Introducing 3D Phase Measurement

New Optical Measurement Technique
For the XLG3 Video Borescope

Based on phase shifting principles of optical metrology, 3D PM is an Exciting Breakthrough for the RVI industry.
3D Phase Measurement

Full-Screen, On-Demand Measurement Technology
Scans the part surface and creates a 3D surface map
All measurements and views performed on the 3D surface
Comparison to Existing Measurement Technology: Stereo

Stereo Measurement

• Optics create a stereoscopic image
• The system matches points and creates depth information
Comparison to Existing Measurement Technology: Shadow

Shadow Measurement

- Optics cast a shadow on the image
- The operator marks the shadow, giving the system distance to target information
Stereo Measurement Limitations

Special-purpose measurement tip is not suited for general inspection.

Measurement requires computer point matching from left to right views. Opportunity for error.

More complicated to use. Inspectors must be highly skilled to obtain accurate measurements.
Other Limitations of Stereo

Point to point measurements

Less productive to use than a measurement On-Demand system like 3D PM.

Less accurate than 3D PM on depth measurements
High-Level Features of 3D PM

Measurement On-Demand
View + Measure without tip change

Full Screen Measurement
Same view, larger defects

Easier to Use
No Shadow Selection or Stereo Point Matching or Laser Point Selection

More Information
3D Surface, Depth Profile
High-Level Features of 3D PM

Range Finder
  Gives distance LIVE

Auto Tip Selection
  No menu step

Better Accuracy
  Especially on Depth

Loose Tip Warning

Increased Measurement DOF
  Closer as well as Larger Defects
High-Level Features of 3D PM

New Measurement Types and Views
Non-Measurable Zone Warning
More User Feedback and Guidance
Customer Values

Productivity from Measurement on-demand vs. changing tips

Aid to shrinking workforce – easier to use, faster

Better results with less training. More inspectors can measure.

More accurate depth measurements in critical applications

Unique measurements like tip clearance, profile view

Unique 3D surface information
Using 3D Phase Measurement

1. View with PM
2. Spot Defect
3. Freeze Image
4. Measure

Fewer Steps
Faster Results
Full Screen
105° FOV
How 3D Phase Measurement Works

Full Screen View
Phase Patterns
Create 3D Point Cloud
Then Measure

Length
Supports All Standard Measurements

Length
Area
Point to Line
Depth
Segment
Leading Edge Pitting

Gas Turbine

Steam Turbine
Turbine Blade Clearance

Only possible with 3D PM!
Gun Barrel Pitting
Pipe Welds
New Applications

3D Surface Image View
Improved Understanding
Gauge Noise vs. Feature Size

Measure Small Features
Higher accuracy in depth measurements
Can compare noise vs. feature size
New Probes!

3D Phase Probes are different
Electrical connections to the
Internal light shutter
All XLG3 Optical Tips fit and work

Stereo Tips
Shadow Tips
General Viewing Tips
3D PM Tips
Side View Tip

- Phase Gratings
- Lens
- Arc Lamp Illumination
- Double Threads

14 mm
9 mm longer than headguard
Forward View Tip

Lens

Phase Gratings

Arc Lamp Illumination

Double Threads
Installing the Probe and Tips

Install the 3D Phase Probe

Attach 3D Phase Tip, either Forward View or Side View

The system will automatically identify the tip installed
Use the probe and tip for general inspection
Range Finder

Bars change color from Red to Yellow to Green
More bars the better
Once you see an indication...

Press and **HOLD** the ENTER Button or Trigger to Capture an Image

Short press of ENTER or Trigger is a Freeze Frame, and will NOT capture an image
Measurement

Once the image is captured, select Measure from the MENU
Measurement

Measurements are made on the 3D Surface Map and projected onto the White Light image that we are accustomed to seeing.
Measurement Type

Then choose Measurement Type

Phase  >  Length
    >  Pt-Line
    >  Depth
    >  Area
    >  Multi-Length
    >  Depth Profile
Length

Place first cursors at one end point of length being measured

Place Second cursor at opposite end of length being measured

Measurement then appears on screen
Pt-Line

Create a reference line by placing first two cursors along reference area.

Place third cursor at the desired location to be measured.

Be sure to place cursors on the edges.
Depth

Place first 3 cursors on the same plane around object being measured

Place forth and final cursor on the point desired for depth measurement

When cursor is placed, Measurement will appear on screen
Blade Tip Clearance

Special type of Depth Measurement

Scan an image that includes the side of the blade and the shroud at approximately a 45 degree angle so both are in view.


Blade Tip Clearance

Position the reference triangle cursors on the shroud below the edge of the blade.

Position the Depth cursor on the NEAR edge of the blade.

System returns an accurate tip clearance measurement
Area

Place up to 24 cursors around object the object being measuring

When final cursor is placed, double click enter to display measurement
Multi-length

Place first cursor at one end point of line being measured

Place up to 24 cursors along measurement location

Double click ENTER to display measurement
Depth Profile – A New Measurement

Creates a cross-section depth cut perpendicular to a reference plane.

Always perpendicular, even if the camera angle is not!

So depth measurements are accurate!
Depth Profile

Place two cursors so that they cross measurement area

A line appears between the cursors

Depth measurement will appear to show the deepest point along the line

Cursors should be on the same flat plane to work best
Profile View

Press and Hold ENTER to switch to Profile View

The center cursor and the two end cursors can be moved to measure different points

Some of the surface waves are noise
Point Cloud

While viewing a Depth Profile Measurement

Menu > Image > Point Cloud

Can tilt, spin image
**Depth Map**

Depth Map is a false color view of the Point Cloud

Blue is closer to the tip

Red is further away

While viewing a Point Cloud Image, Press Menu

Click Depth Map, On
Point Cloud and Depth Map

If no measurement has been made, entire viewing area is displayed.

If a measurement has been made, view is cropped to a circle drawn around the measurement.
Red Areas

Red will appear on screen when a user moves a cursor over an unmeasurable area.

Red areas are caused by glare, distance too far, or lack of pattern distinction.
Max Target Distance - MTD

MTD is distance from tip to furthest cursor

Replaces accuracy index

Lets the user verify they are working within an accurate range
Recap 3D PM

Full-Screen, On-Demand Measurement Technology
Scans the part surface and creates a 3D surface map
Dynamic new technology for new and existing measurement applications
3D Phase Measurement

A new Era in Remote Visual Inspection for part and indication analysis!