# Integrated Wheel/Rail Characterization through Advanced Monitoring and Analytics – an Overview

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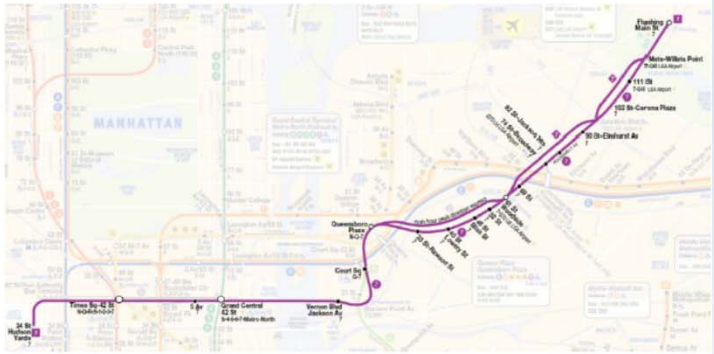
# Outline

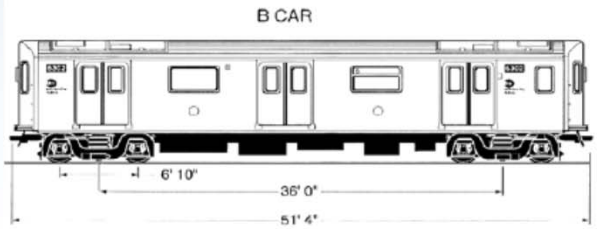
- Background
- Wheel/rail analytics project
  - objectives
  - team, technologies
  - future plans

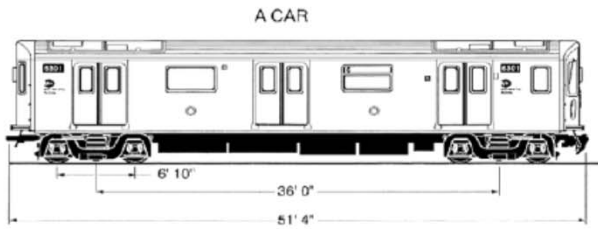
# Flushing Line At A Glance

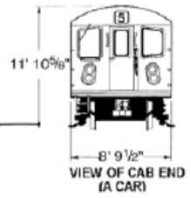
- 27.5 Miles of Track
- 22 Stations
  - 34th Street-Hudson Yards opened in September, 2015
- Average Daily Ridership:
  - Weekday = 525,000
  - Saturday = 350,000
  - Sunday = 300,000




- 7 line (tied with the 6 line) has the most frequency of service in the entire system.
- 27 Trains per hour in each direction during Weekday Peak



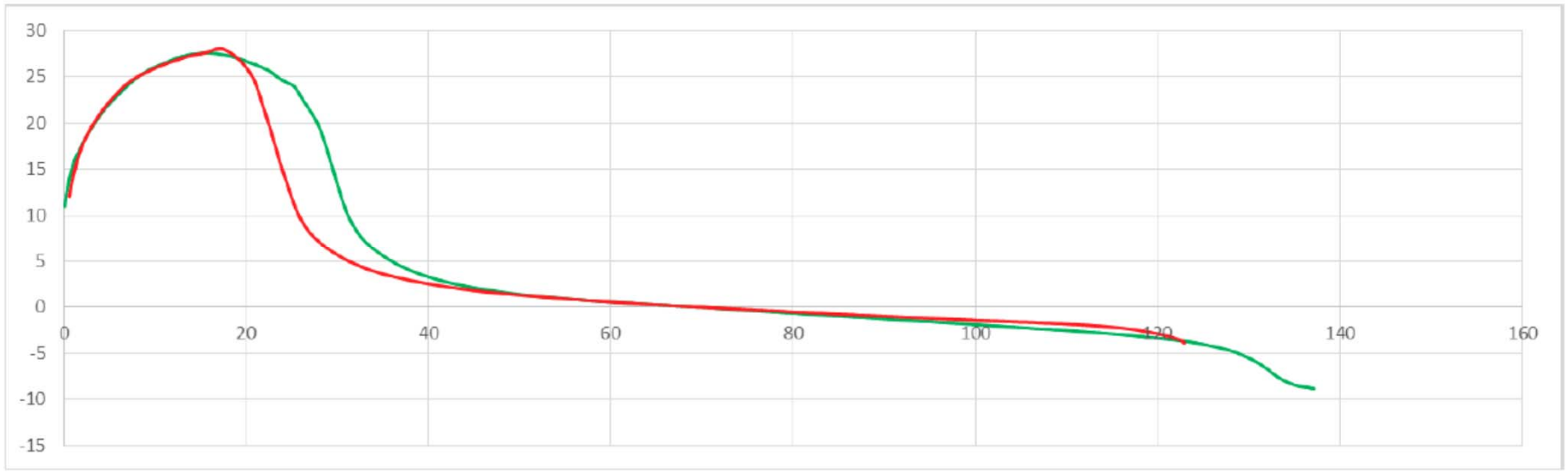



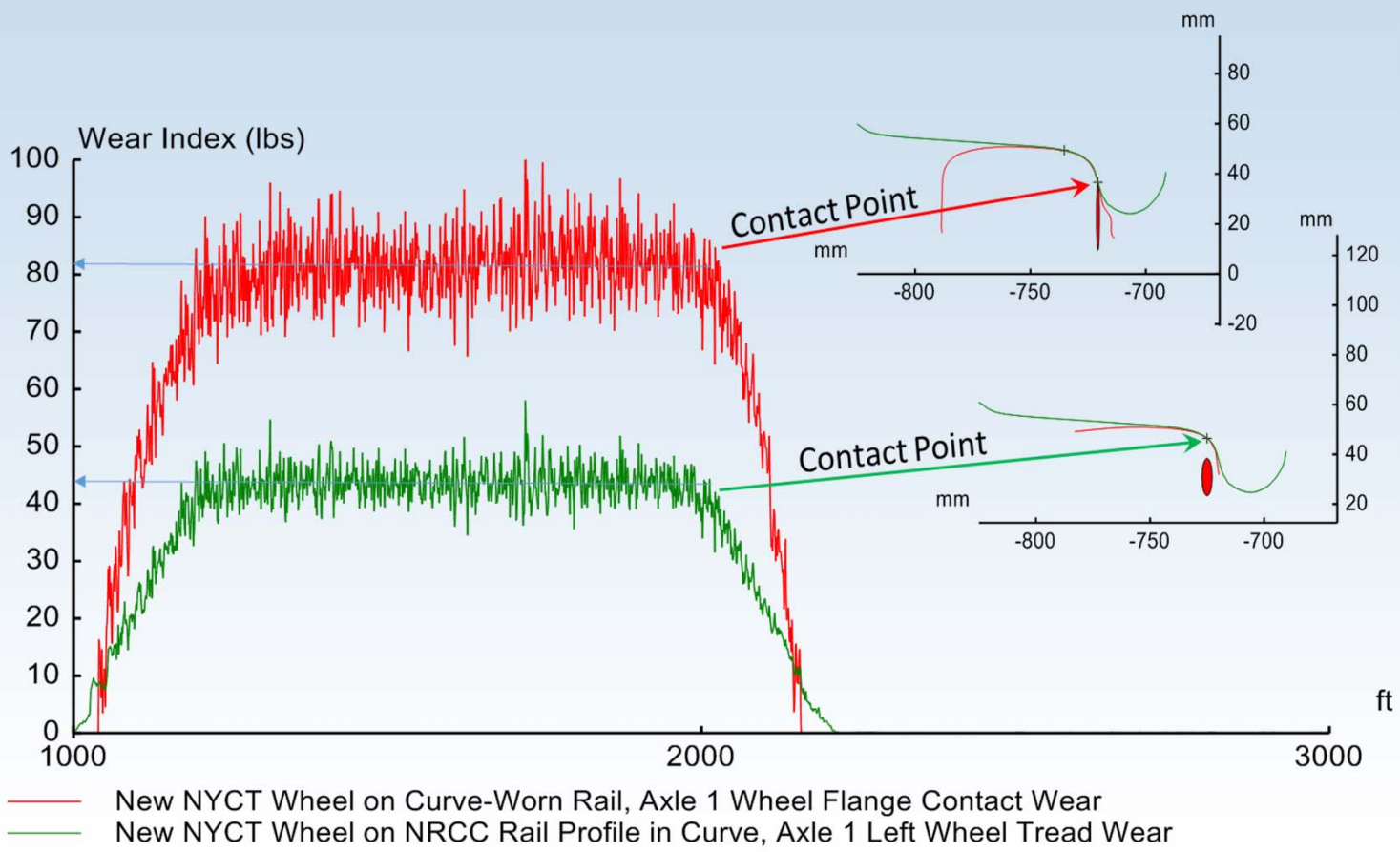

| WEIGHT & CAPACITY | |
|---|---|
| CAR WEIGHT (EMPTY) | |
| A CAR | 72,000 LBS |
| B CAR | 66,300 LBS |
| CAR WEIGHT (LOADED) | |
| A CAR (AW3) | 100,000 LBS |
| B CAR (AW3) | 94,300 LBS |

# Current Rail/Wheel Interface Issues

- Excessive Wheel Flange Wear since opening of the Flushing Line Extension in 09/2015.
- Two slow-speed derailments (15 mph) over a #6 tangential turnout S/O Willets Point Station, a week after new rails, guard rails and a std. RBM frog were installed.




New wheel profile
Worn wheel profile

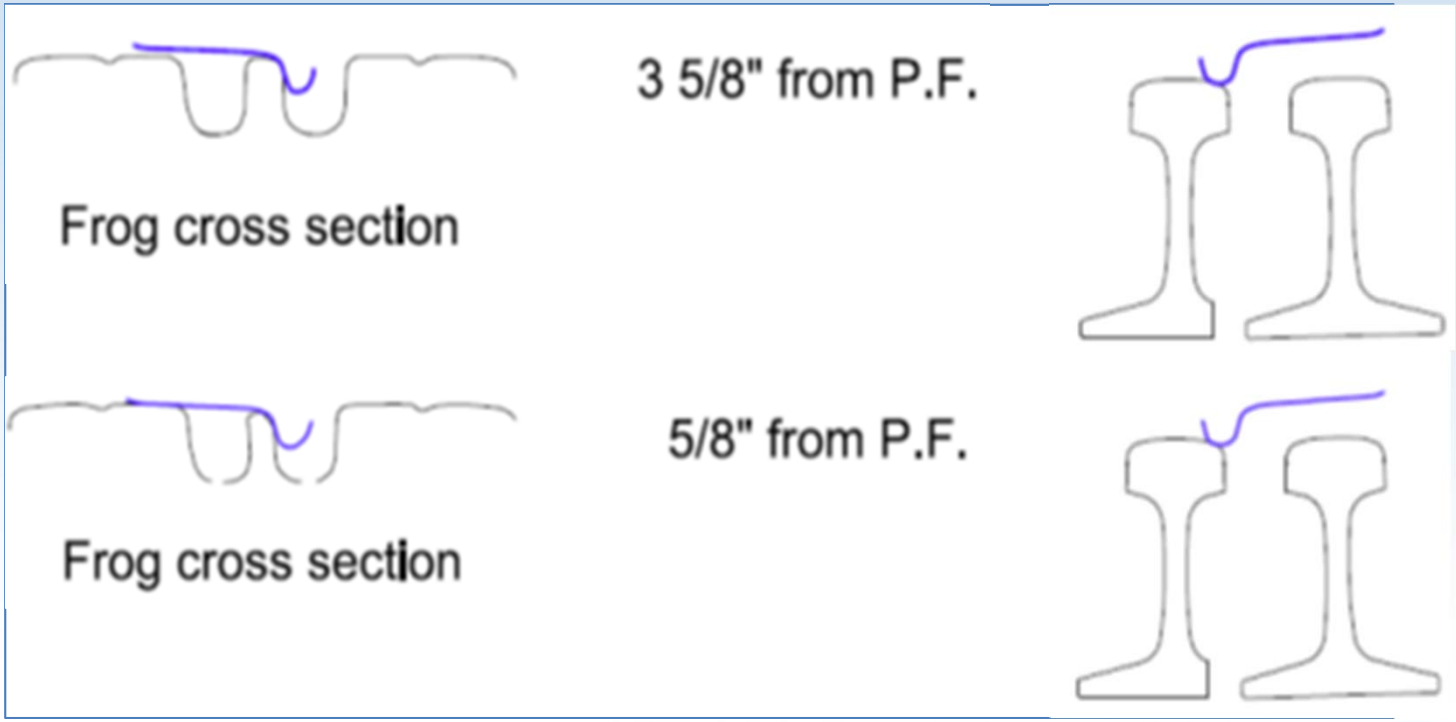

Wear Index (lbs)
100
90
80
70
60
50
40
30
20
10
0
1000
2000
3000
ft
Contact Point
mm
80
60
40
20
0
-20
-800
-750
-700
mm
120
100
80
60
40
20
Contact Point
mm
-800
-750
-700
New NYCT Wheel on Curve-Worn Rail, Axle 1 Wheel Flange Contact Wear
New NYCT Wheel on NRCC Rail Profile in Curve, Axle 1 Left Wheel Tread Wear

P.O.D.

NEW GUARD RAIL
WHEEL MARKINGS
NEW RUNNING RAIL

NEW GUARD RAIL
POD
WHEEL MARKINGS
NEW RUNNING RAIL

# Guard Rail Interaction



# W/R Analytics Project

- Reduce energy use – reduce hunting and improve steering in curves.
- Reduce capital costs – increase wheel life and extend track life cycle.
- Improve asset management (wheels, track)
- Improve customer experience – lower noise, improved ride characteristics

# Approach

- SOA, automated, machine based
- wheel, track and truck data
- characterize and perform automated data collection and analytics
  - safety, resiliency + economics

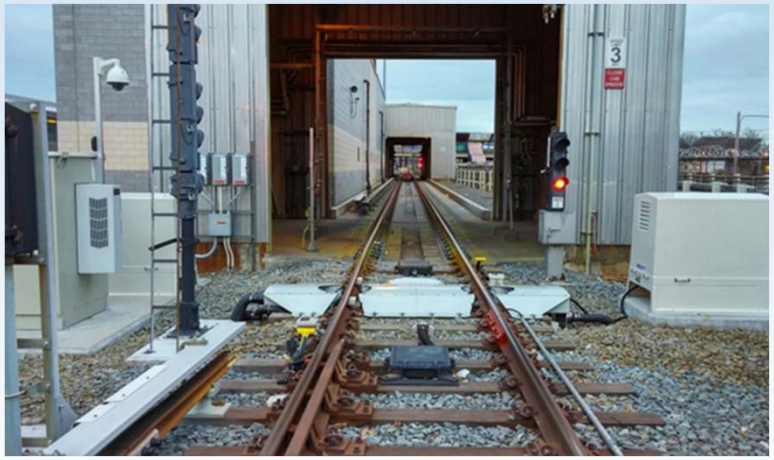
Introducing…

# THE TEAM

# KLD Labs WheelScan

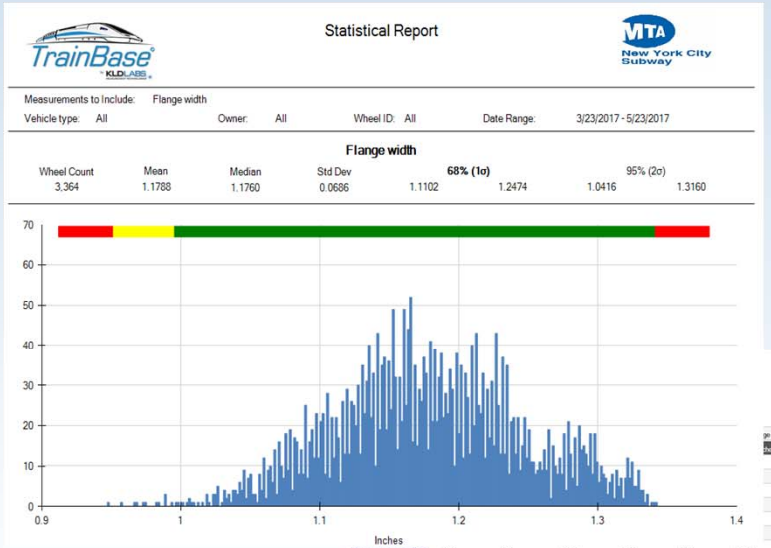
## Automated Wheel Profile Measurement

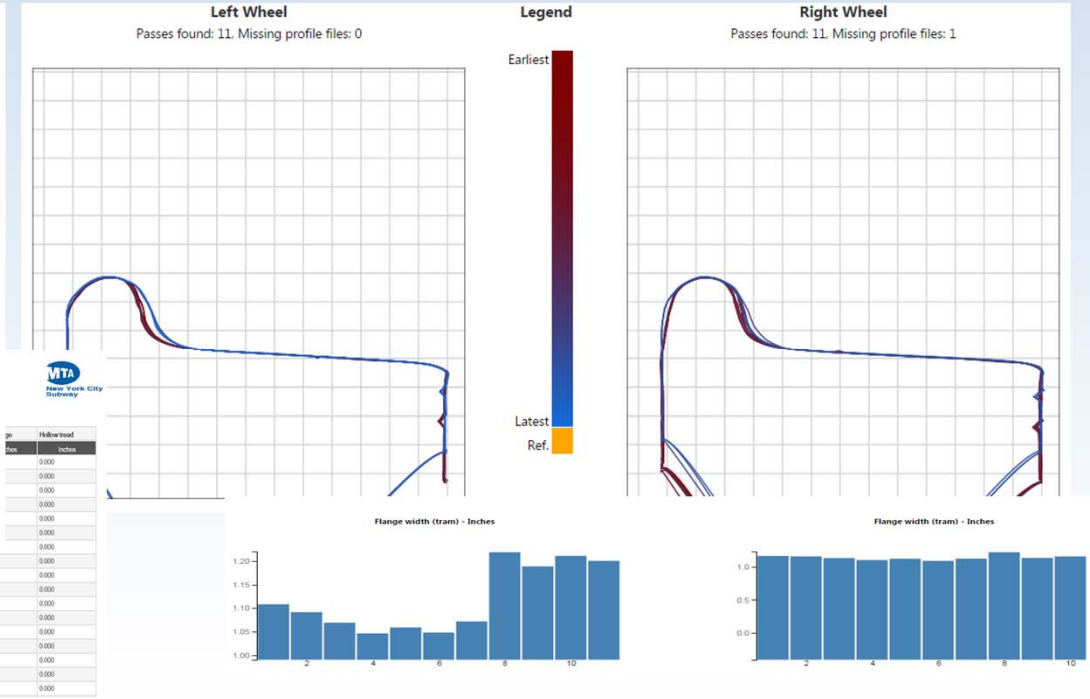
- Installed at Corona Yard
- Currently capturing, measuring, recording and reporting on the condition of the entire Flushing Line R188 Fleet wheels
- TrainBase data management tool utilized by team members for wheel analytics
- Enabling  categorization of fleet wheel wear patterns for input to wheel/rail analytics



KLDLABS MEASUREMENT TECHNOLOGIES

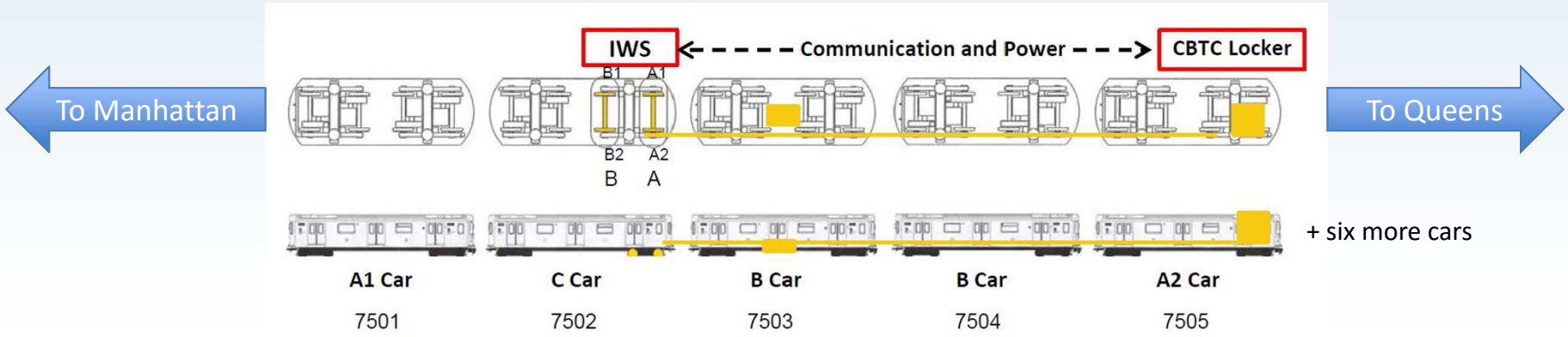
# KLD Labs Wheel Profile Analysis



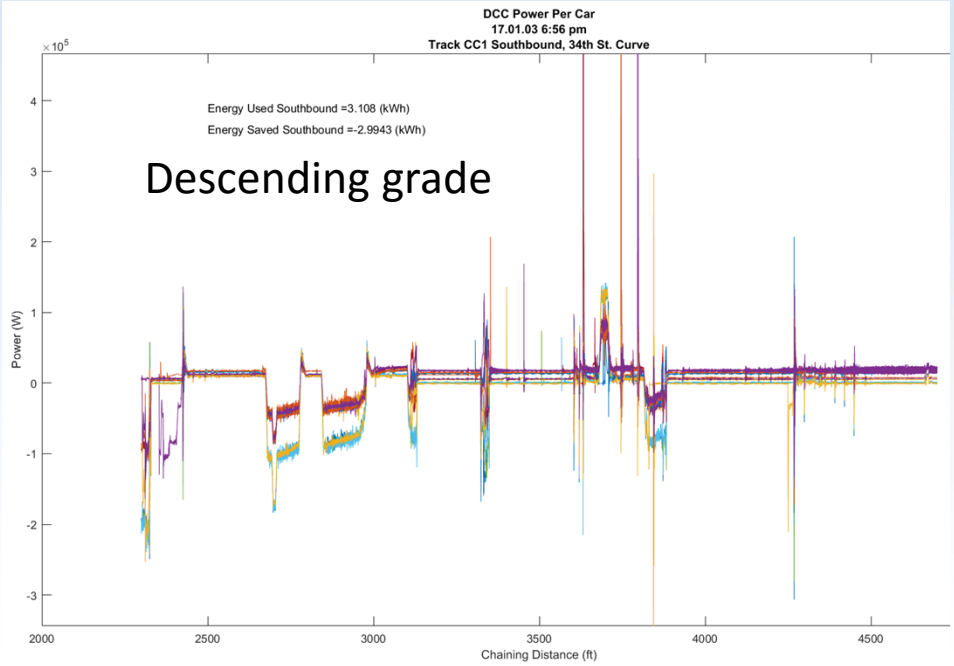



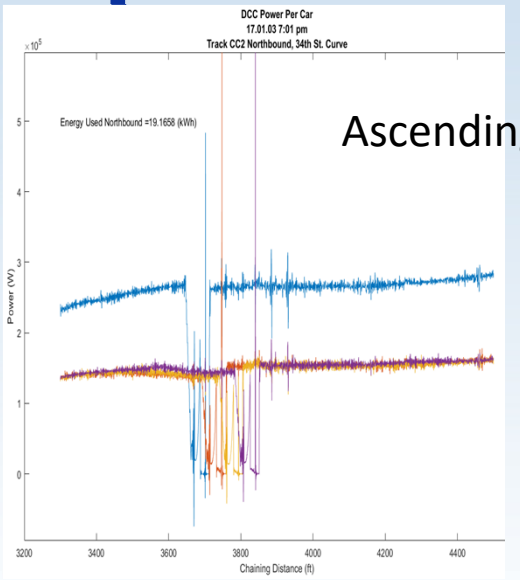
# DCC – Data Collection Car

- **instrumented wheel sets, accelerometers, acoustic recording equipment and propulsion energy recording equipment**



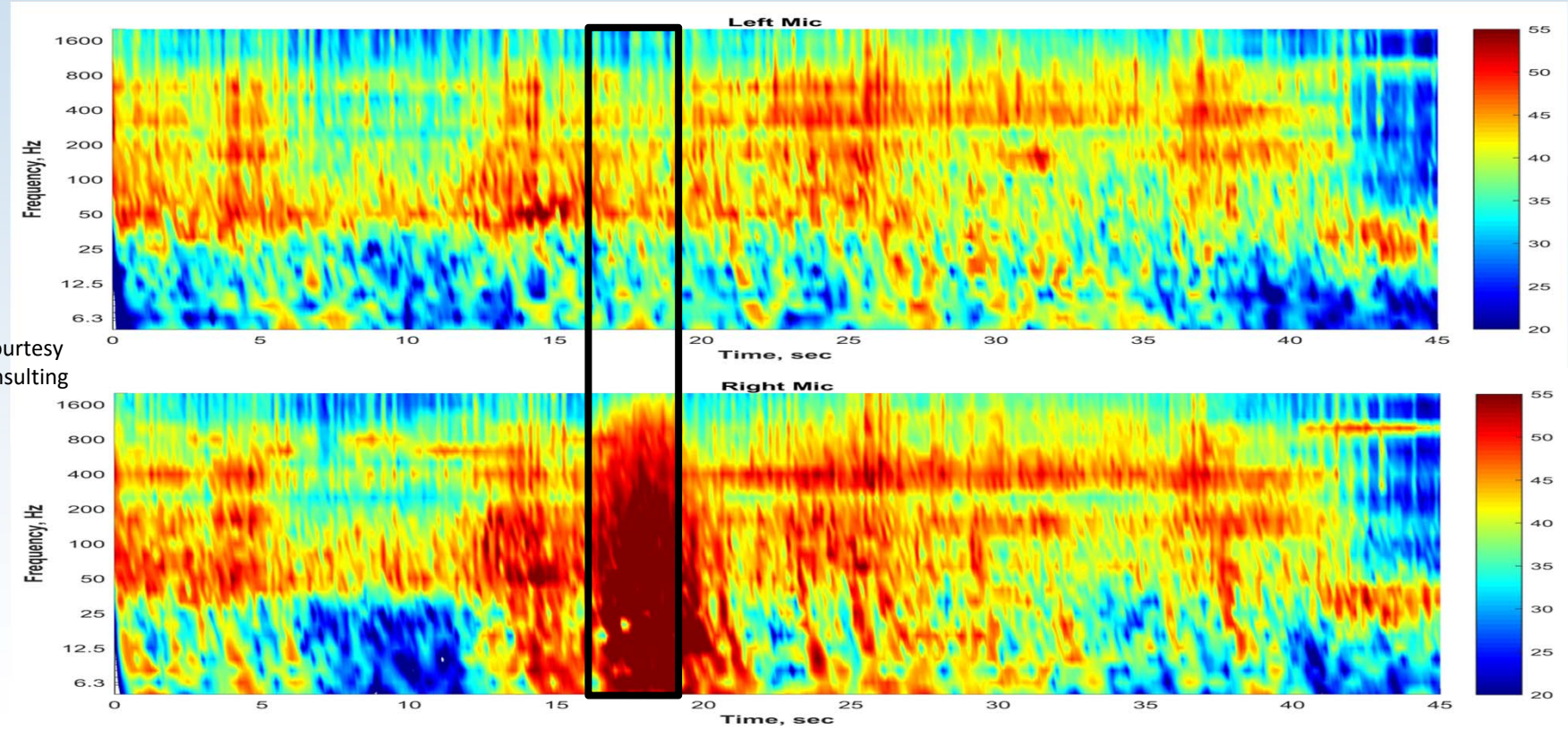
# DTB: Energy Consumption Data



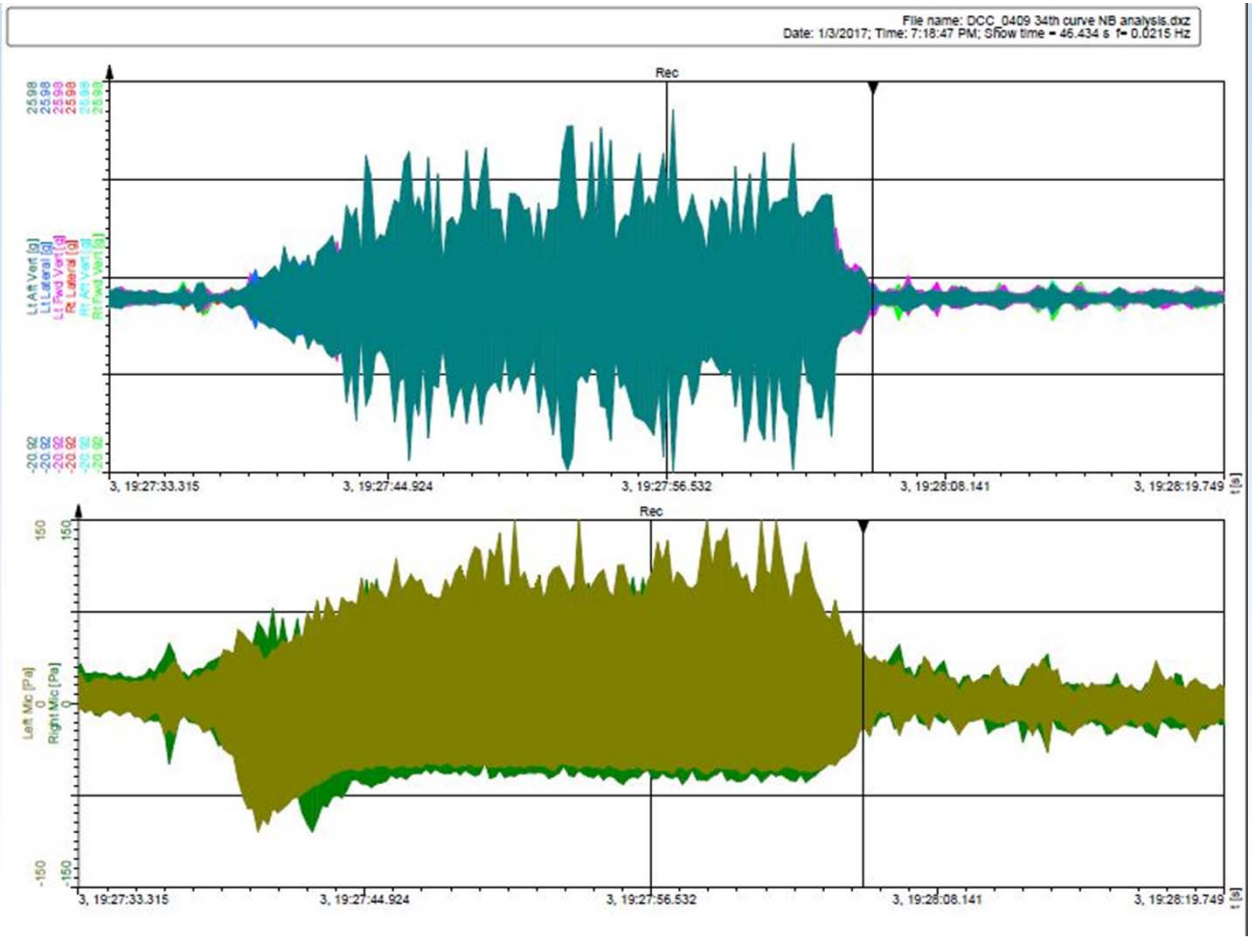



# DTB: Noise






Plots courtesy
ATS consulting

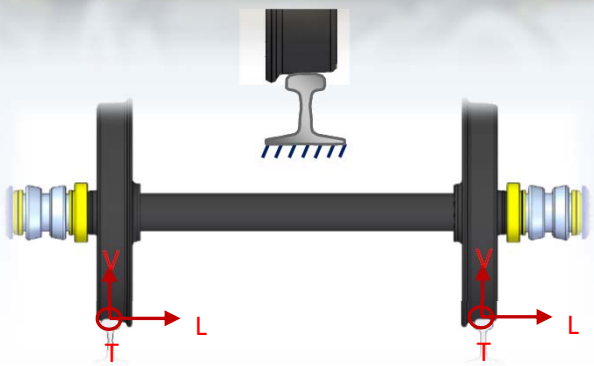


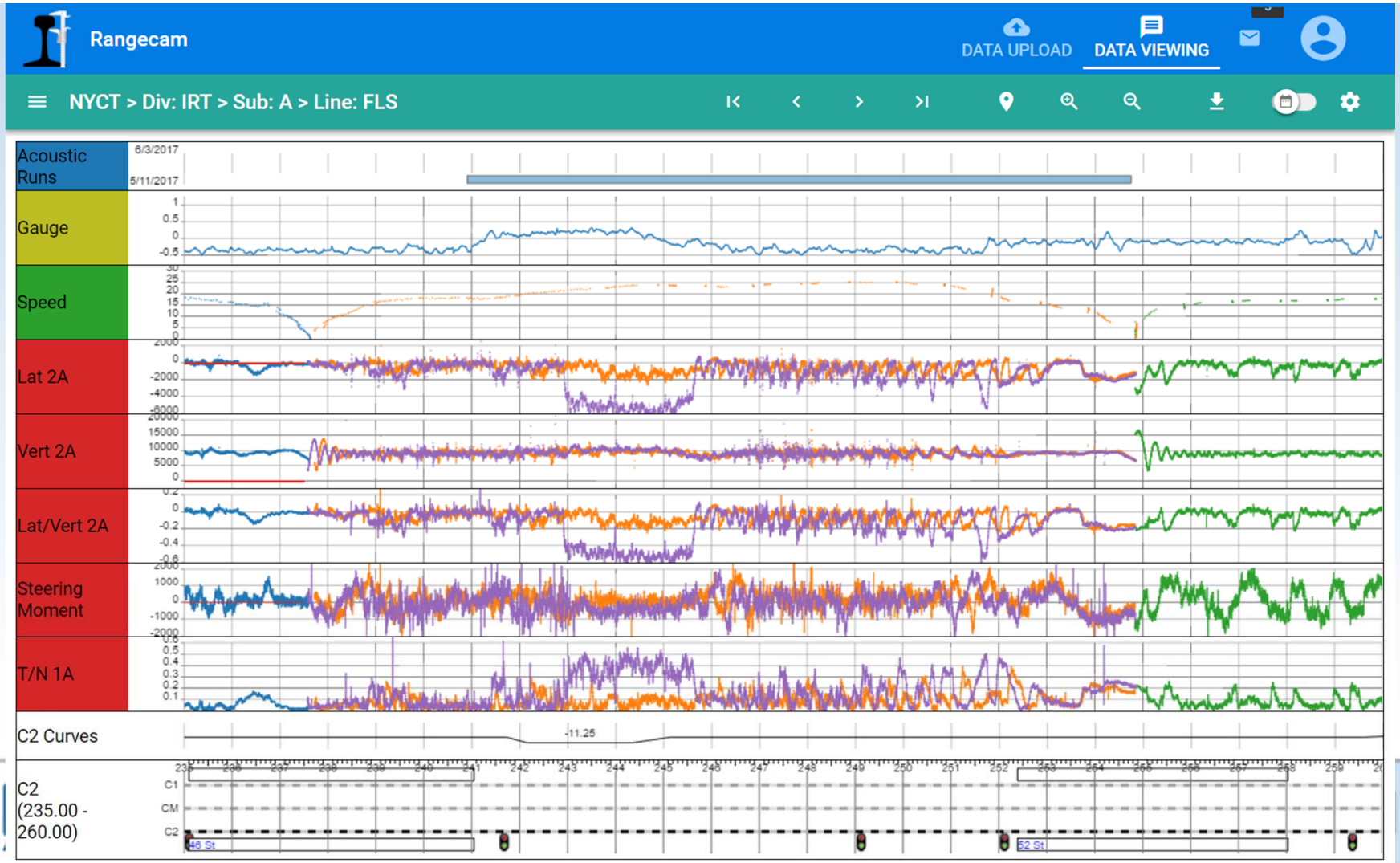

Accelerations

Noise

# NRC Instrumented Wheelsets

- Regular wheelset instrumented with strain gauges and turned into dynamic load cells
- Gives accurate measurements of wheel/rail contact forces in all three axes
- Characterizes track performance: steering, wheel climb, effect of rail profile, friction management, etc.




Rangecam
DATA UPLOAD
DATA VIEWING
NYCT > Div: IRT > Sub: A > Line: FLS
Acoustic Runs
6/3/2017
5/11/2017
Gauge
Speed
Lat 2A
Vert 2A
Lat/Vert 2A
Steering Moment
T/N 1A
C2 Curves
-11.25
C2 (235.00 - 260.00)
C1
CM
C2
46 St
52 St

# AND IN THE NEAR FUTURE…

# Near 111th Street station

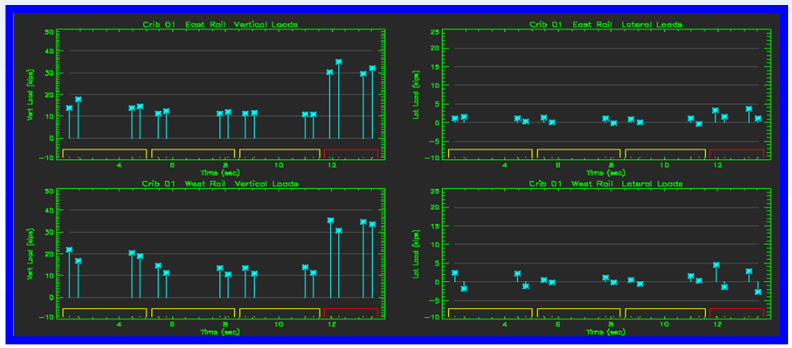
# WID - TBOGI

## Bogie Geometry Measurement System

- **Measures the tracking behavior of bogies. Identify bogies with steering issues.**
  - **Operates in 3rd rail environment.**
  - **Measures the AOA and TP of each passing wheelset, and more…**
  - **Data pushed to TBOGI-DB web database and central data warehouse.**

# ISI – L/V Measurement System

- Remote Data System installed in 3rd Rail environment
  - Lateral and vertical forces
  - Characterize vehicle performance
    - steering, wheel climb, effect of wheel profile, friction management, etc.
- Data is automatically transferred to KLD's central data warehouse



# WHEEL-RAIL ANALYTICS

# Plasser American – Ec Analytics

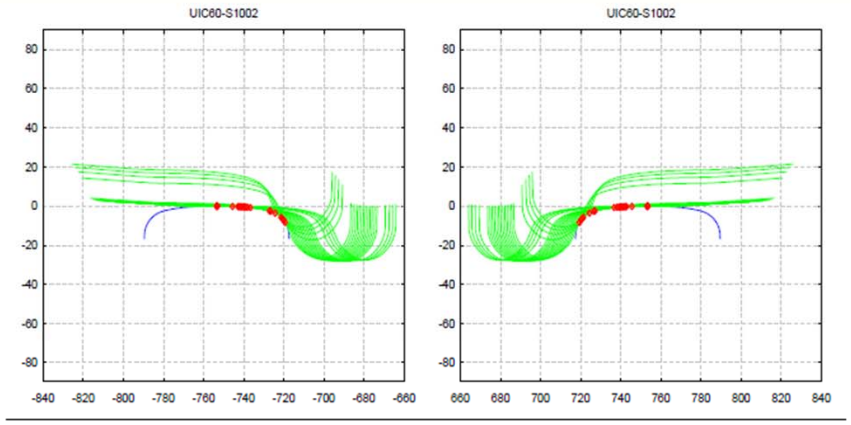
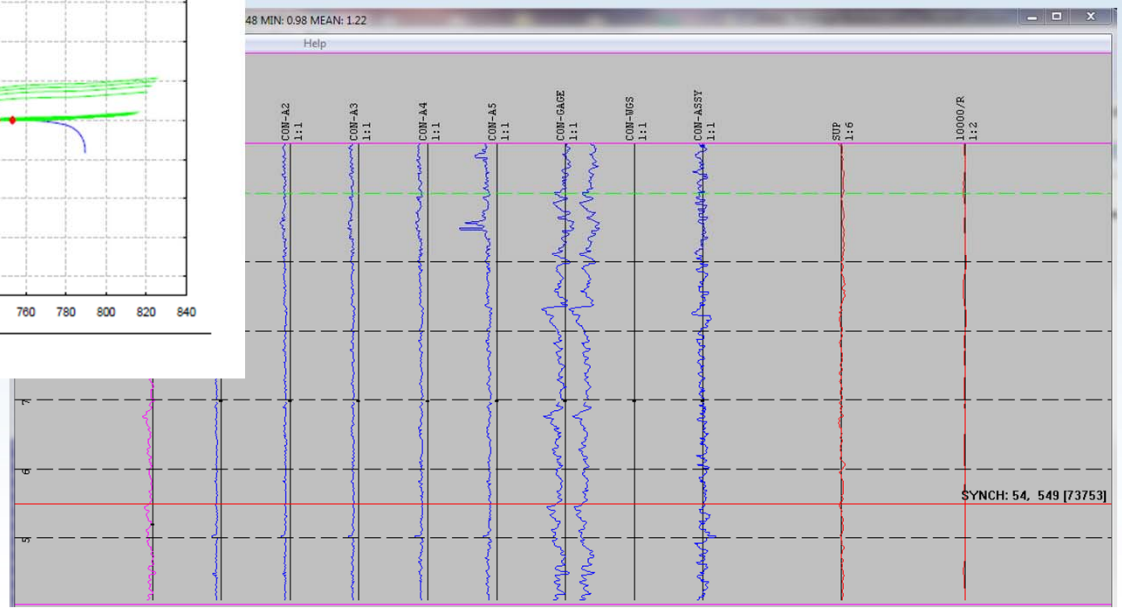
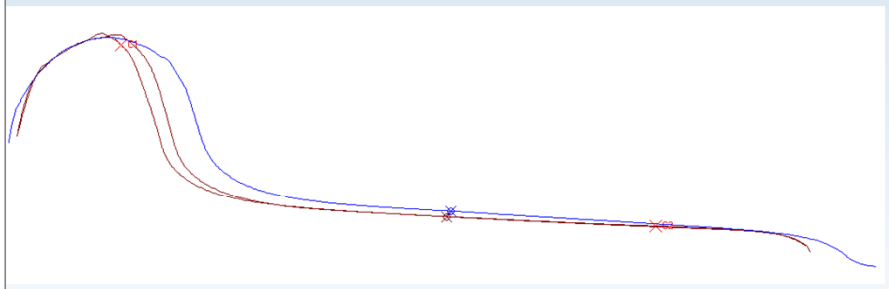



**Figure 1.3.** Contact between wheel and rail



# Conicity analytics



MTA

DAYTON T. BROWN INC.

KLDLABS
MEASUREMENT TECHNOLOGIES

Canada
NRC·CNRC

WID
WAYSIDE
INSPECTION
DEVICES

# TOM LAMB

INSTRUMENTATION
SERVICES,
INC.

Plasser American

# THANK YOU!

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