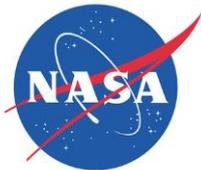


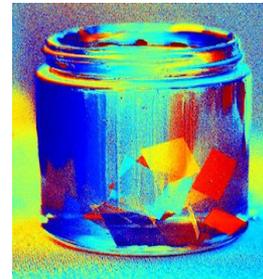
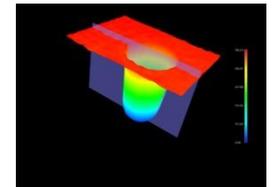


# A Novel Inspection Technique Using Spatial Phase Imaging: Applications for the International Space Station (ISS) Program

*"Capturing and understanding the physical world - digitally"*



Johnson Space Center  
Houston, Texas  
July 15-16, 2014





- The TEAM



Aerospace Programs,  
Space Systems, and  
Integration

**RPS** Knowledge Reservoir

Systems Design,  
Systems Engineering,  
Program Management



Technology Hardware  
and Software



## About Photon-X

- 15 year old company
- Numerous Patents and Patents Pending
- 15 years US Military contractor
- NASA was first customer

## SOME OF OUR CLIENTS

SONY

Raytheon





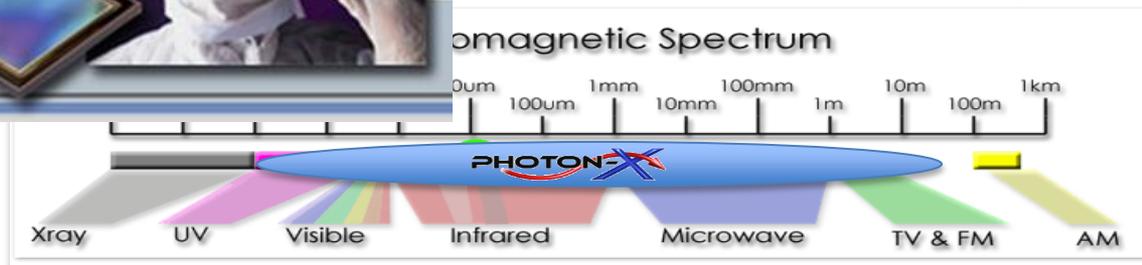
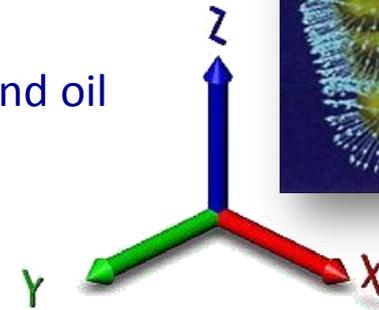
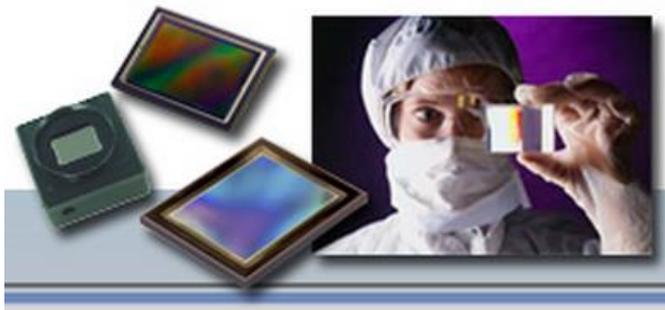
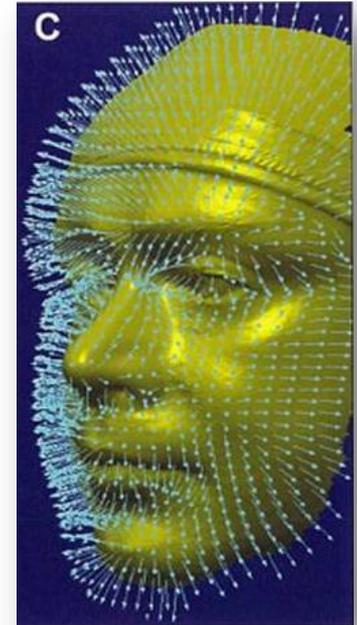
## Spatial Phase Imaging Technology Overview



## SPATIAL PHASE IMAGING (SPI)

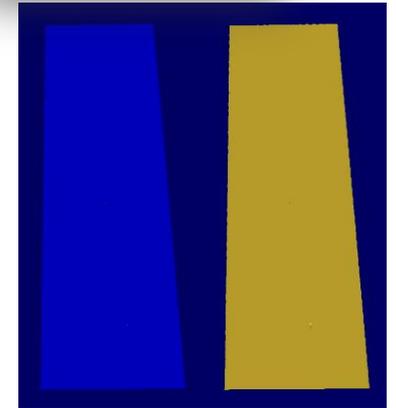
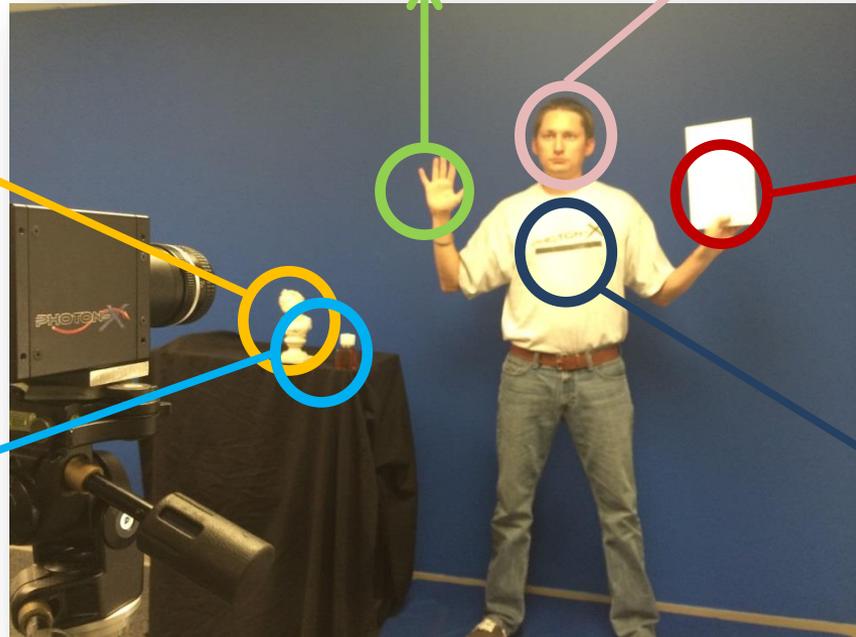
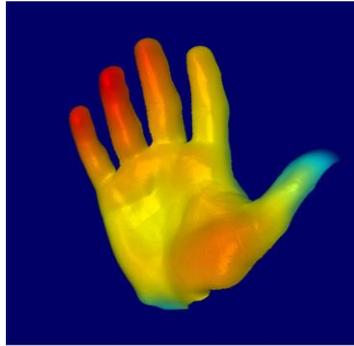


- 3D, mono lens, real-time passive imaging, and analytics technology.
- *Measures orientation of electromagnetic energy passively in real-time*
- Works in most bands of the electromagnetic spectrum
- Measure in microns and microseconds
- Dynamic
- Effective in turbid atmospheres, such as smoke, fog, dust, and oil



SPI Technology: Single Frame or Multi-Frame, Static or Dynamic

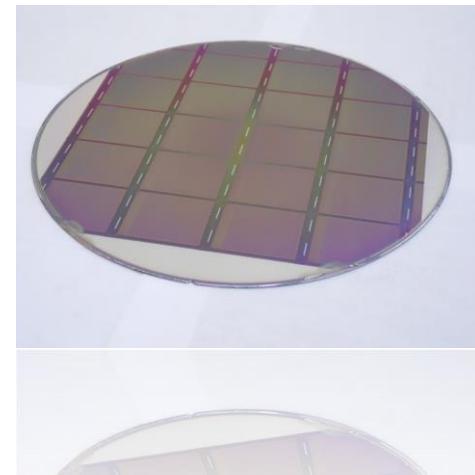




## SPI's UNIQUE ADVANTAGES

3D Camera Technology	Technical Requirements								
	3D Model	Dynamic & Targetless	Emitted or Reflected Energy	Wide Dynamic Range	Line of Sight	High Resolution	Simultaneous Multi-Function	Very Long Distances	Automated Analytics
SPI	●	●	●	●	●	●	●	●	●
Time of Flight	●	✘	✘	✘	●	✘	✘	✘	✘
Stereopsis	✘	✘	✘	✘	●	●	✘	✘	✘
Stereo Correspondence	●	✘	✘	✘	✘	●	✘	✘	✘

**Key:** **Green** = Fully meets requirements  
**Red** = Fails to satisfy requirements





## Surface Inspection and Corrosion Detection

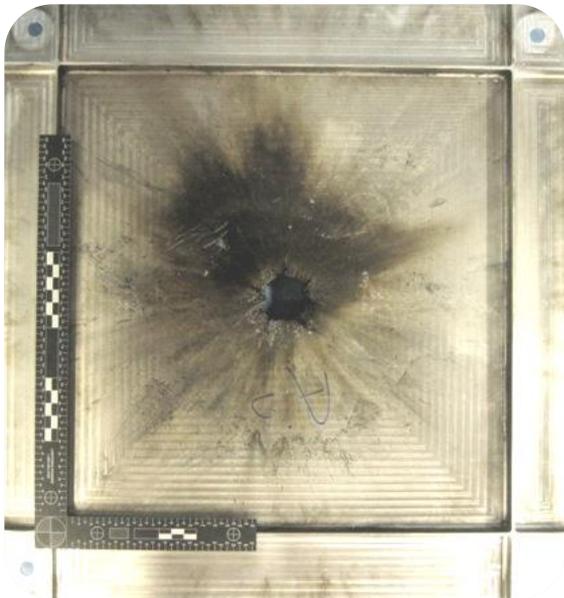




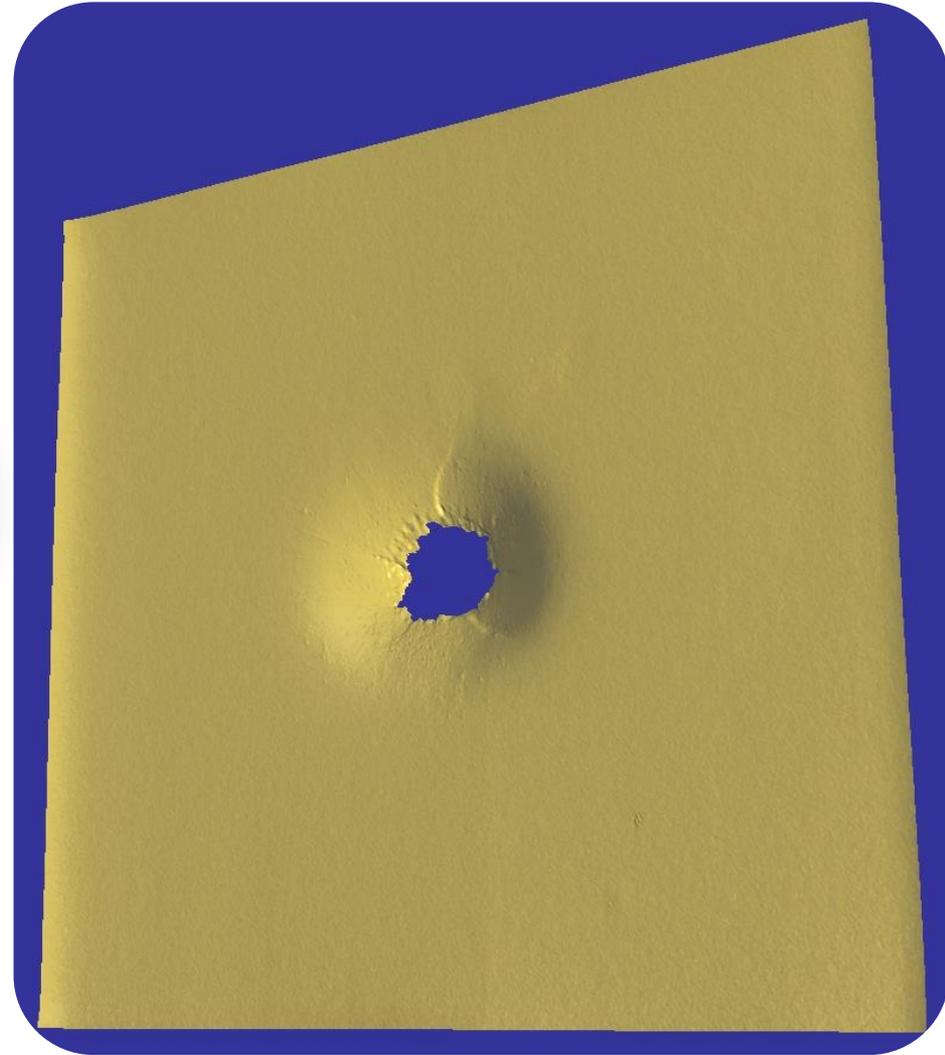
## SURFACE DAMAGE MODELING



July 2014 test at the Photon-X facility in Huntsville, Alabama for JSC was designed to passively measure and print a 3D repair plug for a space debris strike.



NASA MMOD Test Plate

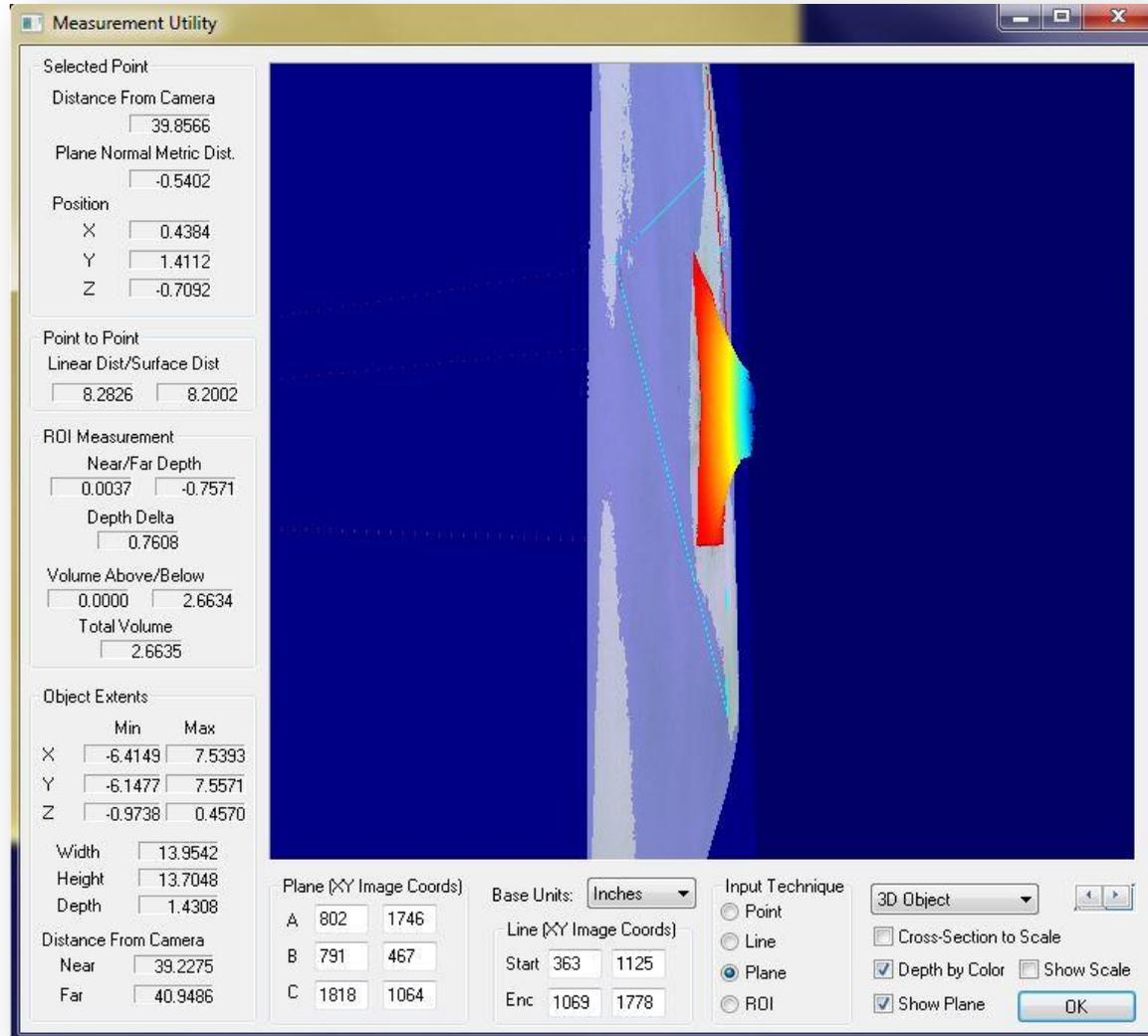




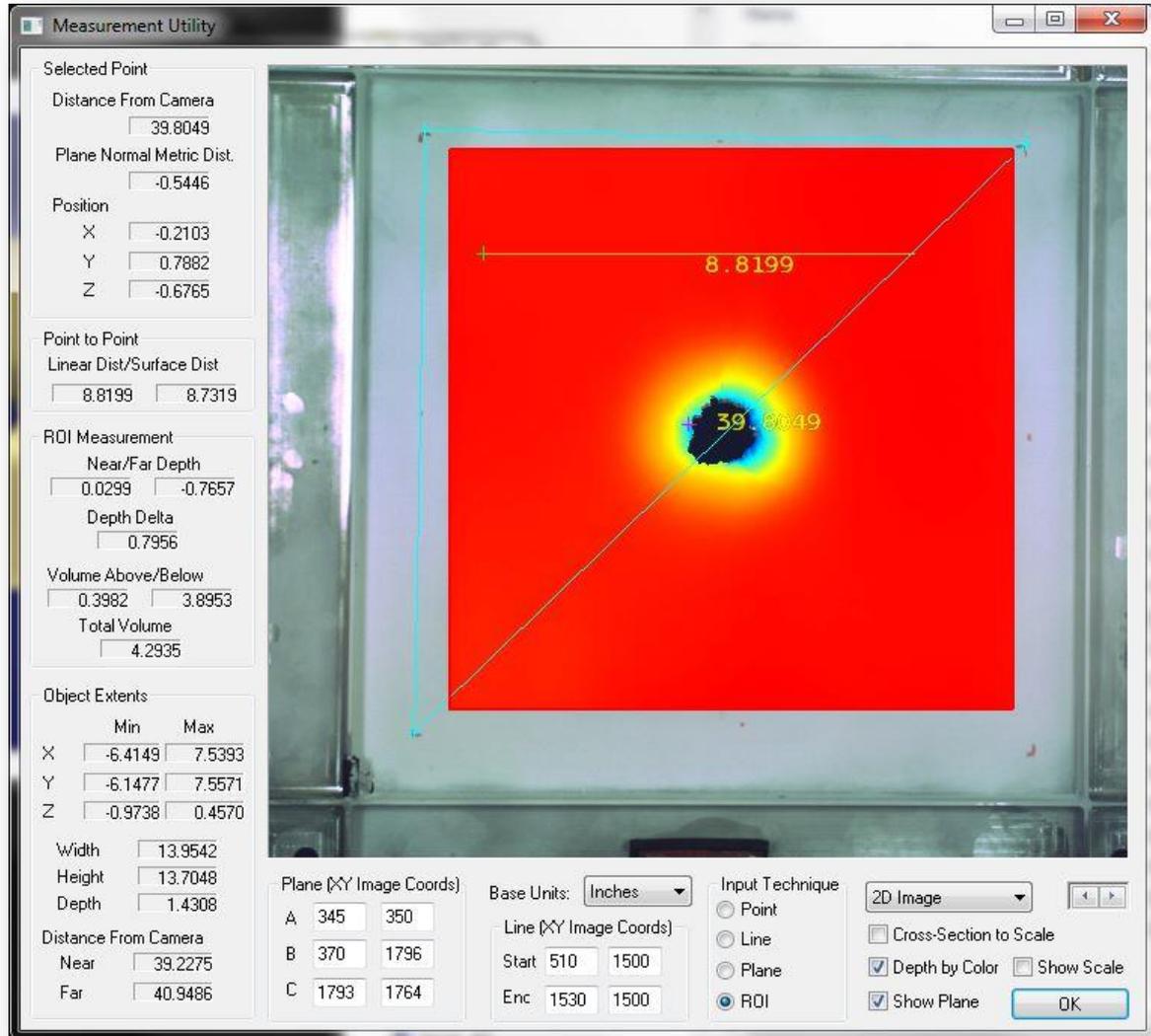
## SURFACE DAMAGE MODELING



SPI accurately measured the MMOD strike deformation

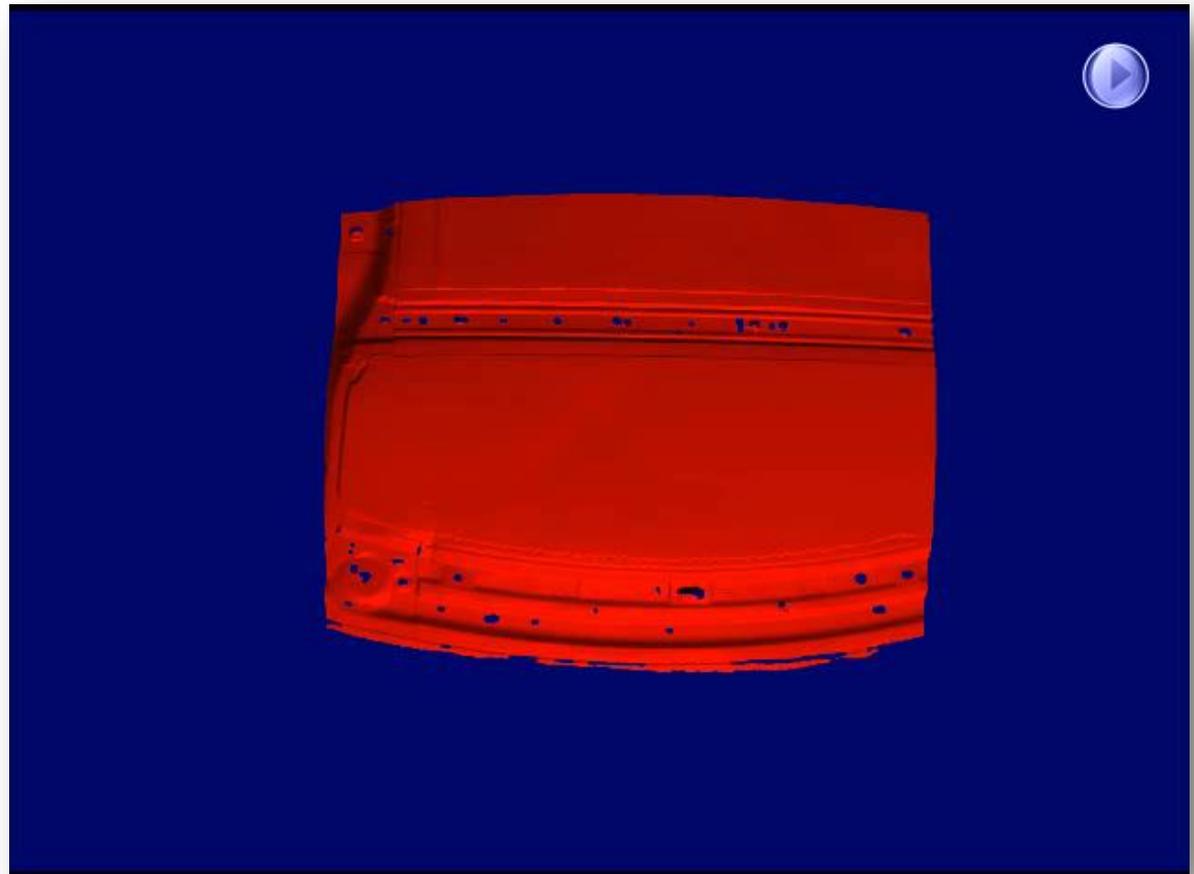


SPI accurately measured the MMOD strike and delineated the Undeformed areas.



Deformation at 1000 FPS  
Video – USDoT

High speed SPI Data  
capture of a car  
dropping on its roof





## 3D Object Mapping



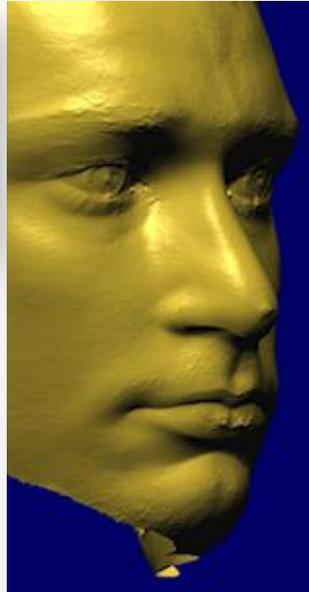
# VOLUMETRIC SHAPE MODELING & 3D MAPPING



**Subject**



**Step 1 – Capture  
3D Image**



**Step 2 – 3D Print the 3D Image**



Color 3D printed face  
(front view)

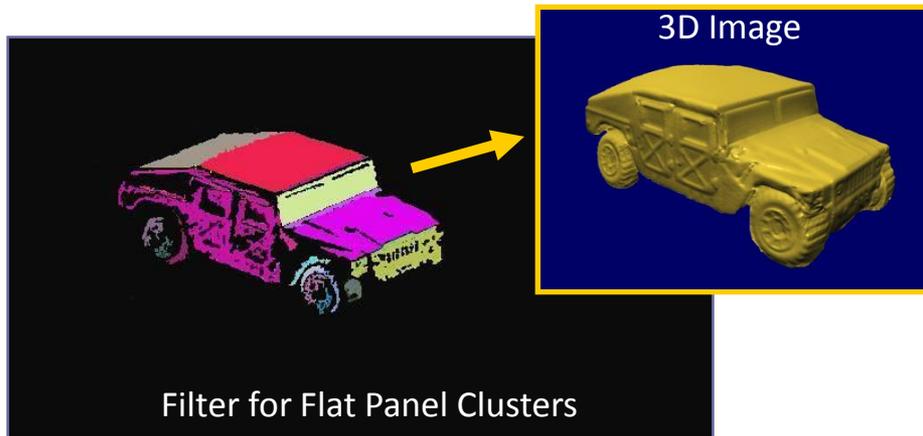
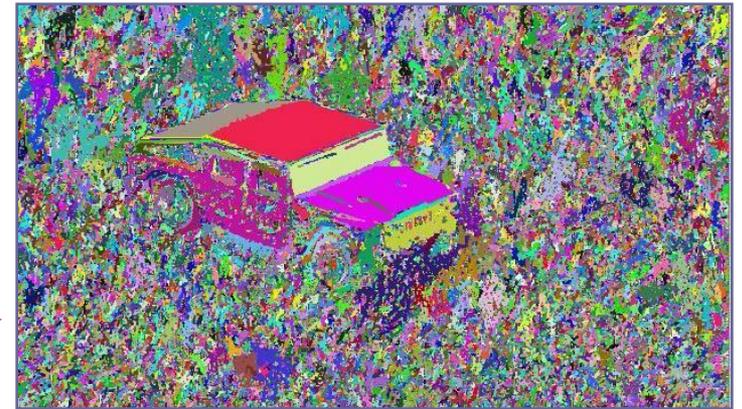


Color 3D printed face  
(right view)

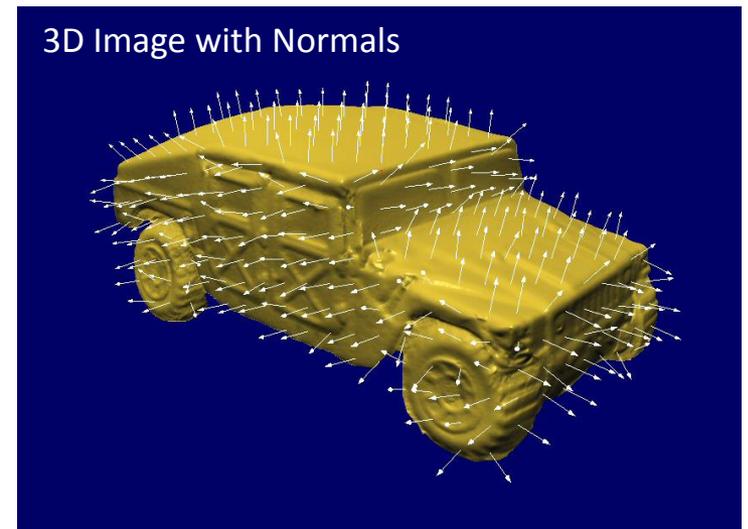
## VOLUMETRIC SHAPE MODELING & 3D MAPPING



The ability to extract flat panels from a scene provides an additional tool for faster and more robust ATR methodologies.



Panel clusters identification is a powerful advantage in target recognition.





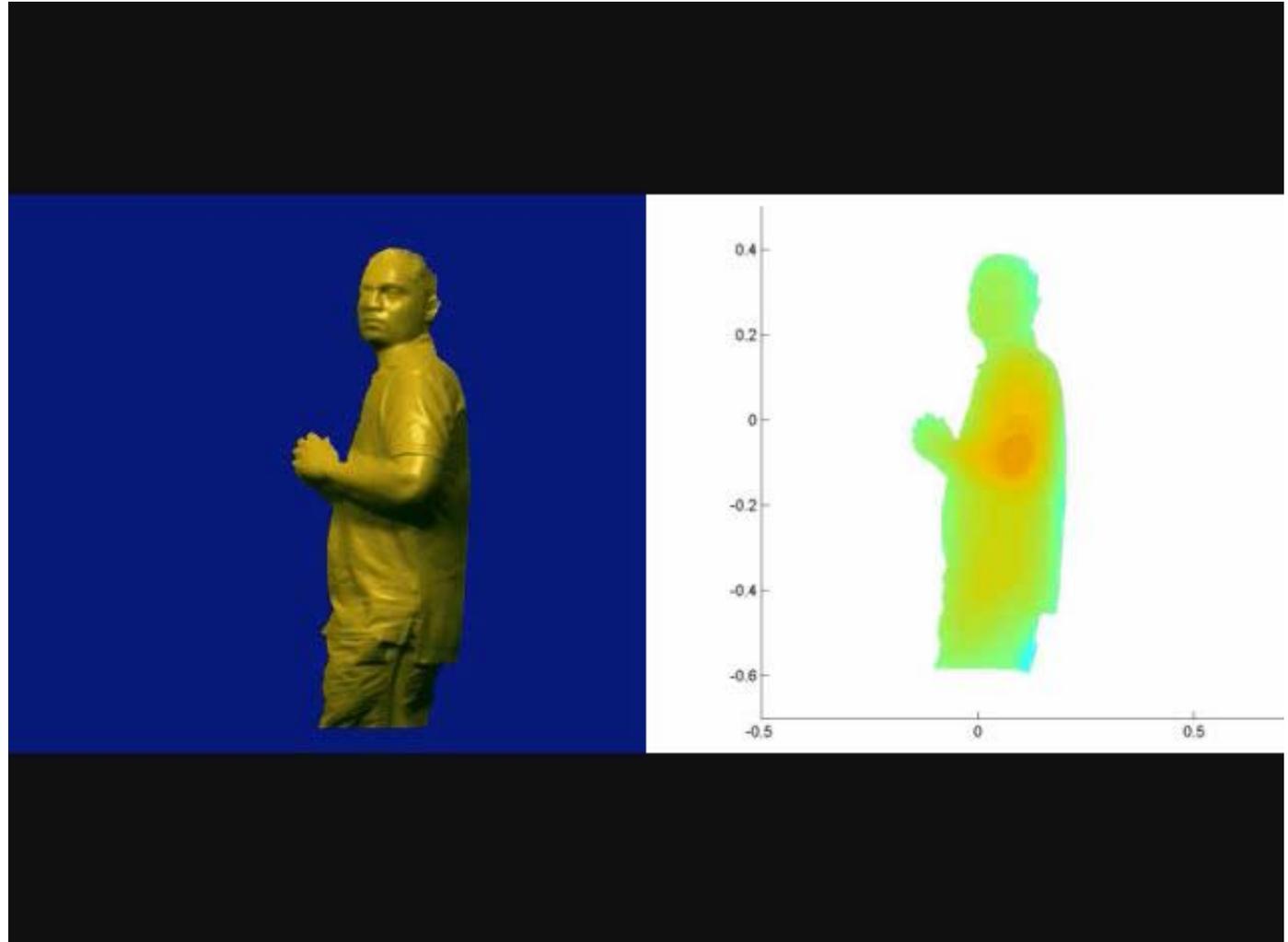
## Human Factors

IDEAS Technology is currently supports these types of biometric analysis:

1. **Physiological Biometrics** are related to the shape of the body. Examples include, but are not limited to facial and iris recognition, hand - palm geometry and fingerprints.
2. **Behaviometrics** are related to the behavior of a person. Examples include, but are not limited to body posture movement, gait, and micro-expressions, and automation from body movements.



Dynamic  
Targetless  
3D capture  
Real-time  
Analytics





## Robotics & Automation

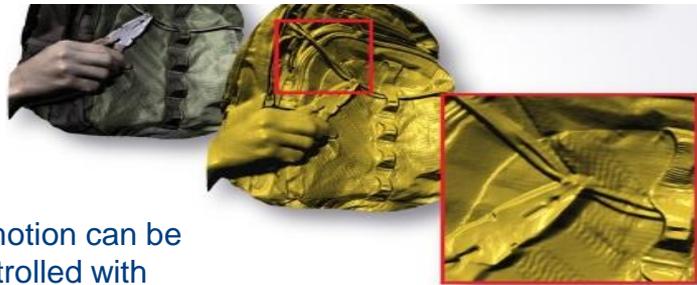


## ROBOTICS



*SPI sensors give visual intelligence and micro-manipulation capabilities to robots underwater, on land, and in the air.*

*Photon-X has ongoing robotic programs with the US DOD.*

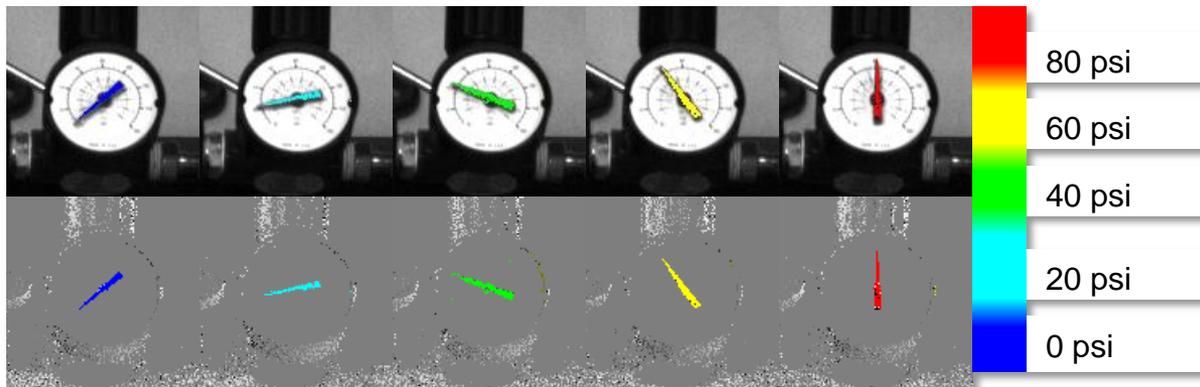


Fine motion can be controlled with Photon-X VID30® cameras



### Photon-X created an automated system to execute the following tasks:

- Personnel tracking
- Automated position of dials, gauges, doors etc.
- Detection of structural changes
- Awareness of people and assets in low visibility



Automated Gage Monitoring Application.  
Demonstration of Intelligent User Friendly Automation.



Recent advances in SPI:

3D Synthetic Aperture Radar

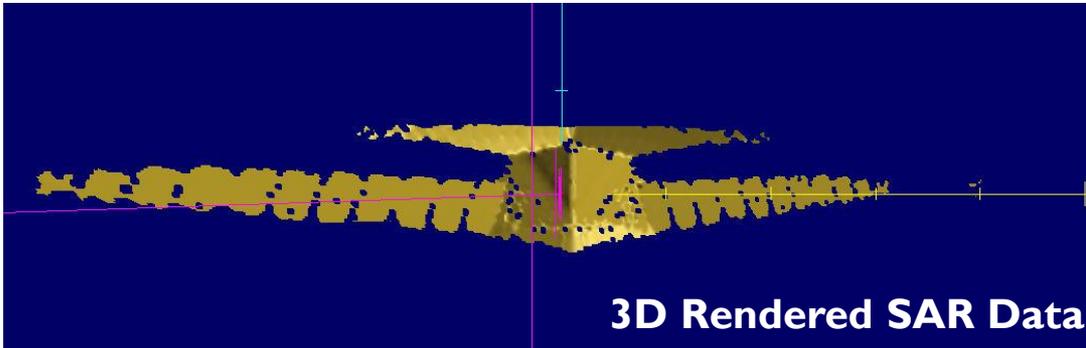


## 3D SAR Capabilities

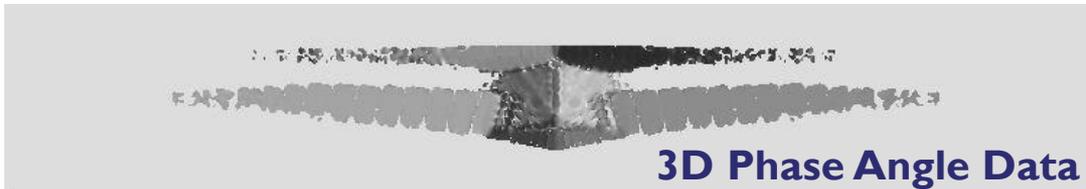
- Photon-X's powerful and unique 3D technologies offer a method for viewing 3D SAR data.
- Photon-X innovative technology can provide high resolution 3D data from a single sensor pass.
- Photon-X patented techniques offer valuable target invariant 3D data for SAR Sensors.



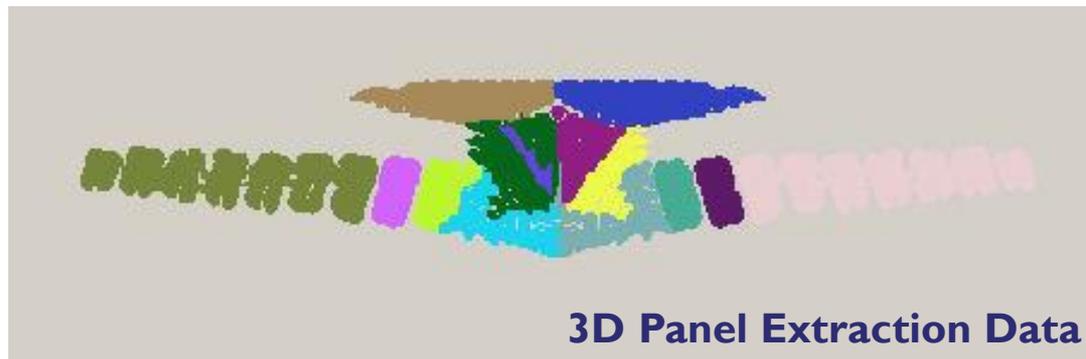
## 3D SAR Capabilities



3D Rendered SAR Data



3D Phase Angle Data



3D Panel Extraction Data

- 3D rendered data from simulated SAR data.
- Low observable target object
- Photon-X innovative technology provides high resolution 3D data from a single sensor pass.
- Photon-X sensor provides accurate 3D information in all wavebands.

- **Inspections**

- Corrosion detection external
- Corrosion detection internal
- Real-time stress analysis

- **Human Factors**

- **Automation**

- Robotics
- Auto navigation

- **3D Mapping & Modeling**

- **Virtual reality**

