP possible for micro-satellite platform deployment
  - 3DFLC = digital 3D camera; laser = "flashbulb"

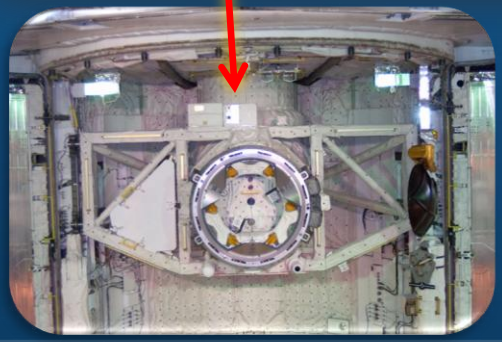
1998	2005	2009	2011 ? $$
3 ft x 2 ft x 2 ft	11" x 6" x 8"	4" x 4" x 4"	1.5" x 1.5" x 1.5"
Rack Mounted	Portable	TigerEye	FlyEye

Rendezvous and Docking

ASC's 3D Flash LIDAR in Space: NASA: STS-127 DTO







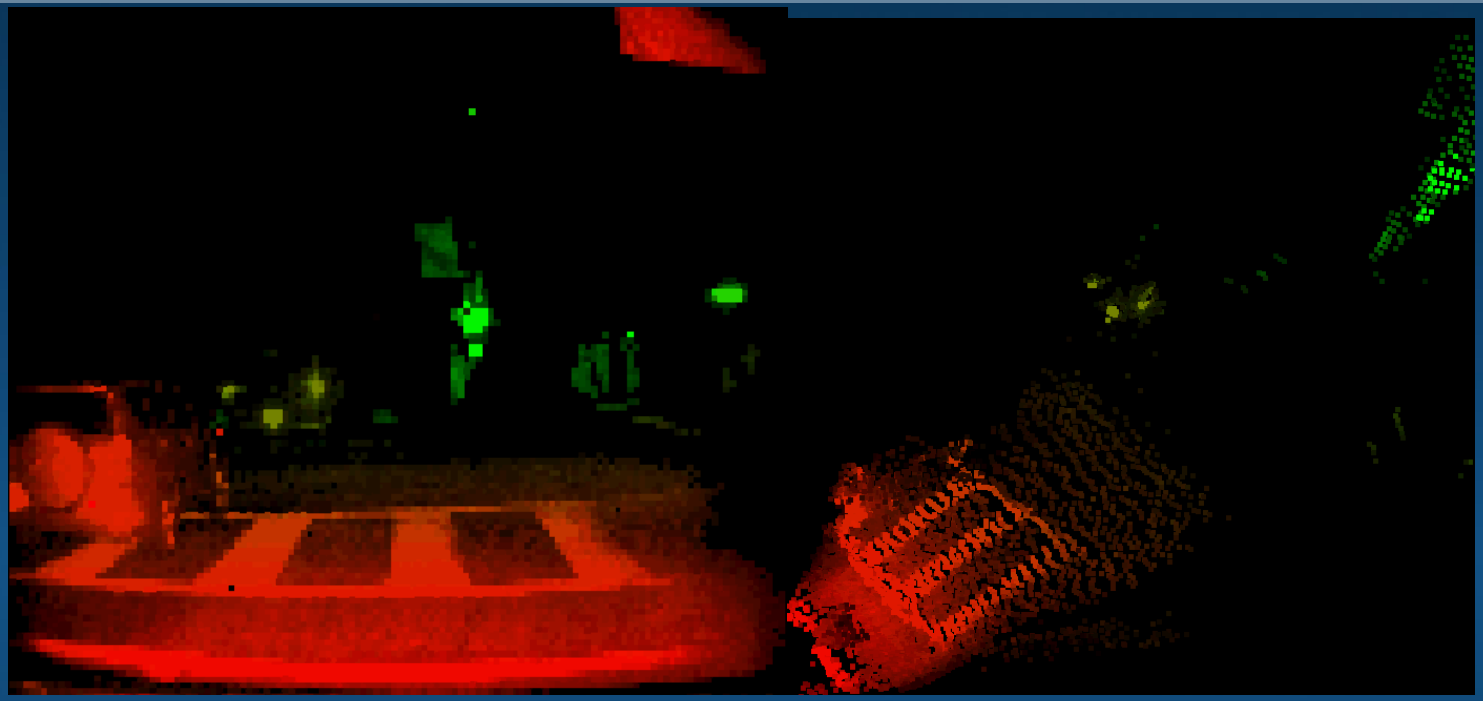
DragonEye mounted on the Endeavor Space Shuttle STS-127 DTO for AR&D exercise.

Launched July 15th '09

Schedule: 5.5 months from ASC contract to delivery

Cost < $500K

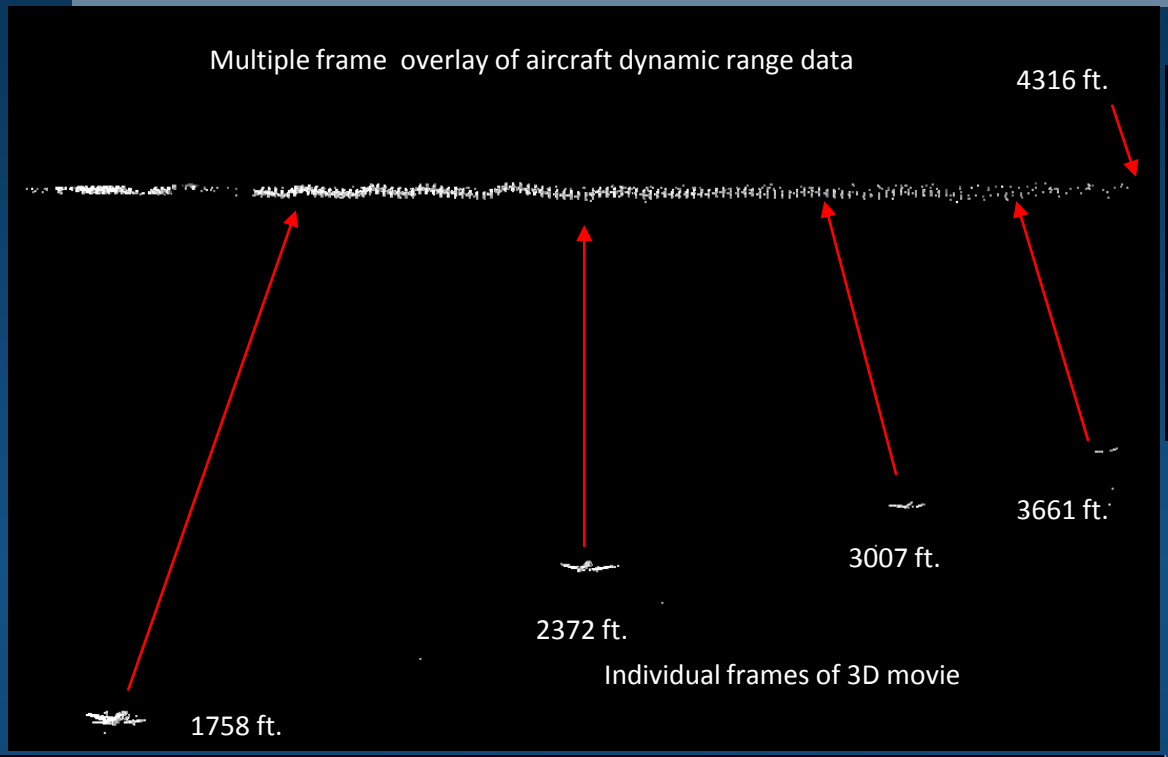
Navigation
City Driving Example
One data set (raw) shown from two different view points; no visual 2D data; Red = 3m; Green = 100m

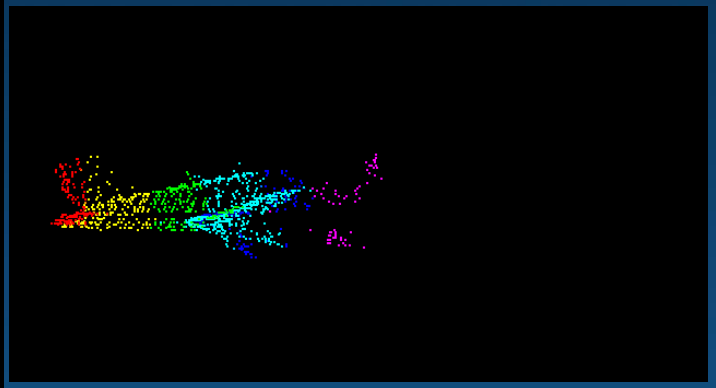


45º field of view, raw point cloud data captured at 10 Hz; the right scene is exactly the same data as the left with different viewpoint s. (Data 2007)

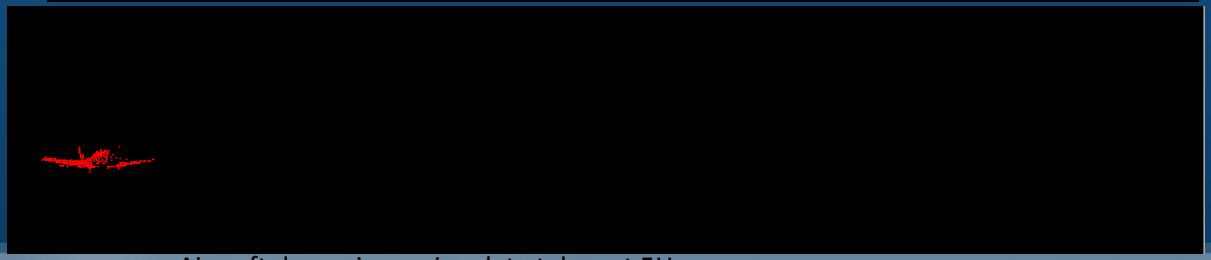
Animations created using SAIC's Urban Reality 3D Viewer
Left 'click' on left scene to start animation

Inspection and Defect Detection of Moving Objects
Aircraft Example





Single frame rotated to show 3D profile of aircraft in flight

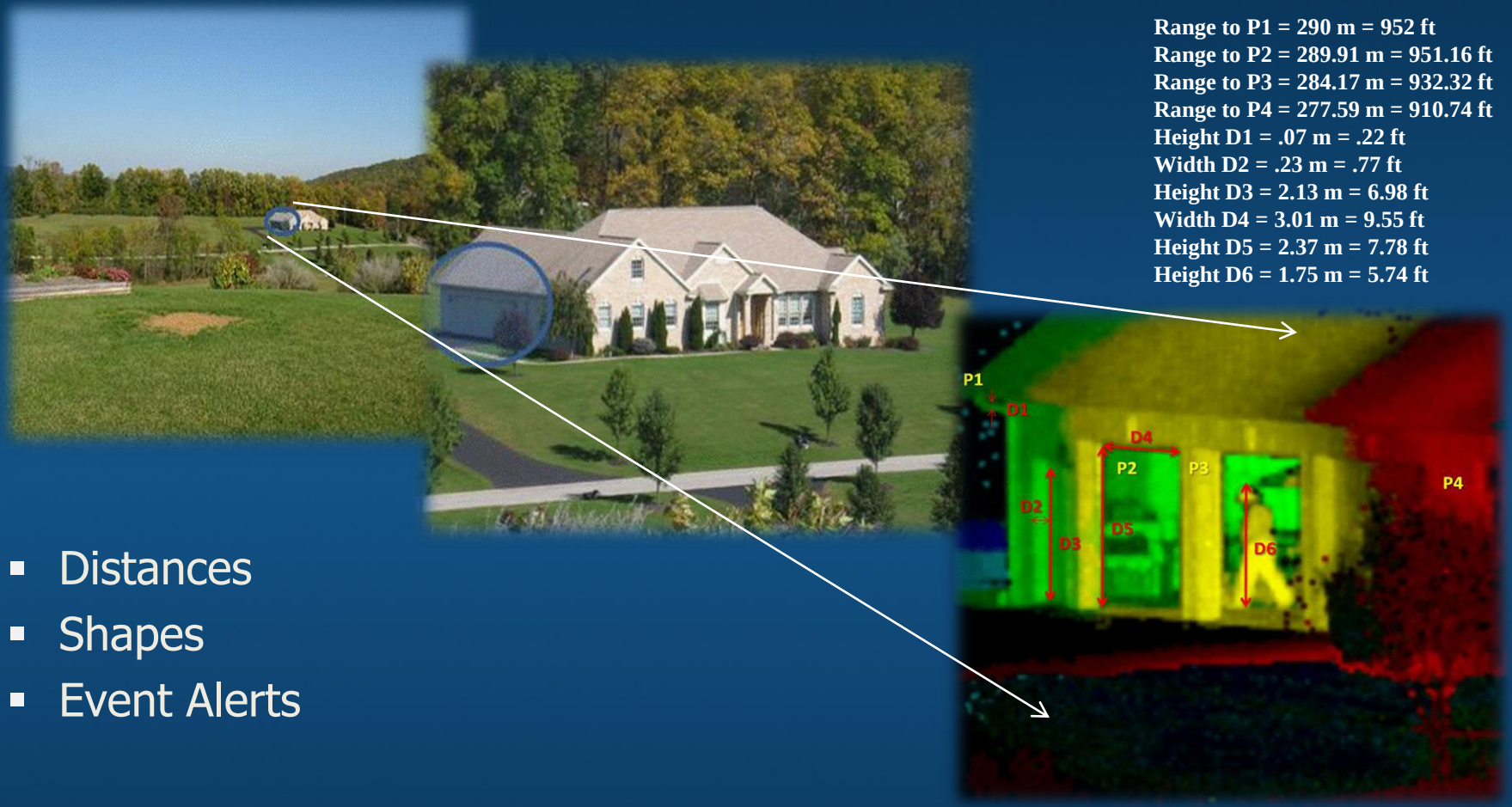


Aircraft dynamic ranging data taken at 5Hz

This data sample captures the climbing airplane @ 5Hz and tracks it 1,900' for ~11 sec.

Inspection and Defect Detection

Measuring & Capturing Accurate Inspection Data, Terrestrial Object Example



Range to P1 = 290 m = 952 ft
Range to P2 = 289.91 m = 951.16 ft
Range to P3 = 284.17 m = 932.32 ft
Range to P4 = 277.59 m = 910.74 ft
Height D1 = .07 m = .22 ft
Width D2 = .23 m = .77 ft
Height D3 = 2.13 m = 6.98 ft
Width D4 = 3.01 m = 9.55 ft
Height D5 = 2.37 m = 7.78 ft
Height D6 = 1.75 m = 5.74 ft

- Distances
- Shapes
- Event Alerts

Data 2008 Used by permission from Applied Research Laboratory, Penn State University

www.asc3d.com

Advanced Scientific Concepts Inc.

Approved for public release, distribution unlimited.

Long Range 3D Modeling

Raw Terrestrial Object 3D Point Cloud Data Textured with 2D Data

NOTE : Scene "rotating" in order to show 3D on a 2D display

Six frames taken from 1.1 km distance then stitched together and textured with 2D images as overlay; acquisition time 1/5 sec, each point (pixel) contains x,y,z and RGB data) experiment done for data capture, not image quality (2006)

NASA-Related Development Projects at ASC

1. Autonomous Landing & Hazard Avoidance Technology (ALHAT)
   1.1. ASC 3DFLCs used in NASA Langley experiments
   1.2. NRA for large format ROIC > 256 x 256 - Langley

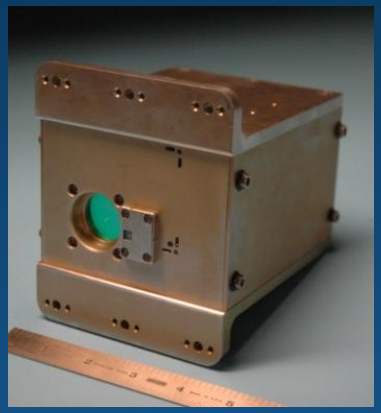
2. Other NASA Projects (Langley, JPL and Johnson)
   2.1. 3D FLC receiver space qualification, including S-level parts - JPL
   (3D FPA components inherently hard to total dose and single event upsets.)
   2.2. Define EDL requirements and provide 3DFLC test bed (complete)-JPL
   2.3. Increase detector sensitivity and develop ceramic FPA packaging for ASC 3DFLC - JPL
   2.4. Provide a qualification and flight AR&D sensor to SpaceX for Launch (2010) - Johnson
   2.5. High Sensitivity ROIC for > 256 x 256 format - Langley

3. Aerospace Company Space Projects

4. ASC commercial projects: Except for radiation hardening, are being developed in the same direction as NASA = Cost Savings and Synergy

ASC 3DFLCs for OOS Applications
STS Flight Qualified 3DFLC

Quantities Measured:	**Range and Intensity**
Detectors:	128 x 128 ROIC/ InGaAs APD array.
Performance:	1 meter (5 cm precision) to 4 km (60 cm precision).
Optical/Mechanical Design:	12 mm aperture f/1.6 telescope, aluminum construction.
Field of View:	45 by 45°
In-Flight Calibration:	Single time of flight optical reference.
Mounting Orientation:	Fixed to spacecraft.
Thermal Requirements:	Operating 10° C to +40° C.
	Storage -20° C to +60° C.
Frame Rate:	20 Hz
On-board Data Processing:	Virtex 4 FPGA
Mass:	3 kg
Size:	12 x 12 x 12 cm
Power:	30 W 100% duty cycle (28 -32 Vdc)



As Flown Configuration 7/15/09