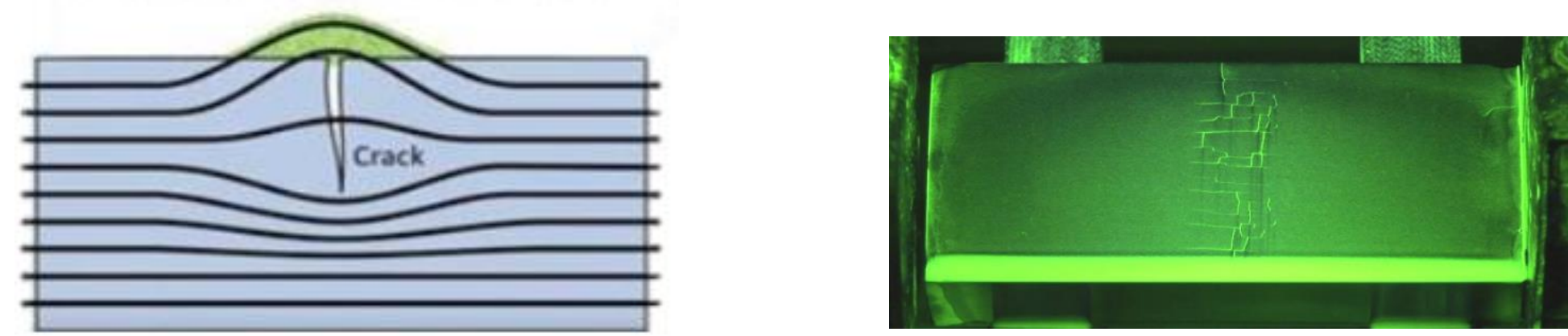


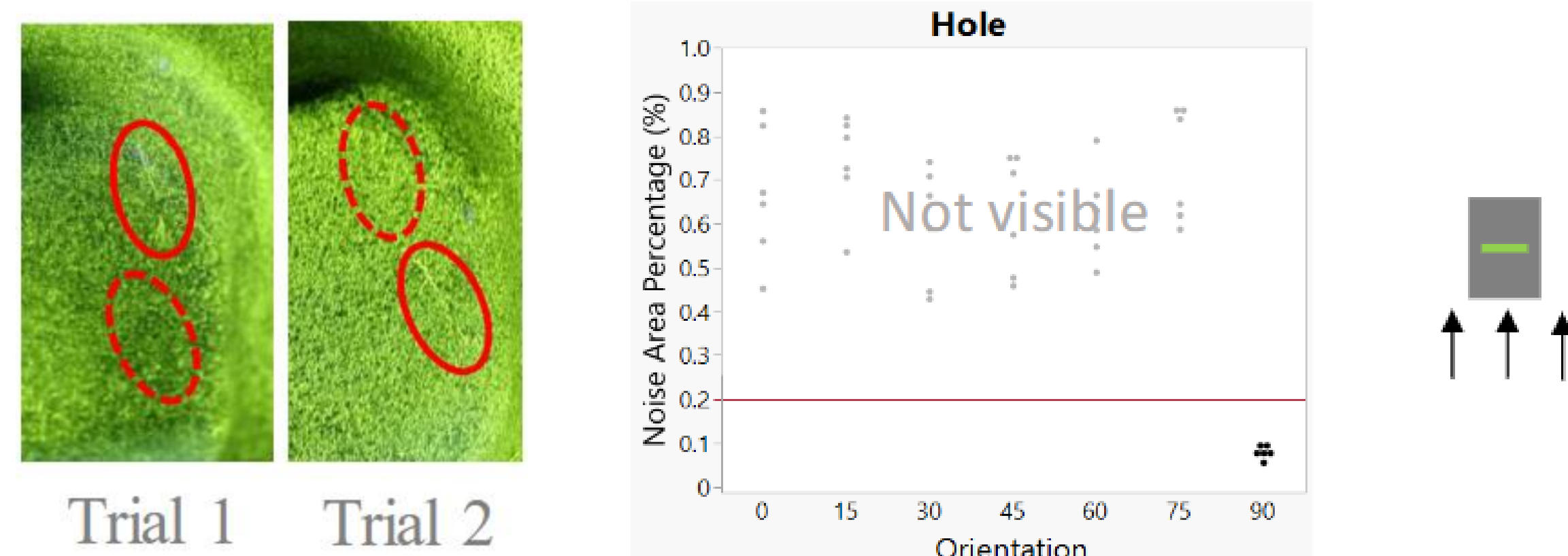
Reducing Measurement Error in Wet Magnetic Particle Inspection in Steel Castings

Introduction

Background: Wet magnetic particle inspection (MPI) is a common nondestructive test (NDT) method used to find defects in steel castings

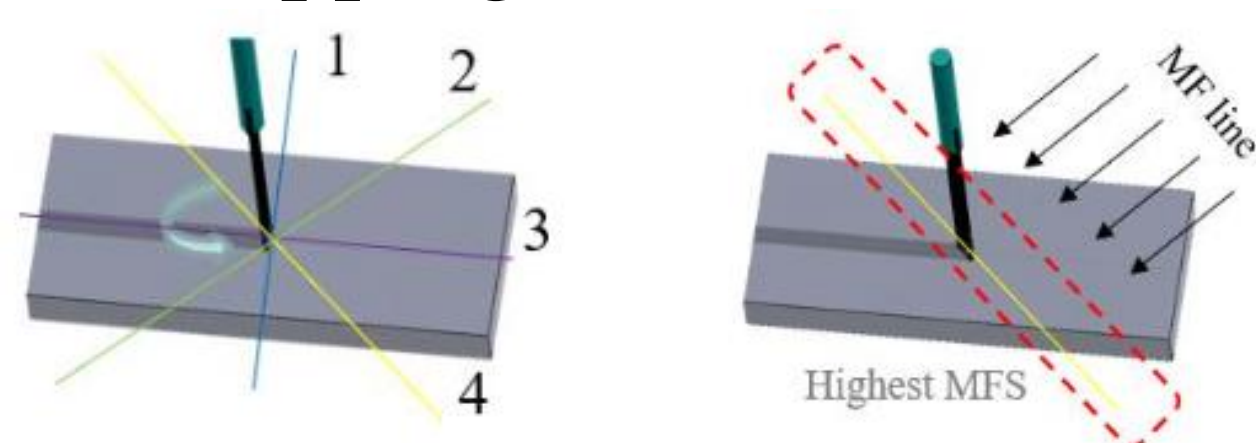


Problem Statement: A gauge repeatability & reproducibility (R&R) study across 4 foundries showed poor results (70% escape) in the MPI process which reduces the likelihood of creating reliable castings

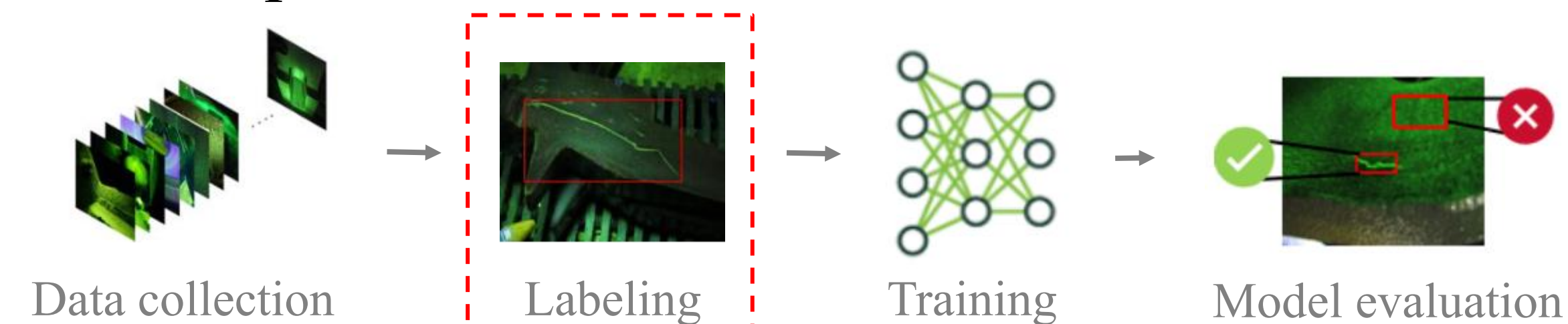


Items Investigated:

- Orientation mapping



- Inspector aid

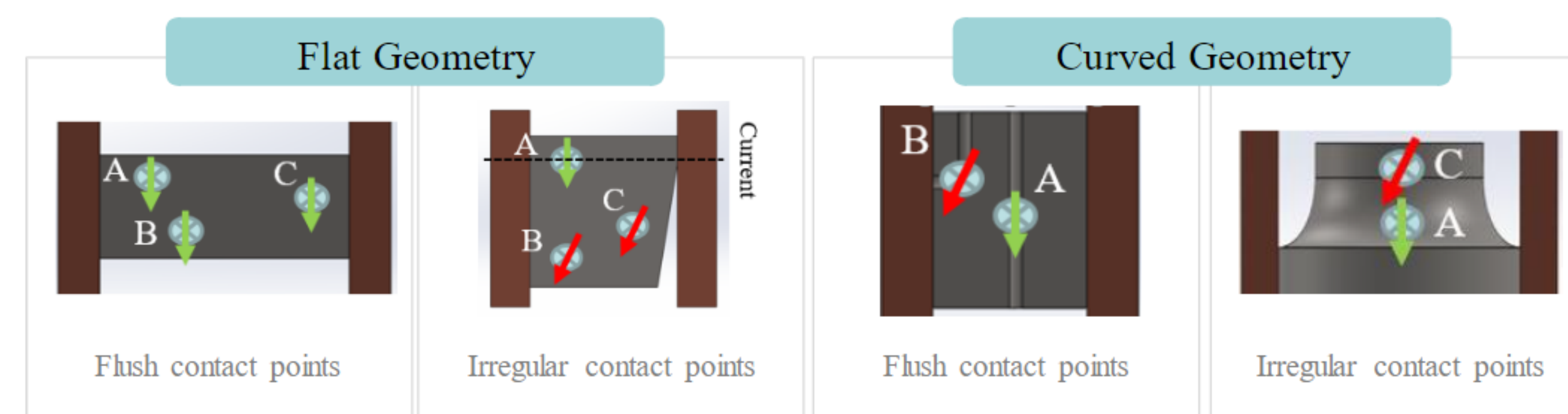


- Best practices videos

- New MPI operators may not have easy access to training videos due to cost

Results

Orientation mapping

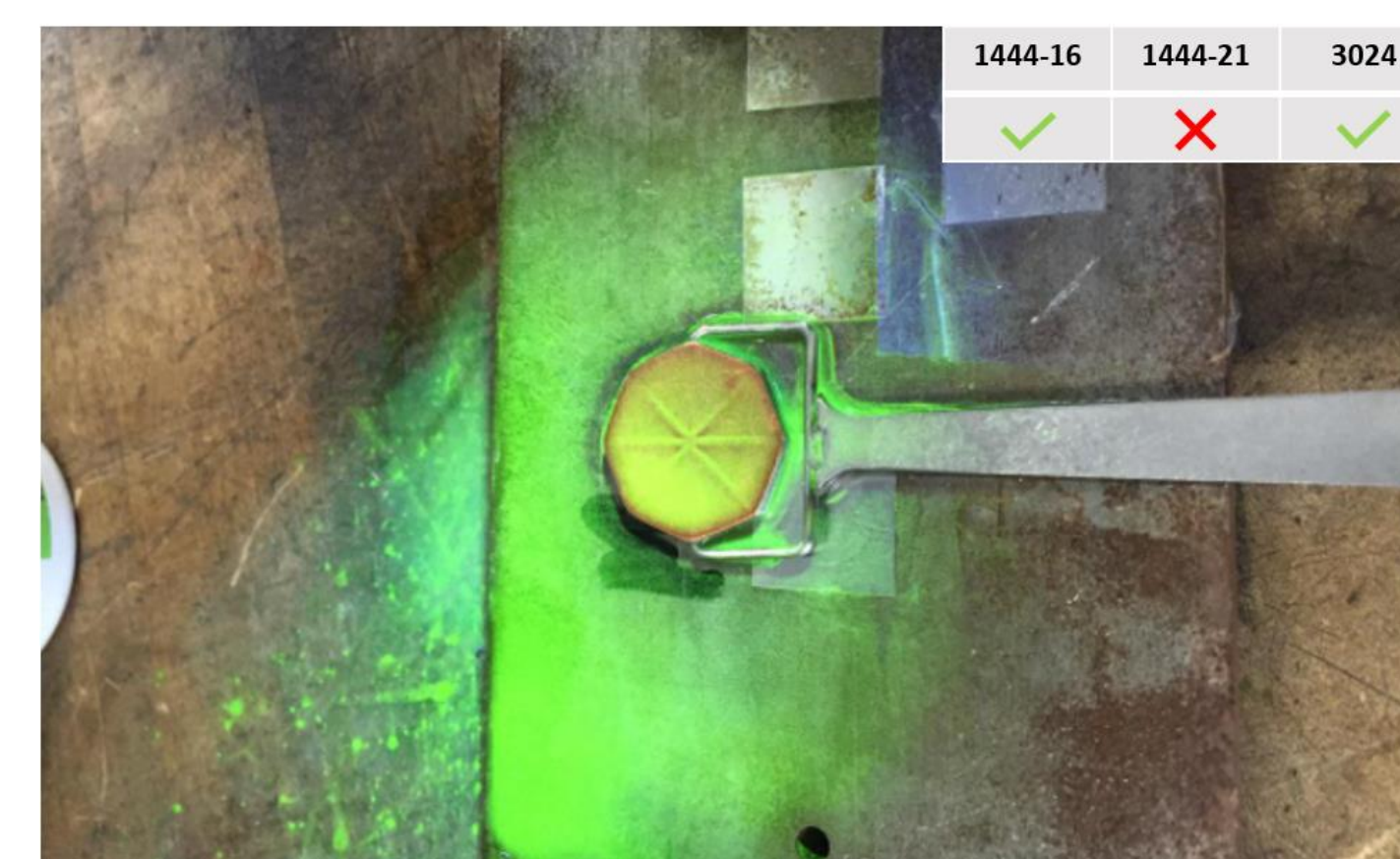


- Only flat & flush contact had results as expected for all points

Videos

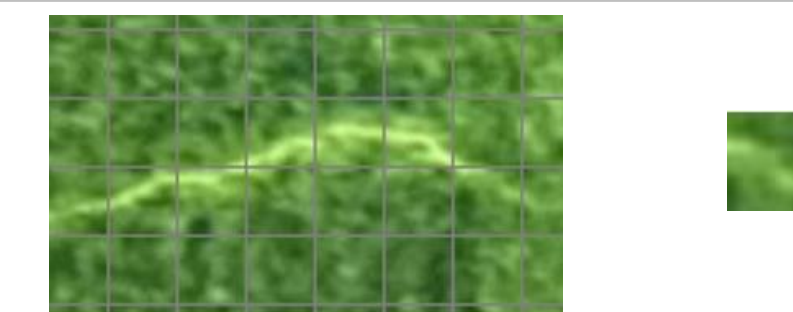
- Highlight research findings in digestible form for industry
- Significant ASTM changes happened in 2021

✓	Video 1: Introduction
✓	Video 2: Bench Setup
✓	Video 3: Testing Efficacy
✓	Video 4: Running an Inspection
✓	Video 5: Identifying Defects
	Video 6: Post-Inspection
	Video 7: Conclusion



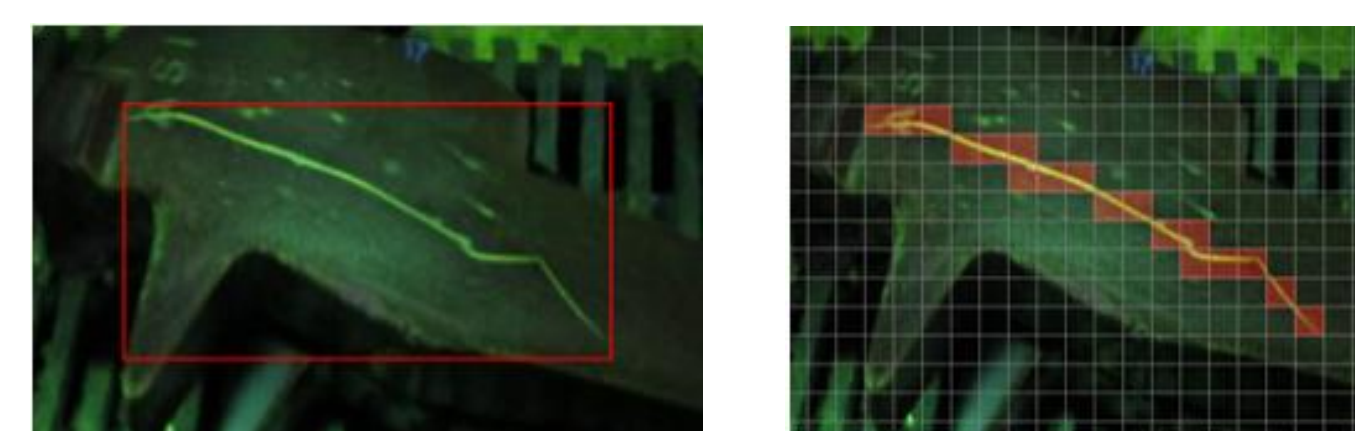
Inspector aid

- Proposed grid style labeling method for cracks
- Most other objects need whole bounding box for context



Advantages of grid style

- Faster
- Less background



- **Grid style reduced the escape rate of defects to 13%**

Impact on Industry

Orientation mapping



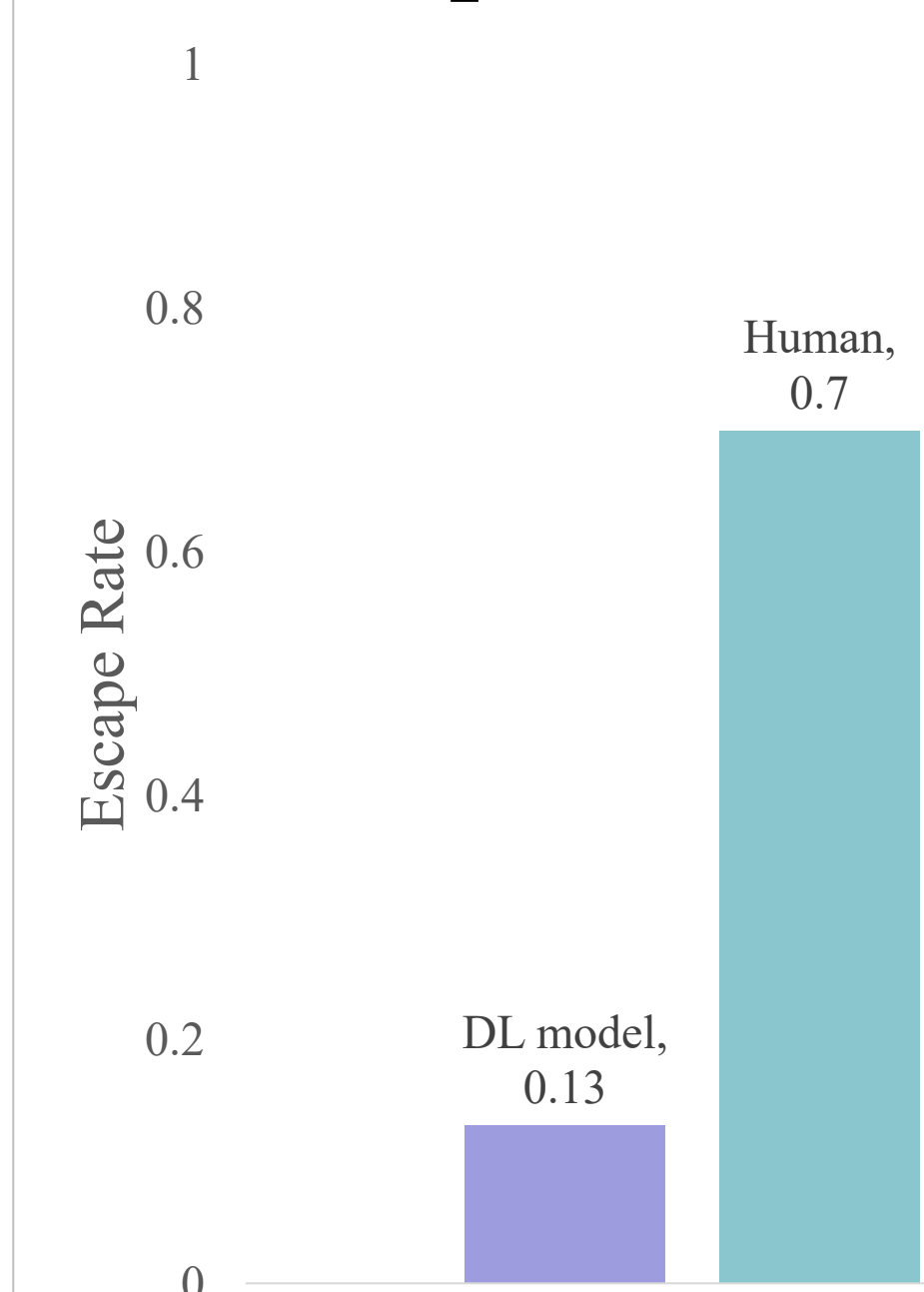
- Castings have complex geometries
- This study shows field direction is dependent on geometry
- This work could lead to design recommendations to optimize defect detection

Videos



- The MPI videos help foundries globally reduce measurement error in wet MPI

Inspector aid



- Grid style labeling reduced escape rate to 13%
- Currently, the model itself performs better than the human operator
- Foundries will be able to produce higher quality castings using this solution