Athena Industrial

Industrial Technology Suite
for Railway Integrity

ATHENA INDUSTRIAL

Presented By Paul Gies

SUITE OF PATENTED TECHNOLOGY

Athena has developed a technology aimed at rail damage detection in three distinct areas:

- High speed non-contact rail head inspection
- In rail wheel inspection
- Rail break and train presence detection

ELECTROMAGNETIC FIELD IMAGING

Electro-magnetic Field Imaging (EMFI) is a non-contact technology used to inspect rail for Rolling Contact Damage, metallurgical properties, geometric changes, and liftoff (distance from sensor). EMFI is based on focused magnetic fields and eddy currents.

SHAPED SENSOR

- Measures strength, direction, and shape of eddy current in target material

CRACK AND SPALLING DEPTH

- Crack depth measured up to 7mm
- Spalling depth measured up to 5mm
- Unaffected by environmental contaminants

Visualization

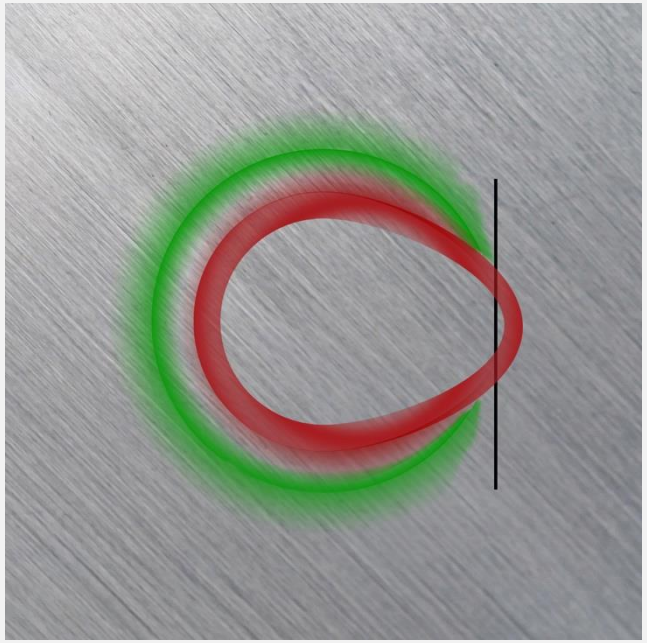
Athena's Electromagnetic Field Imaging (EMFI) produces a focused magnetic field specifically shaped for rail head inspection.

FIELD INTERACTIONS

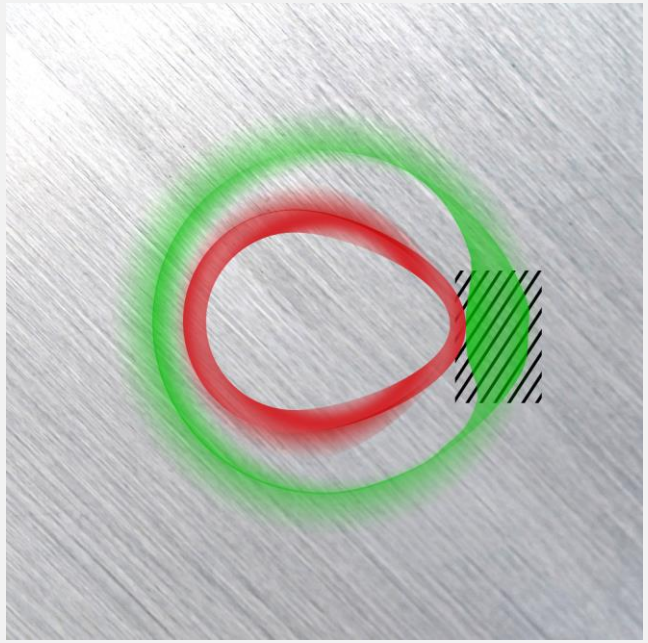
- Each defect type results in a unique field response that is proportional to defect severity & depth.

SHAPED SENSOR

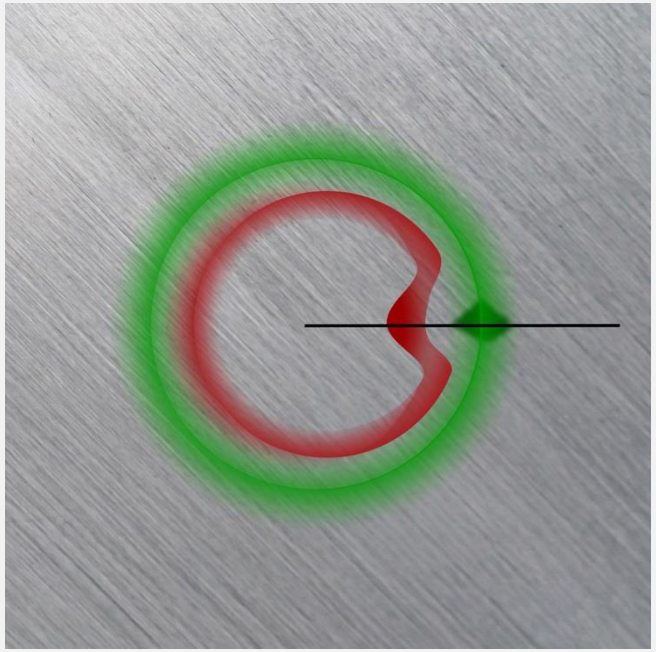
- The EMFI shape is measured by two layers of specially-spaced coils that detects damage in three dimension .



Axial Cracking



Corrosion

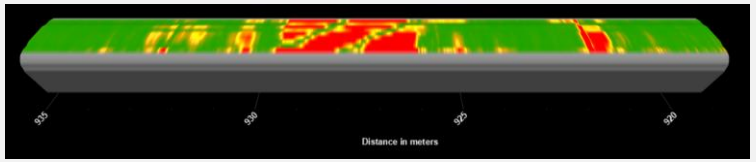


Longitudinal Crack

High Speed Non-Contact Rail Head Inspection (RAGA)

A trolley-based solution was developed over 4 project phases and validated by MxV Rail (formerly TTCI),

and lead investigators Anish Poudel and Matt Witte.

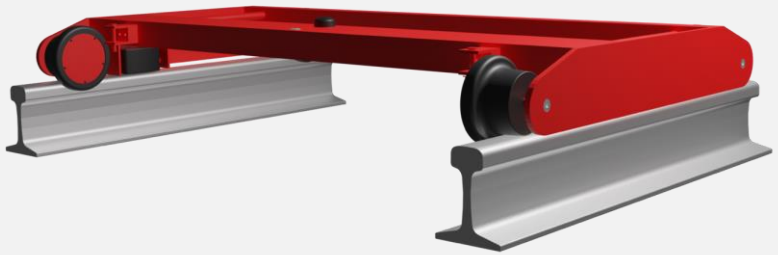


PHASE 1 - POC

Determine if Athena's current EMFI technology could detect and potentially quantify railhead damage. The results were encouraging, and a phase 2 program was developed.

PHASE 2 – Rail Shaped Sensor

A shaped sensor was developed and tested for inspecting the gauge face to the field corner. Gauge face inspection was impractical due to mechanical interference at crossings. Initial damage severity calibration data was acquired.



PHASE 3 – Flat Sensor

A flat sensor with a refined field generator was developed and tested for gauge corner to field corner inspection. Speed effects and calibration reference data was gathered. A preliminary damage analysis algorithm was developed.

PHASE 4 - Verification

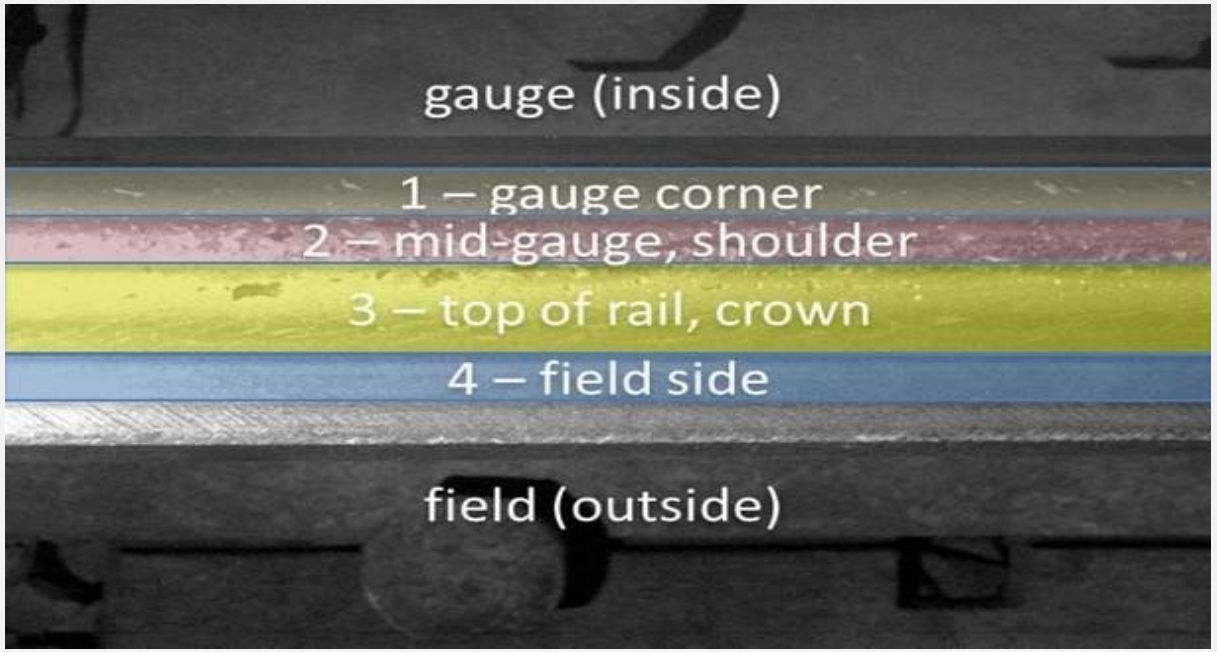
Rail section information from Phase 3 was used to refine the damage analysis algorithm. Additional testing was performed to verify speed and damage analysis performance.

POST PROCESSING

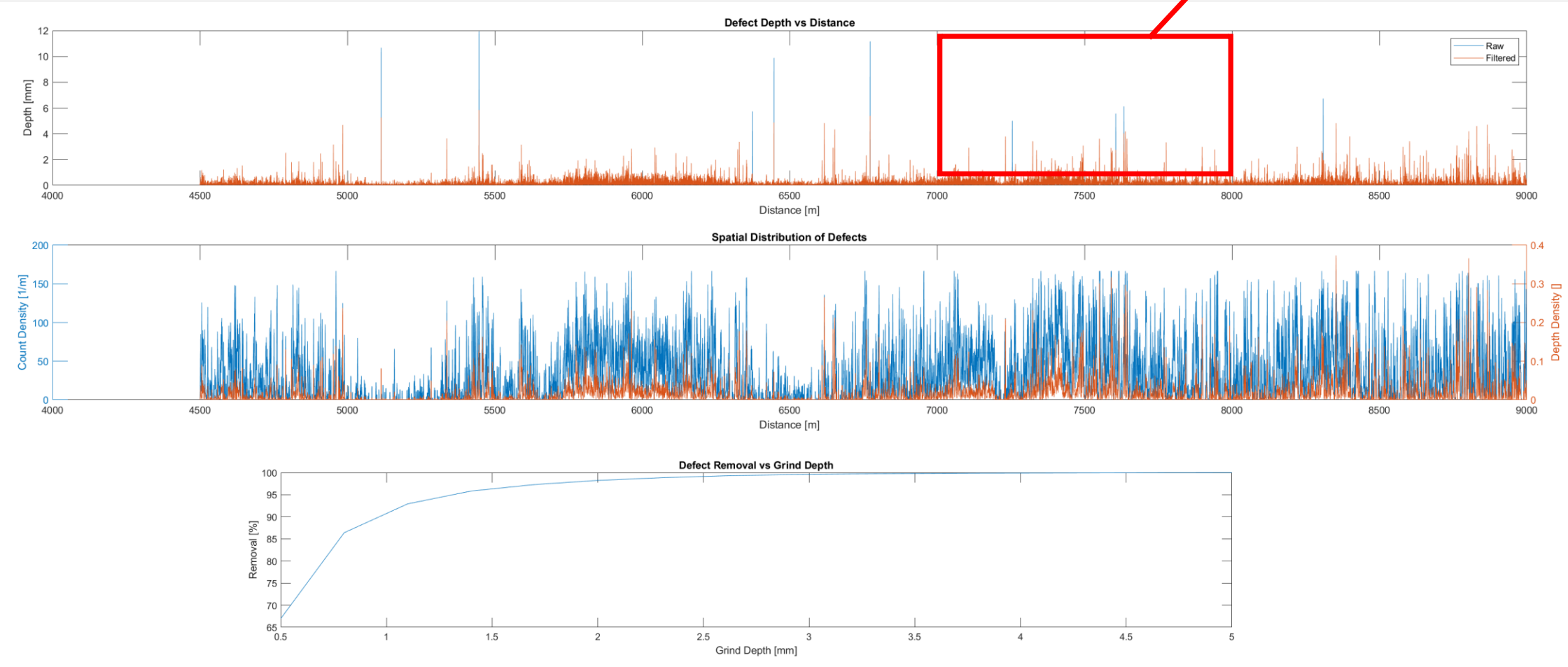
Signal collection and data analysis from all phased studies allowed for results to be presented based on rail head running surface region plots or as single plot of worst-case rail head damage.

RESULTS INCLUDE

- Display severity and distribution of damage.
- Defect density by count & depth.
- Estimated grind depth effectiveness.
- User selectable area of focus

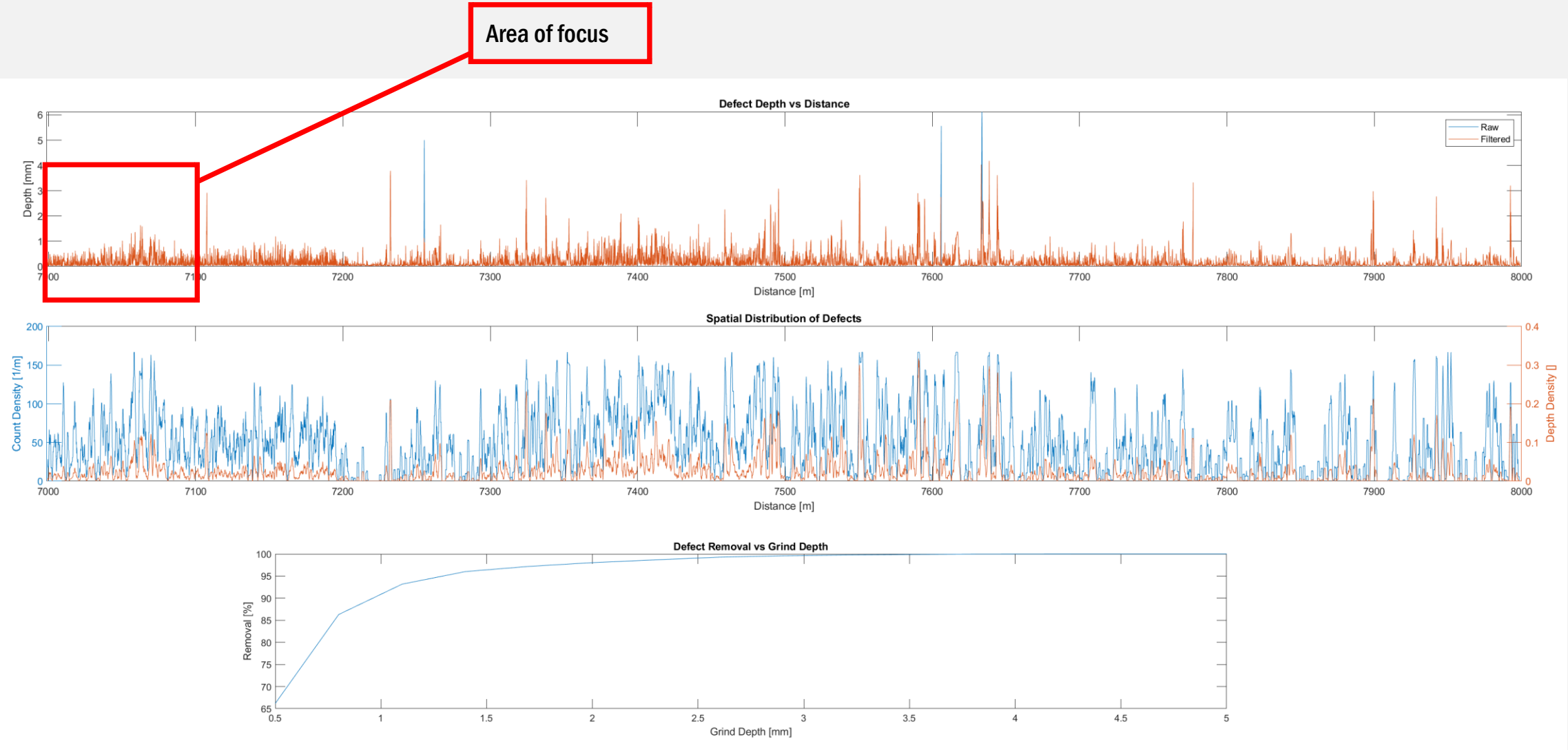


POST PROCESSING



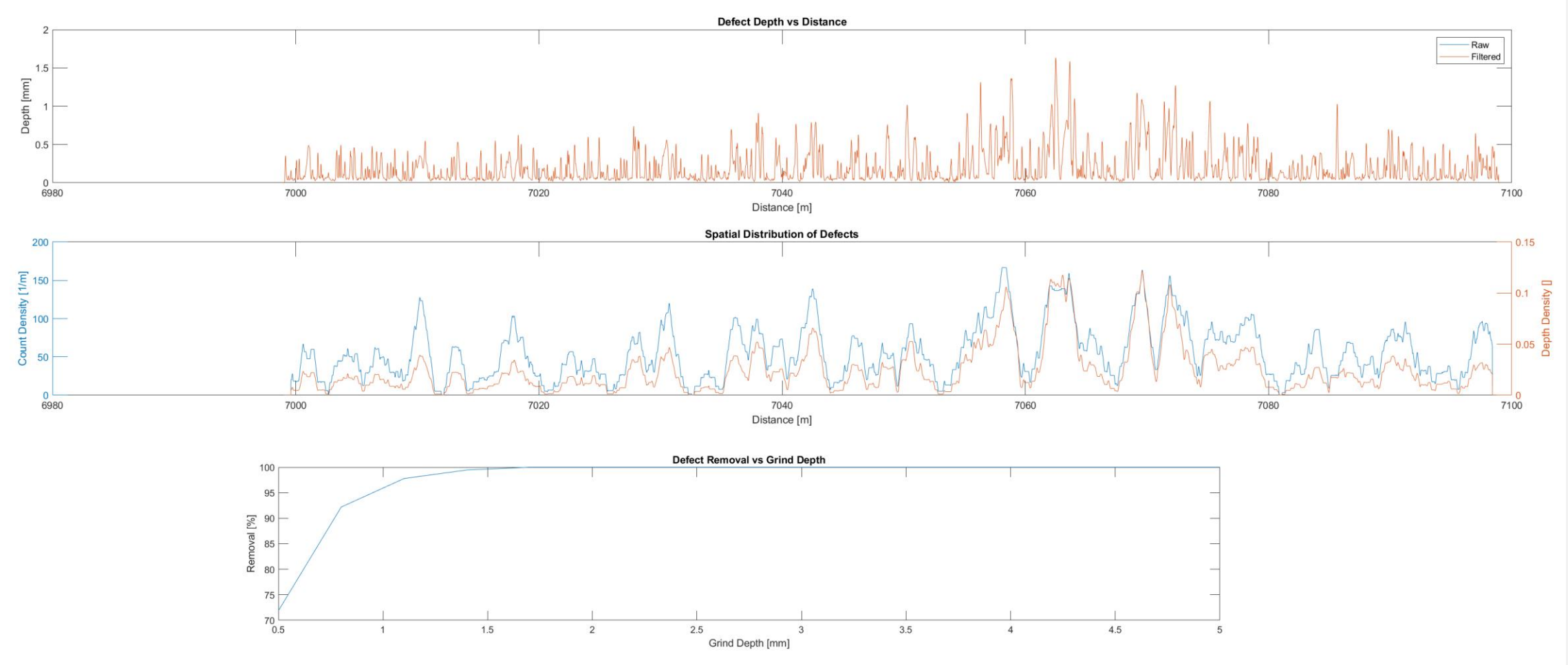
Full scan for a total of 5000m

POST PROCESSING



Focused area of 1000m

POST PROCESSING



Focused area of 100m

In-Rail Wheel Inspection (RODA)

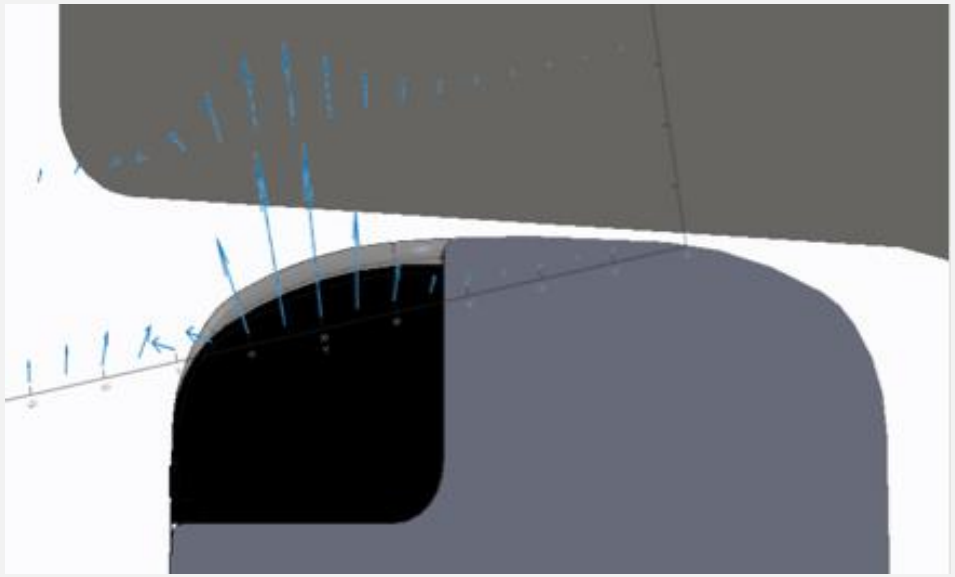
In-Rail Wheel Inspection was developed with the support of Canadian Pacific Railway.

STATIC IN-RAIL SOLUTION

Utilizing the EMFI technology, a series of sensors embedded in the rail scans the outer 2” of the wheel tread including the rim.

WHEEL COVERAGE

The current configuration covers between 75% and 95% of the wheel circumference depending on the wheel diameter.



ALPHA TEST PHASE

- Showed need for better EMFI field control
- More durable packaging to deal with corrosive contaminates (potash).

BETA PHASE

- Improved tread and rim coverage.
- More effective damage identification and severity classification.

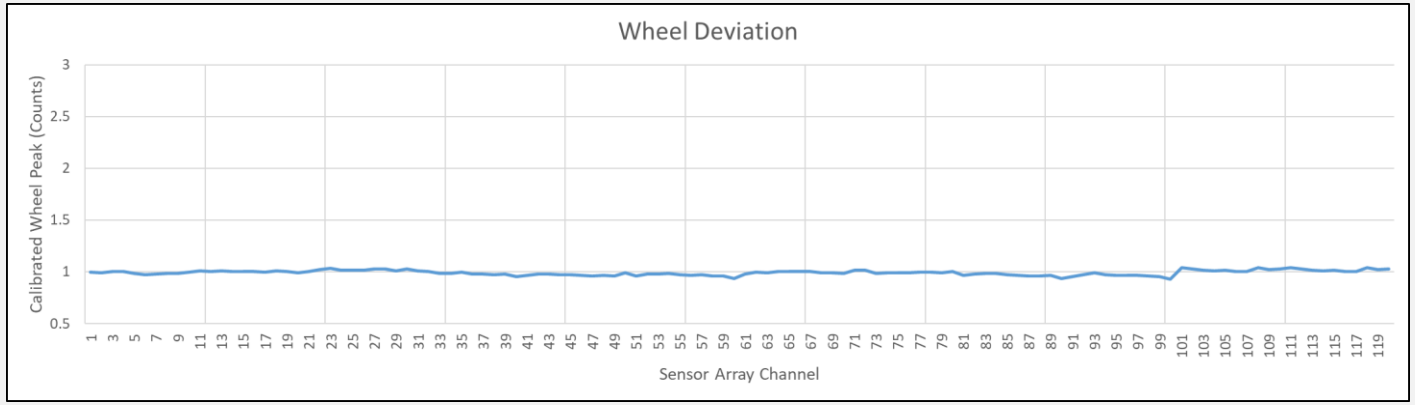
In-Rail Wheel Inspection (RODA)

Testing parameters - & specs

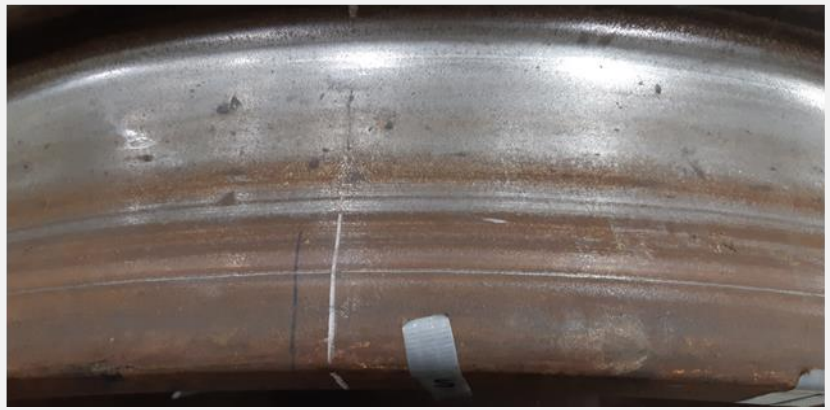
- Operating temperature range -45C to +85C
- Unaffected by environmental contaminates (water, dirt, grease etc.)
- Inlaid sensors are adjustable in height to accommodate normal rail wear.
- No fluids or consumables required or used.
- 2km/h minimum speed limitation.
- Initial maximum inspection speed is 40km/h. Testing to increase to 80km/h.
- Installed on standard ties or sleepers for support. Welded or bolted to connecting rails.
- Only local power and LTE internet communication infrastructures used.
- Inlaid system consists of 2x28 ft long sensor rails sections.

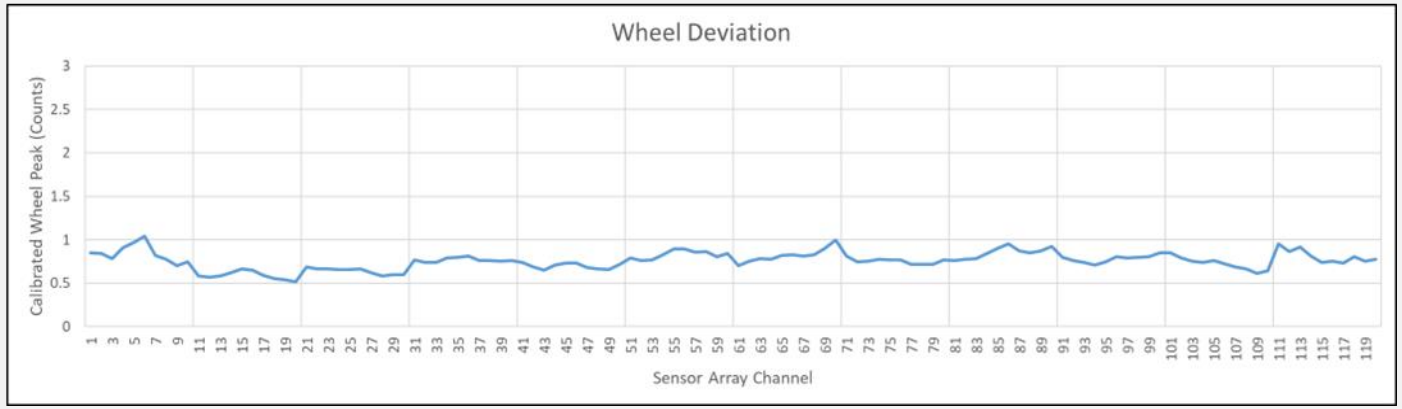
In-Rail Wheel Inspection (RODA) Results

New Wheel Response



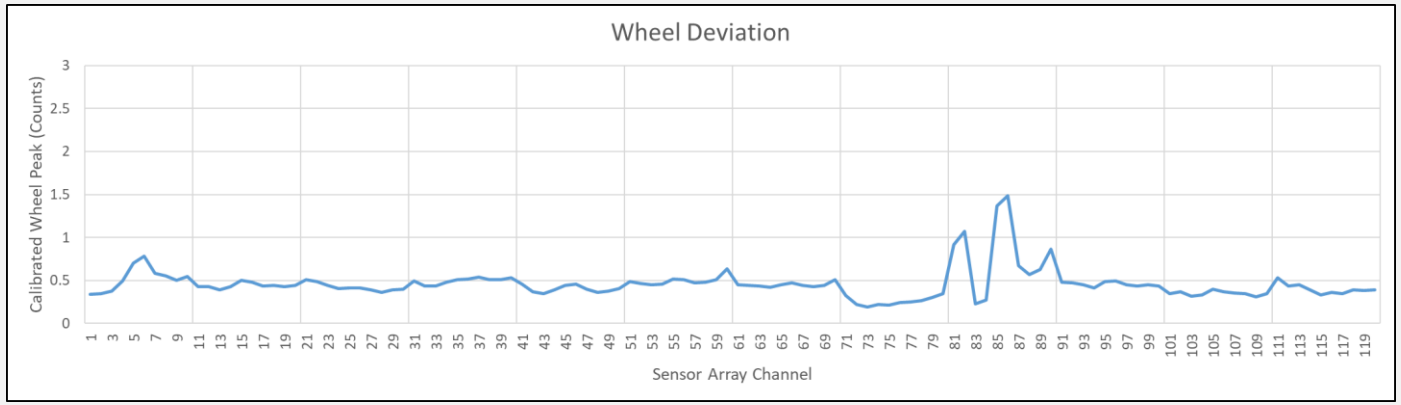
Damaged but serviceable Wheel Response

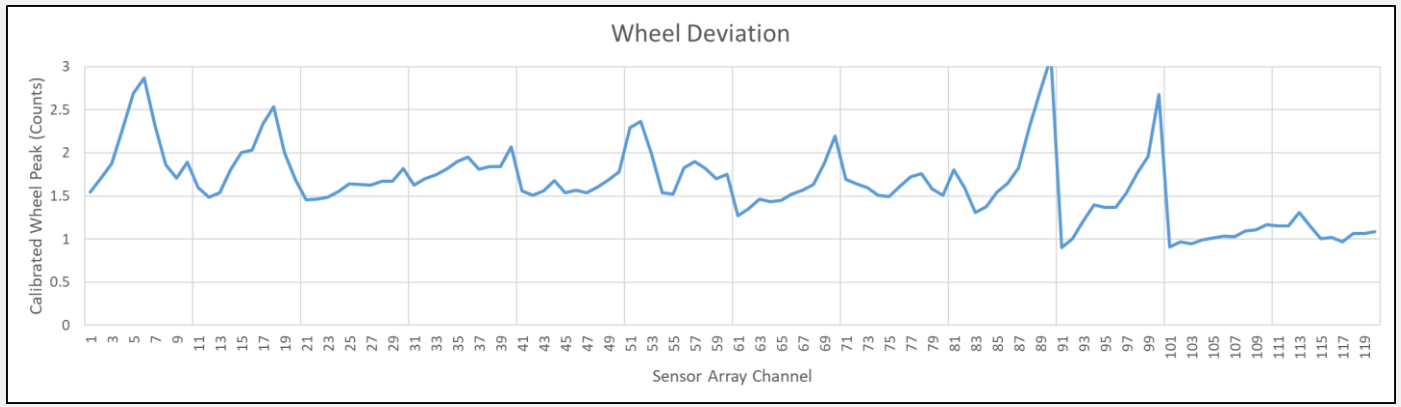




In-Rail Wheel Inspection (RODA) Results

Damaged Wheel Response





QUESTIONS