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Institute of Railway Research

Rail Wear and RCF Damage Modelling

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Modelling Approaches

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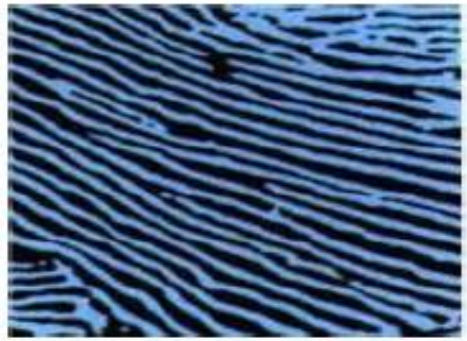
- Vehicle dynamics route simulations
  - Represent the duty conditions of the rail
    - Traffic mix
    - Variable wheel-rail profiles
    - Traction/braking forces
    - Friction conditions
    - ……
- Contact patch energy methods
  - Whole Life Rail Model damage function
  - BR Research wear function
- Archard wear model



Current Areas of Development

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- Damage classification based on direction/magnitude of wheel-rail forces
- Contact patch energy ≈ damage relationship in lubricated conditions
- Damage functions for alternative rail materials
  - Characterising performance of different material
    - Site data, full scale and twin disc testing
- Plastic flow / low rail damage
- Wear mapping based on vehicle dynamics simulation outputs

Damage Classification

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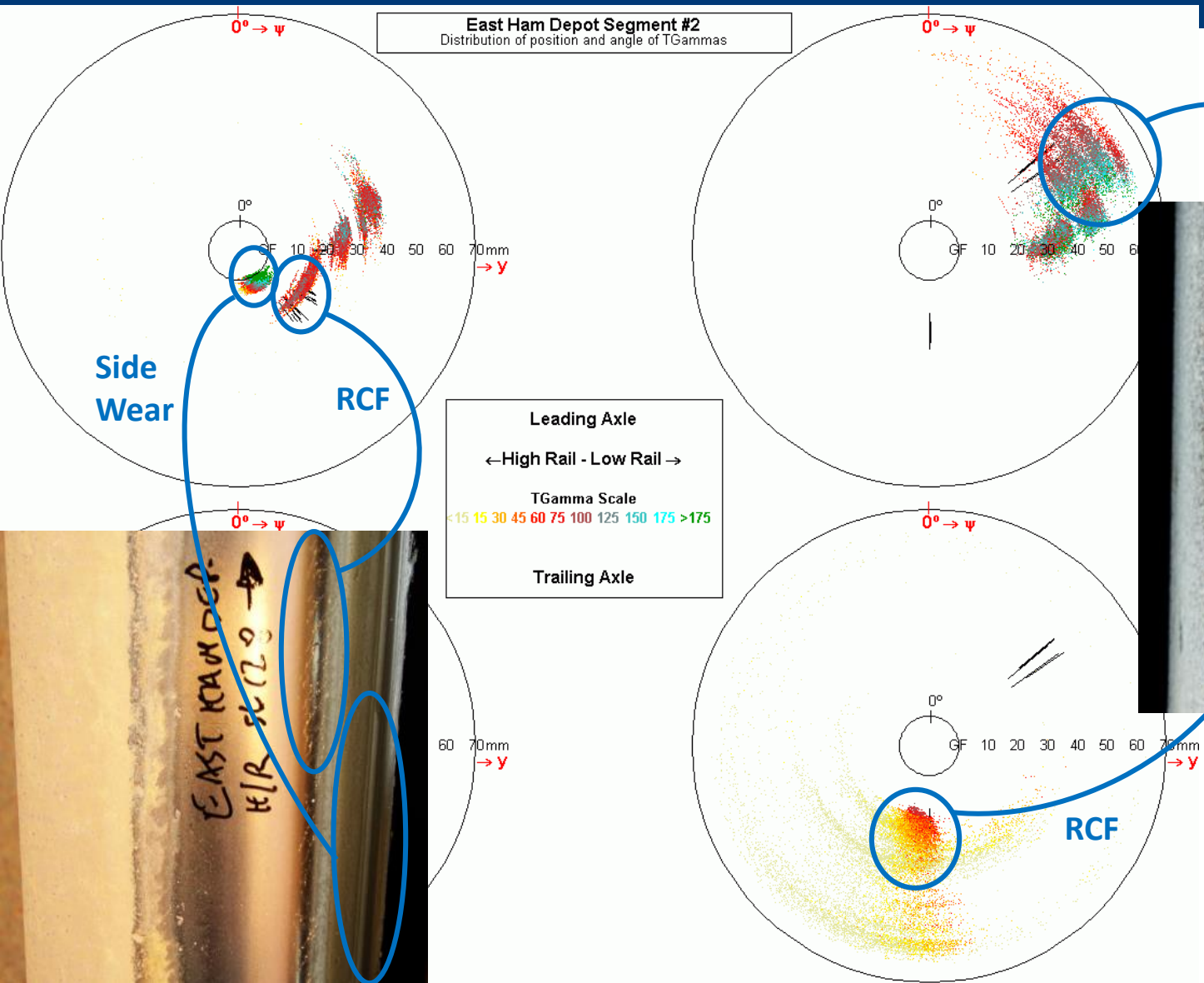

Plastic Flow & Fine Cracking

ICRI Data Package

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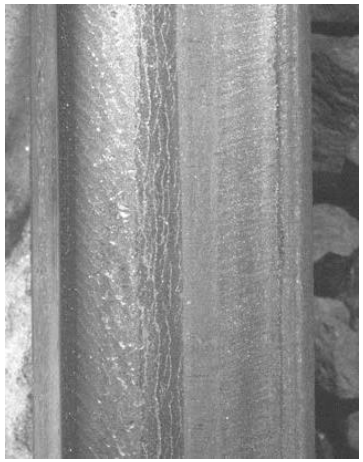
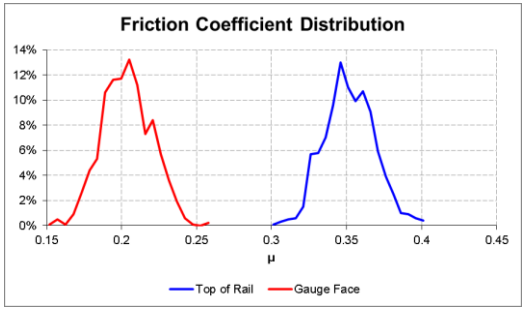
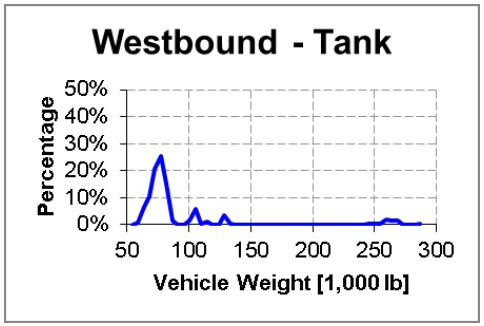
- NRC provided simulation and site data for 426 m radius curve near Minneapolis (USA)
- Site data was taken during March 2014, included:
  - Track geometry information
  - Rail profiles
  - Wheel profiles
  - Crack depth measurements
  - Photographs of surface condition



- Simulation data included 6000 output files (1000 for each vehicle type) covering a range of parameters:
  - Vehicle weights
  - Vehicle speed
  - Friction coefficient
  - Wheel profile pairs





Modelling Approach

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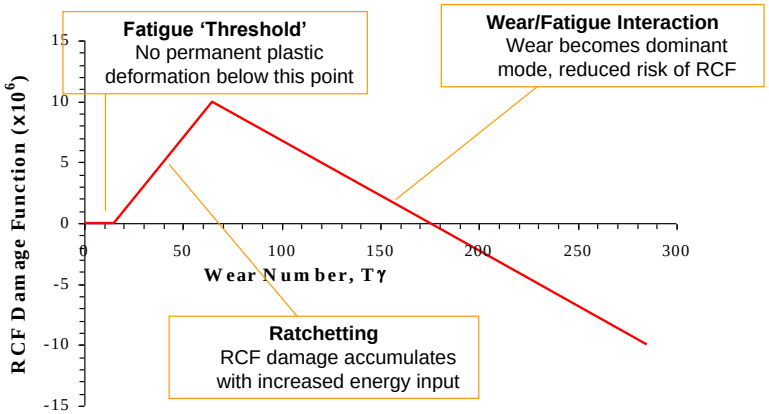
- Convert simulation data to required format and units
- Calculate damage (RCF and wear) for each vehicle type/output file
  - Contact patch energy (Tγ) approach
- Accumulate damage (RCF and wear) across the rail head
  - Based on parameter distribution (e.g. weight, speed, friction) for each vehicle type
  - Based on distribution of traffic
- Compare predicted damage to observations of surface condition



Results for Flat Car Type

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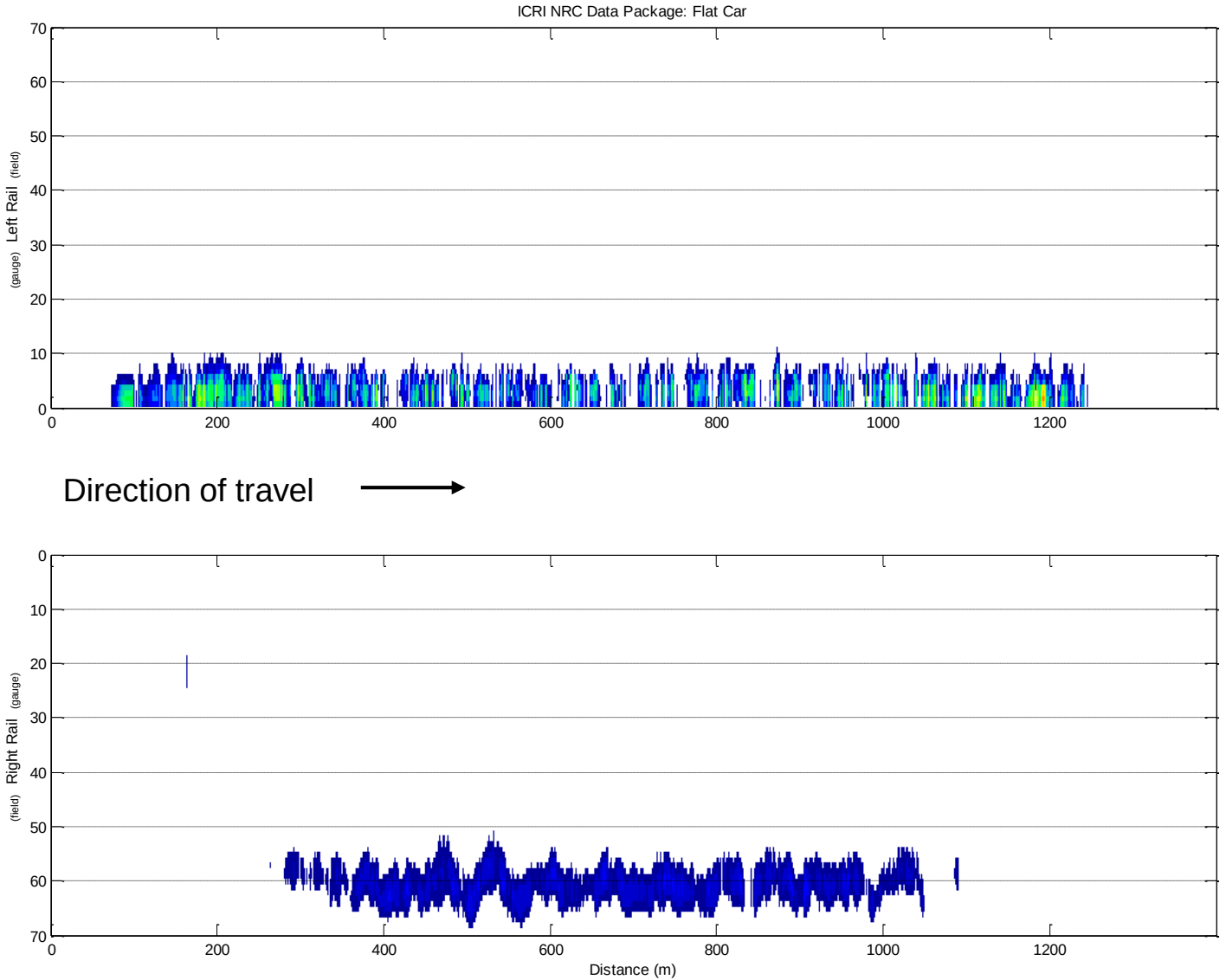

Direction of travel

Next Steps

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- Calculate damage for other vehicle types
- Accumulate damage based on traffic volumes / time
- Compare results to crack depth data and observations of surface condition