An Optimal Inspection Strategy for Coke Drums

Steven A. Garcia

President

AMERISCAN

TESTING-INSPECTION

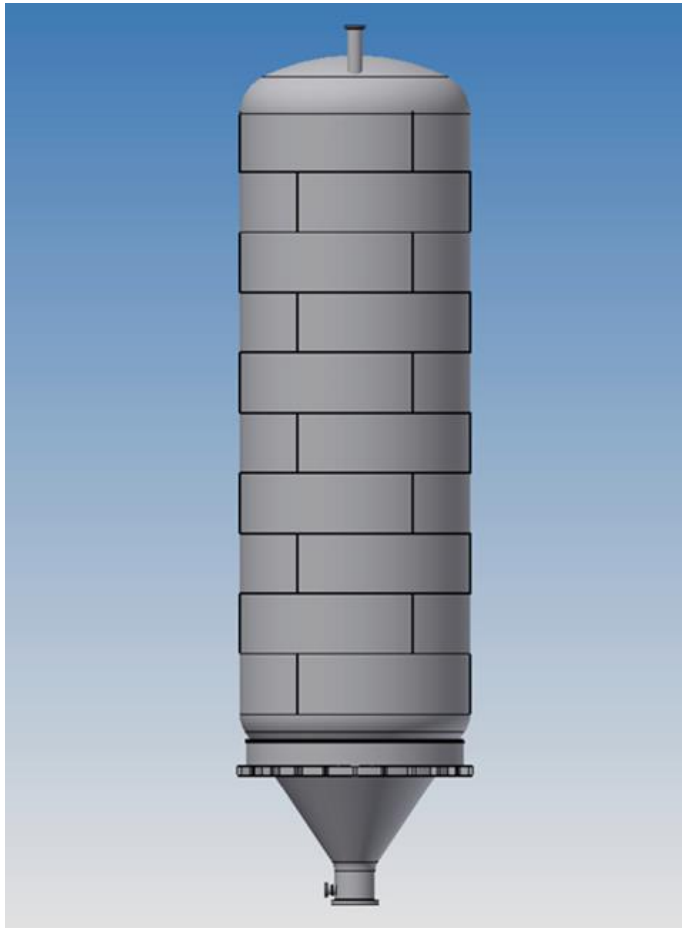
Overview

- Problem definition
- Acoustic emission testing
- Laser Scanning
- High-resolution imaging
- Optimal strategy

AMERISCAN
TESTING-INSPECTION

Problem Definition

- Coke Drum Damage Types
  - Bulges
  - Internal shell cracks
  - External shell cracks
  - Skirt attachment cracking
  - Nozzle cracks
  - Blow down line cracks
- Inspection Challenges
  - Shut down equipment to inspect
  - Internal scaffolding
  - Insulation removal
  - Cost



AMERISCAN
TESTING-INSPECTION

Acoustic Emission Testing (AET)

- In the API Survey of 2013 on coke drums – 76% reported using AET during operation to detect and locate cracking.
- AET is incorporated into several standards, including: ASME, ASTM, API 579, API 572, and many others.
- Can provide source location for active flaws on large structures, to minimize repair efforts.
- One of the many types of NDT methods available and it is complementary to all other NDT methods.

AMERISCAN
TESTING-INSPECTION

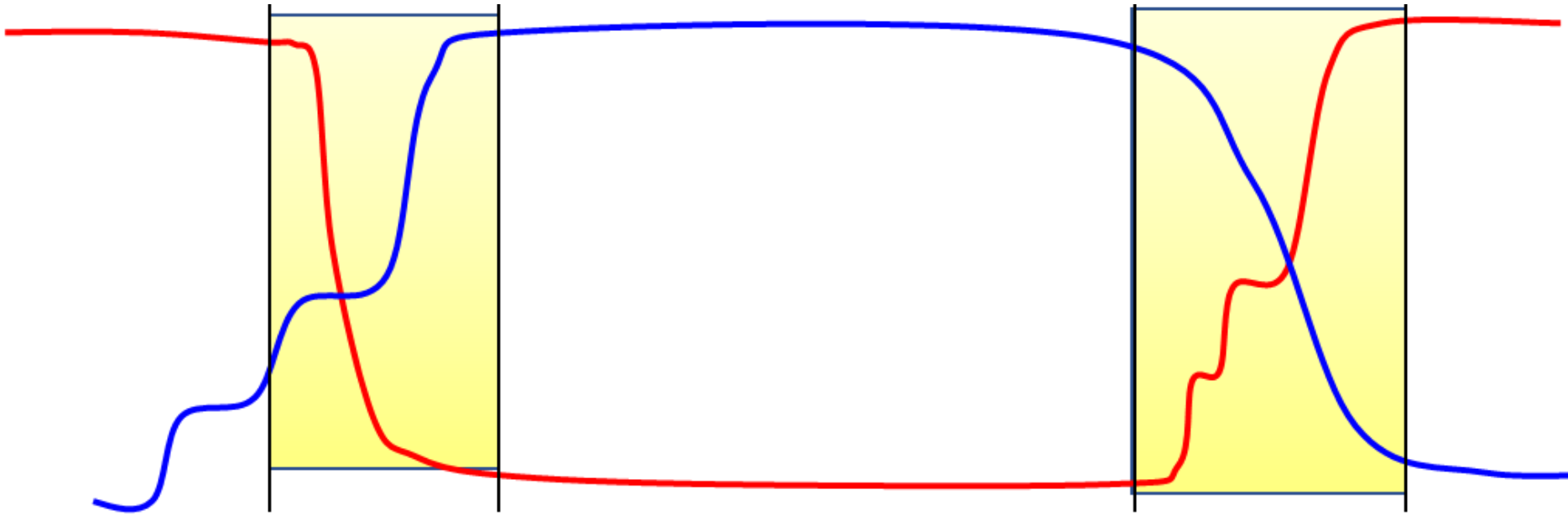
Acoustic Emission Testing (AET)

- AET applied to coke drums can be effectively used as a global inspection method without requiring shutdown or insulation removal.
- Sensors can be applied using rope access crews, eliminating the need for scaffolding.
- Normal coking cycles provide the stimulus – typically 3-5 cycles needed for evaluation.
- Modified cycles during testing can improve detection.

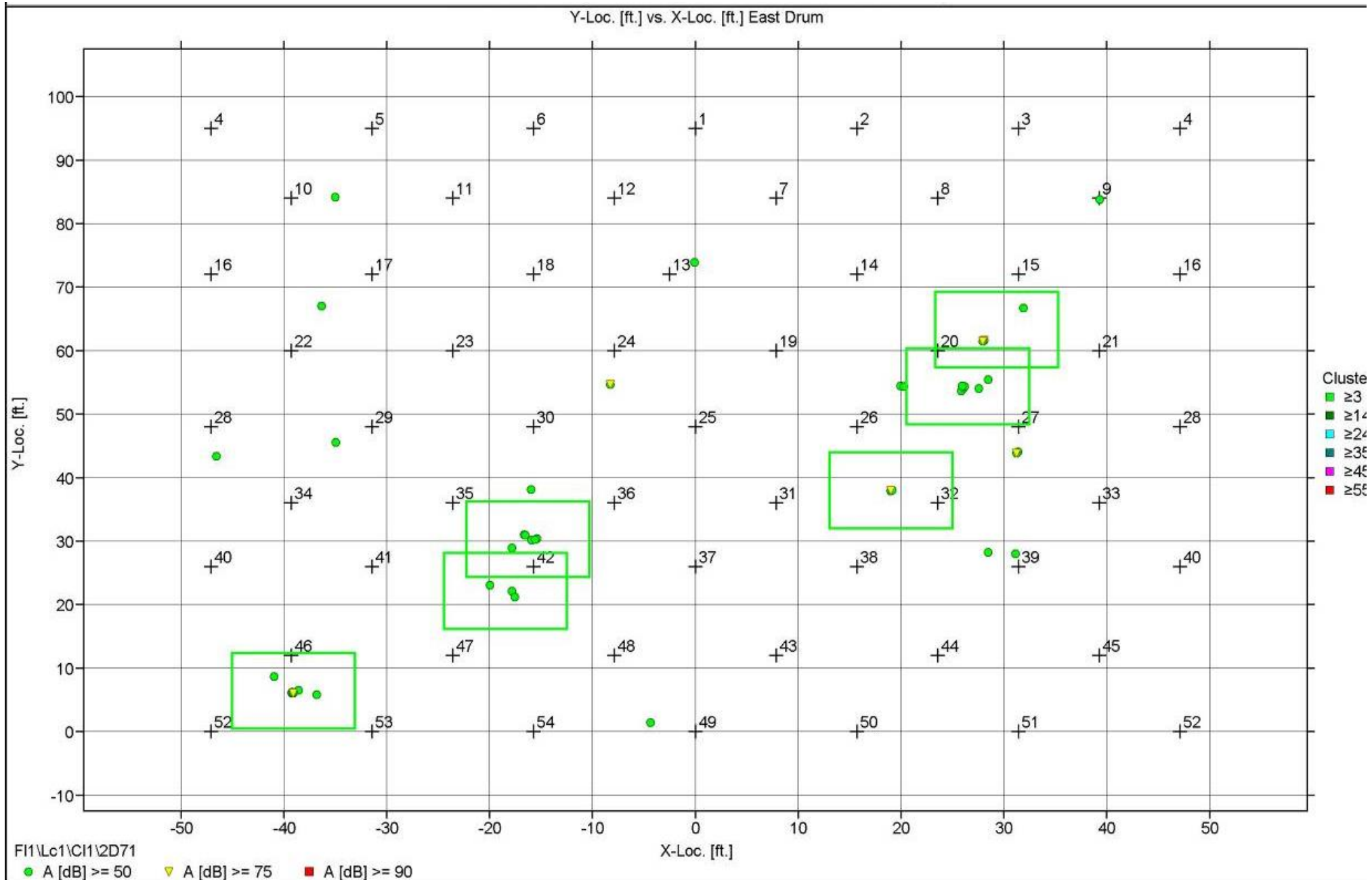
AMERISCAN
TESTING-INSPECTION

Acoustic Emission Testing (AET)

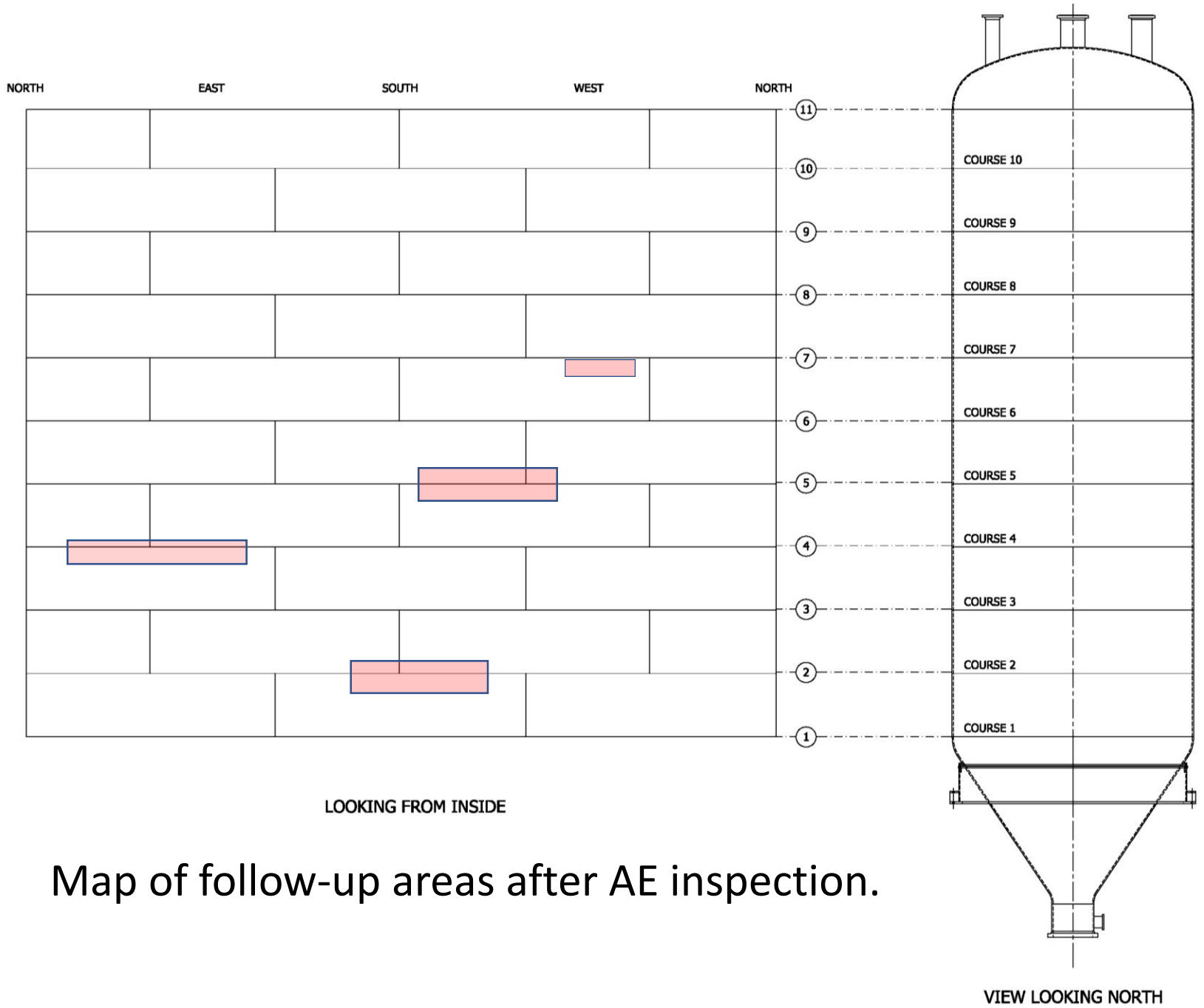
- Thermocouples placed on the drum shell used to identify cycles and helps correlate AE activity with process.
- For AE data analysis, only look at the data during Heat-Up and Quench cycles.



AMERISCAN
TESTING-INSPECTION



AMERISCAN
TESTING-INSPECTION



Map of follow-up areas after AE inspection.

AMERISCAN
TESTING-INSPECTION

AET is the only inspection method that can:

- Provide a global Inspection of the entire coke drum, including the head, shell, skirt and cone at the same time.
- Detect growing cracks significant to the drum's structural integrity caused by thermal fatigue.
- Be applied in-service during normal coking cycles without insulation removal
- Be remotely monitored to keep non-critical personnel off structure during cycles.
- Guide T/A inspection and repair planning efforts.

AMERISCAN
TESTING-INSPECTION

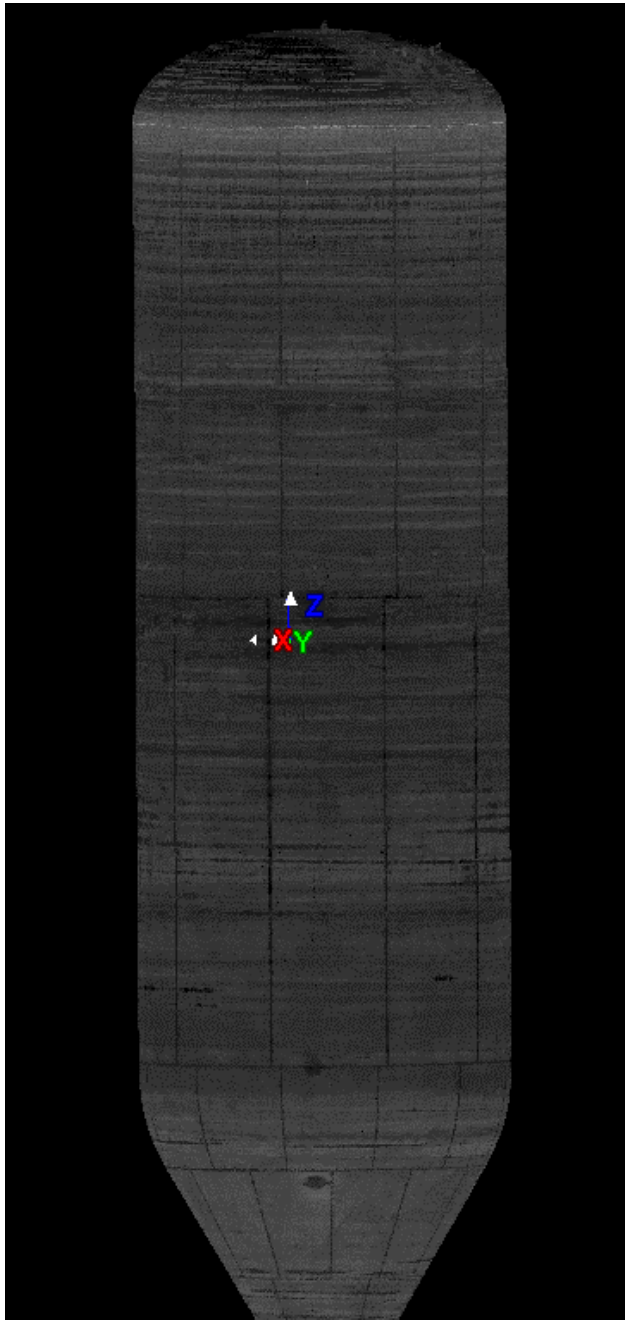
Limitations of Acoustic Emission Testing (AET)

- Cannot size defects. Must be used with other NDT methods to give a complete picture of any discovered defects.
- Cannot find inactive flaws (Not growing under normal process conditions or test conditions)

AMERISCAN
TESTING-INSPECTION

Laser Scanning

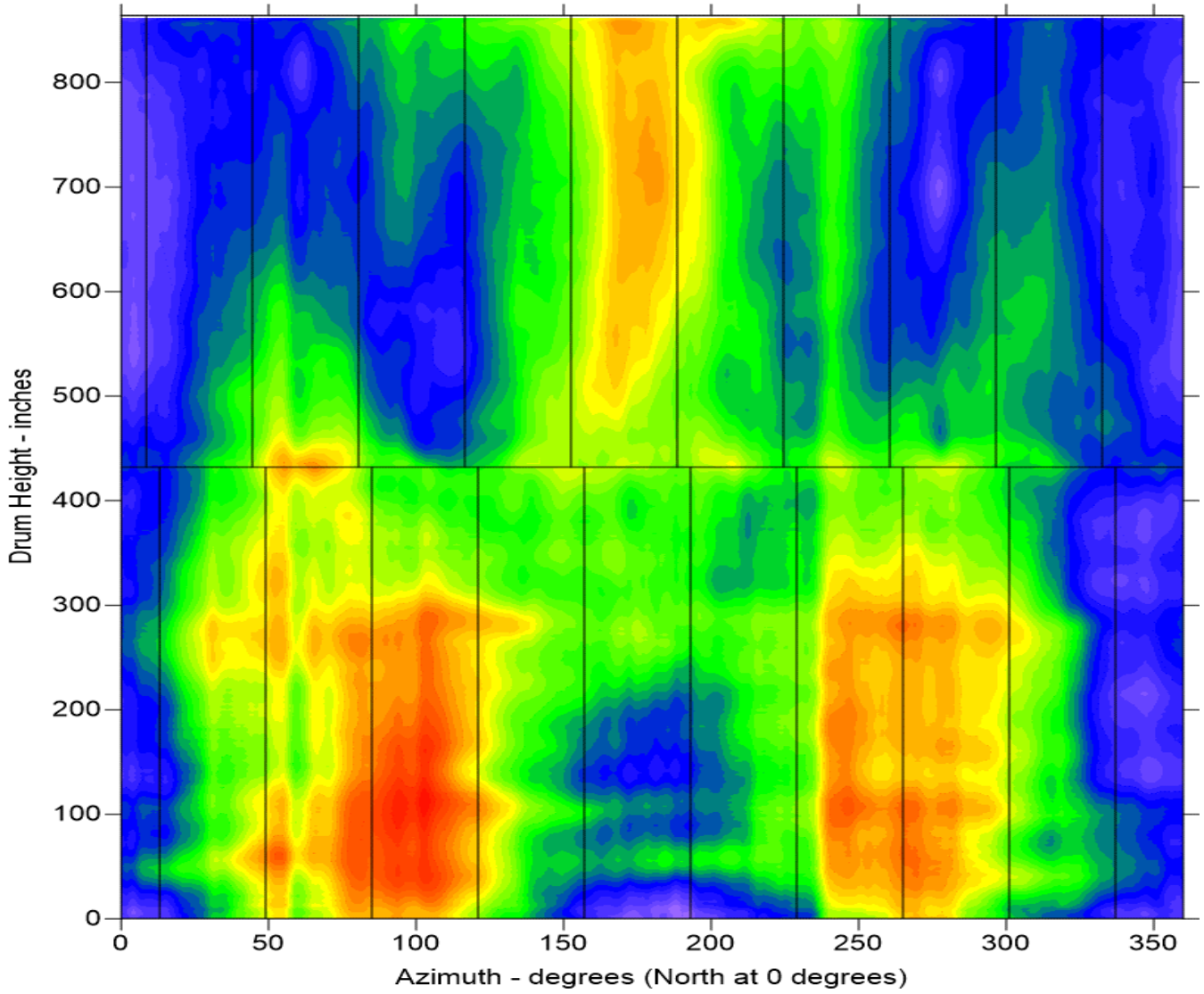
- Internal inspection
- Radius measurements
- Bulging profiles
- Sharpness maps
- Leaning/Tilting analysis



AMERISCAN
TESTING-INSPECTION

Radius Measurements

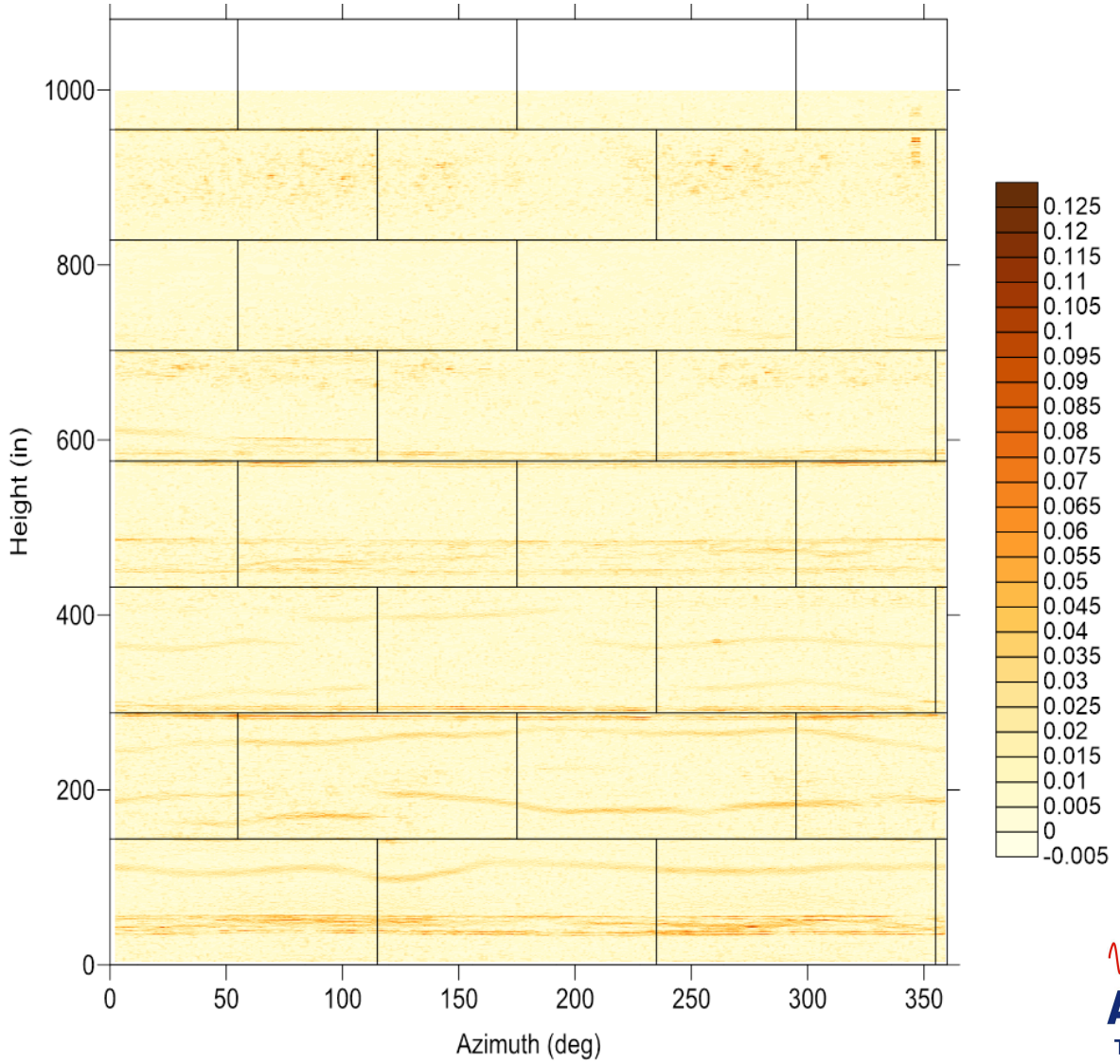
- Contour map of radius



AMERISCAN
TESTING-INSPECTION

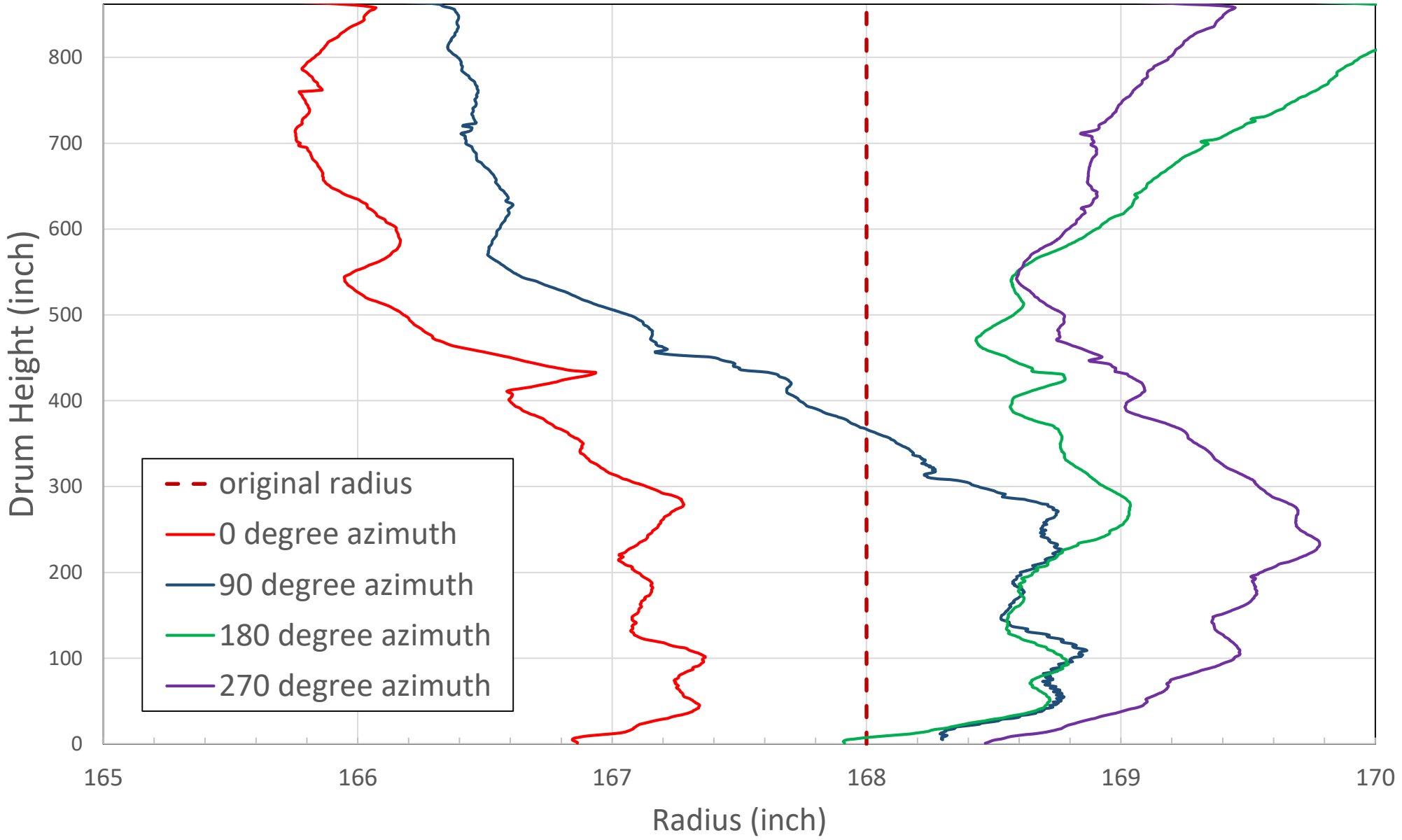
Sharpness Maps

- Screening tool for potential areas of concern
- Not a substitute for engineering assessment



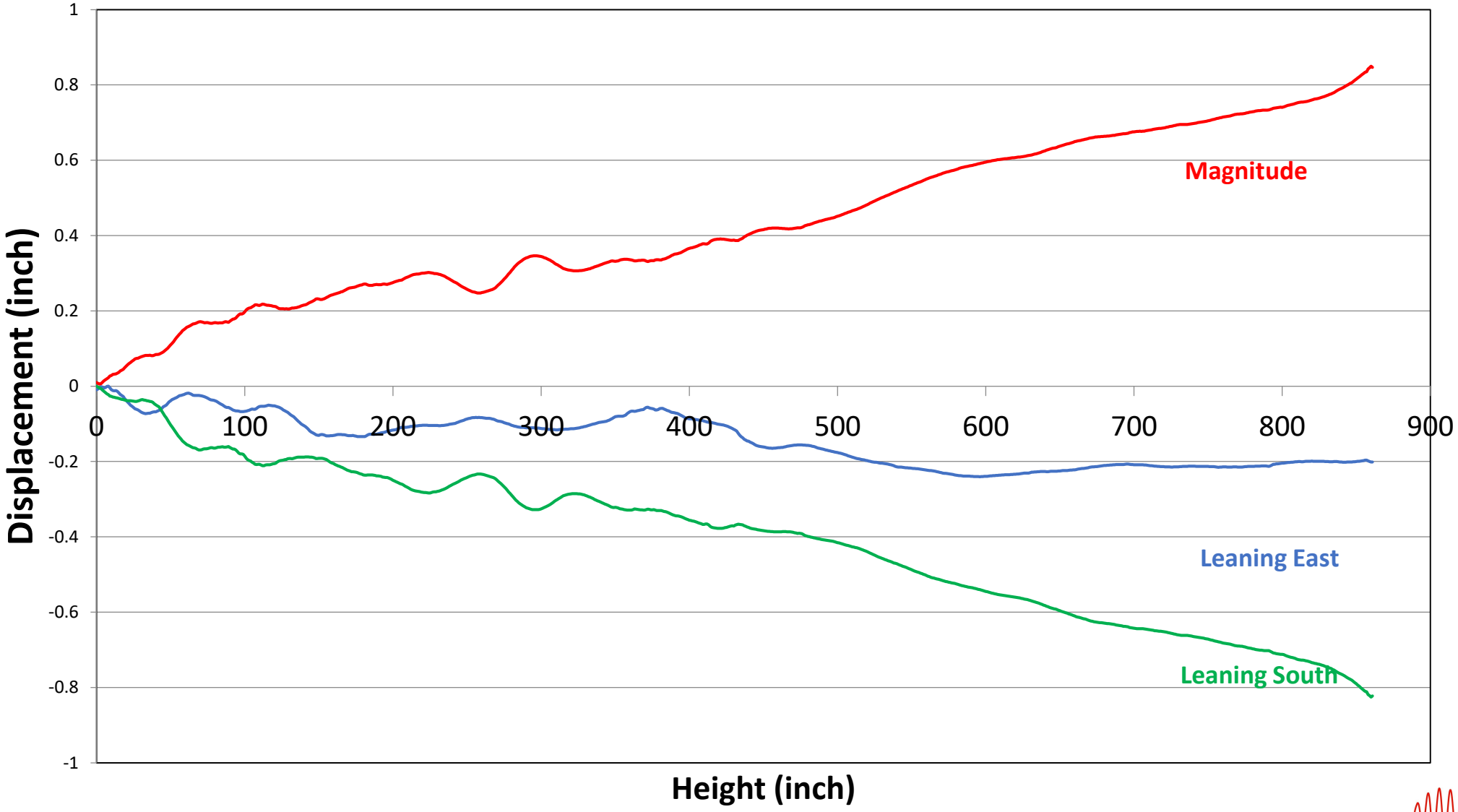
AMERISCAN
TESTING-INSPECTION

Bulge Profiles



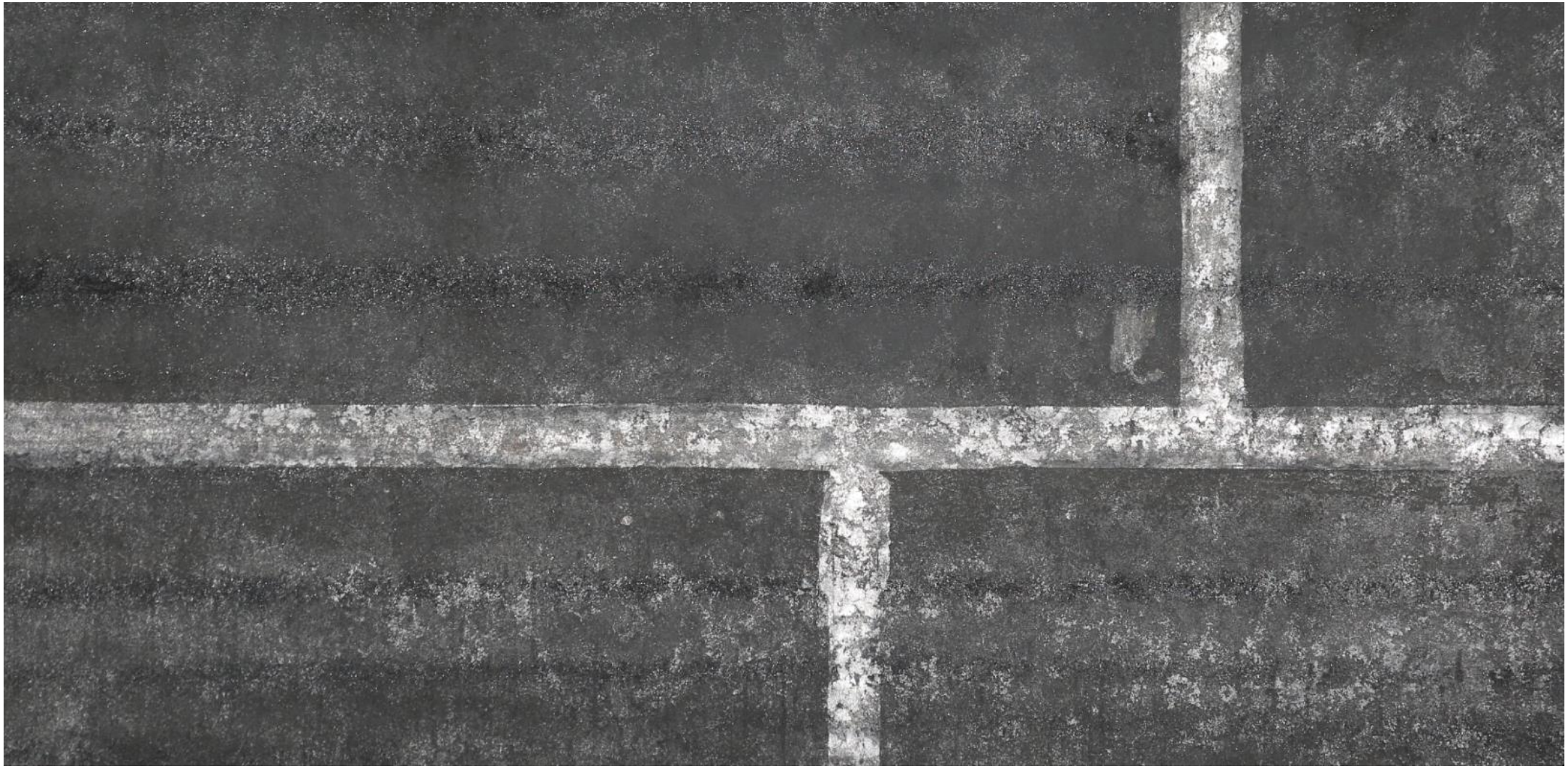
AMERISCAN
TESTING-INSPECTION

Leaning/Tilting Analysis



AMERISCAN
TESTING-INSPECTION

High-Resolution Imaging



AMERISCAN
TESTING-INSPECTION

Optimal Inspection Strategy

- Perform all 3 inspection techniques at same time (only company in the world)
- Same crew
- Performed in parallel
- Comparable costs

AMERISCAN
TESTING-INSPECTION

Recap

- Problem definition
- Acoustic emission testing
- Laser Scanning
- High-resolution imaging
- Optimal strategy

AMERISCAN
TESTING-INSPECTION