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Analysis of energy data from  
DC trains

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- Overview of our DC train energy monitoring project
- Summary of instrumentation
- Results
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- Ongoing work and future work
- Conclusions



# Merseyrail

- Angel trains rolling stock
  - Class 507 & 508
  - CAM controlled
  - Rheostatic braking
  - No regeneration
- 60 mph top speed
- 28 mph average speed

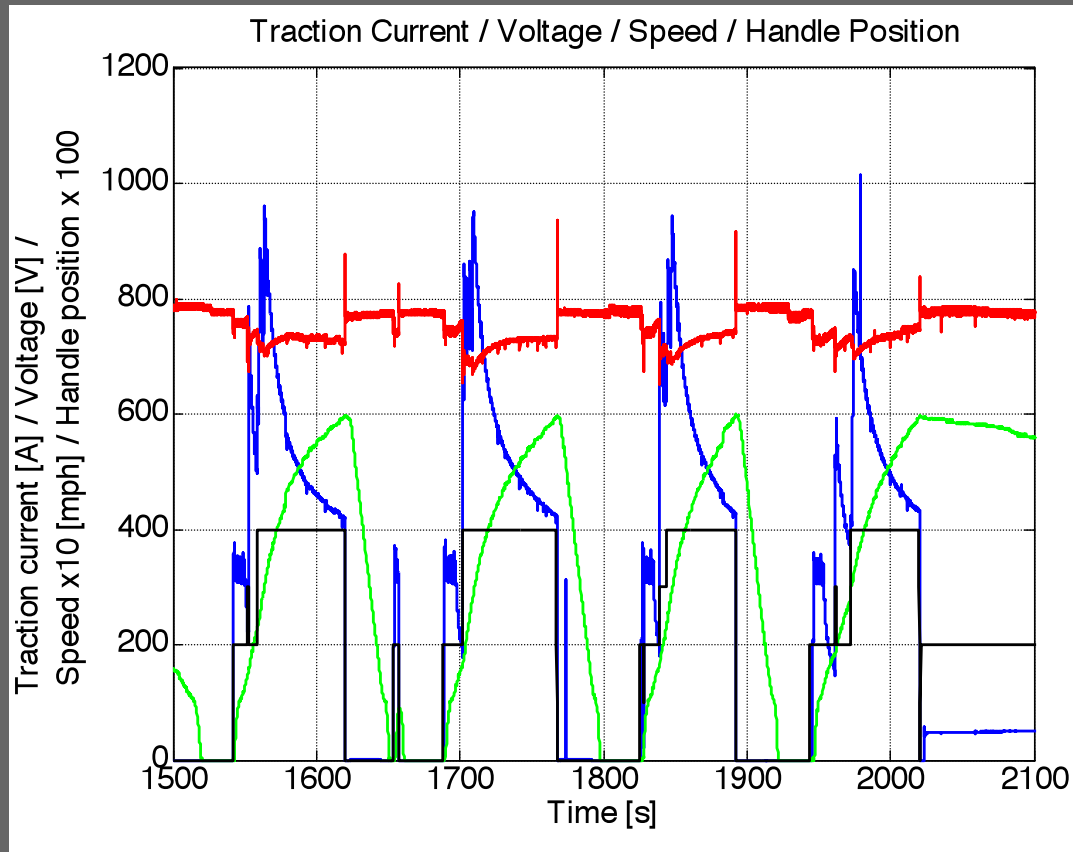


# Train instrumentation

- ❑ Traction current
- ❑ Aux current
- ❑ Line voltage
- ❑ Driver's demands
- ❑ Camshaft operation
- ❑ Passenger weight
- ❑ Tacho
- ❑ Inertial measurement
- ❑ GPS position and time
- ❑ SD card data storage

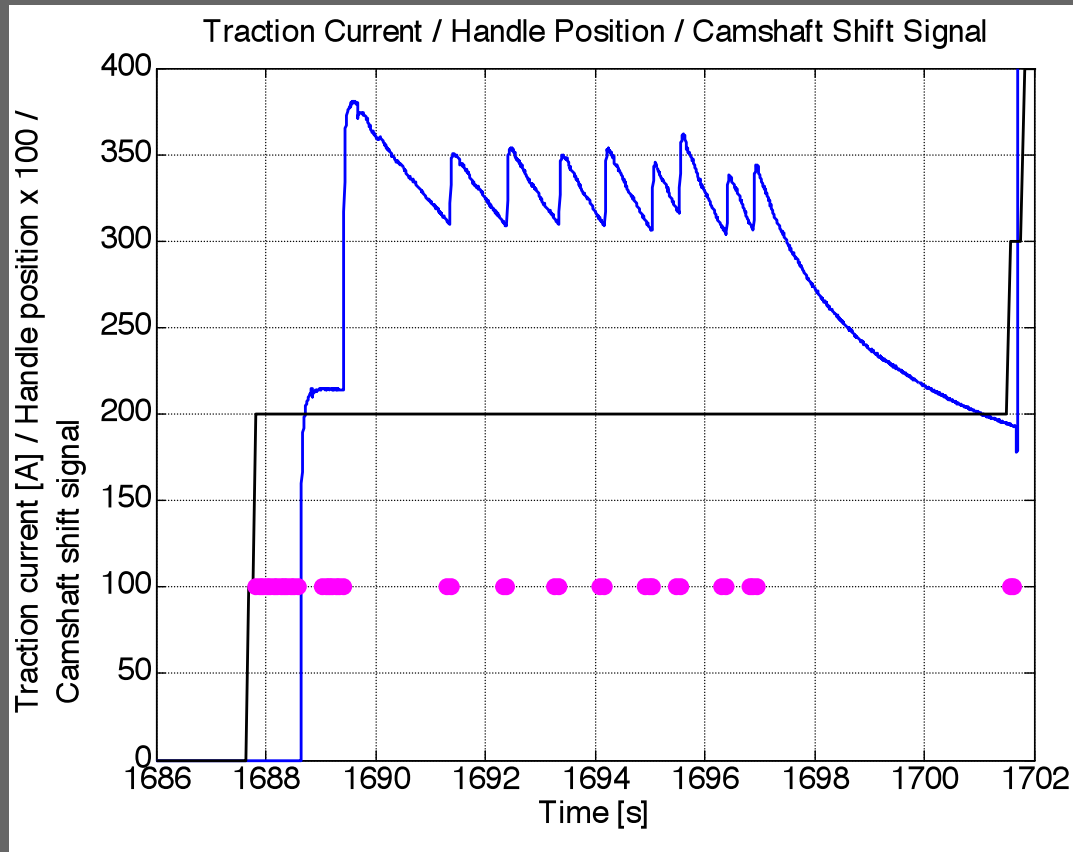


# Initial Results



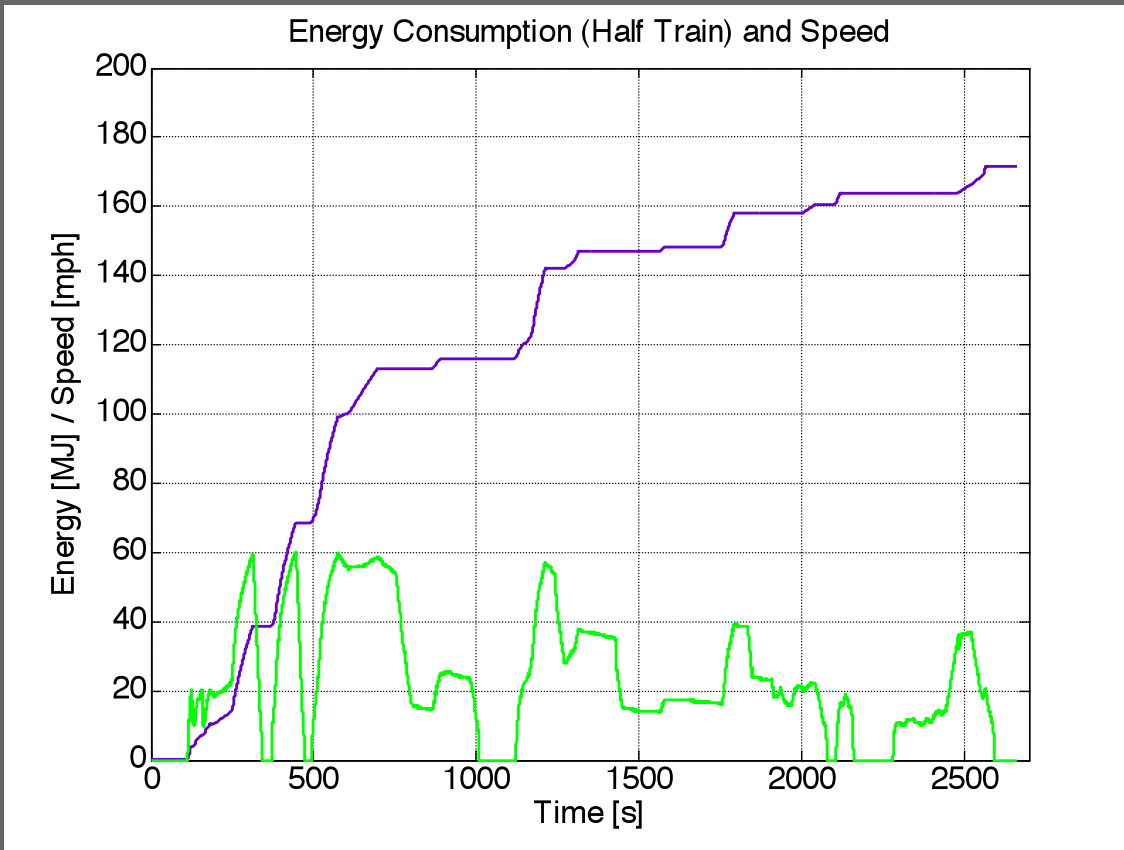
- Traction current
  - Half Train
- Line voltage
- Speed
- Handle position
- Brake tests

# Initial Results from 1 day trial



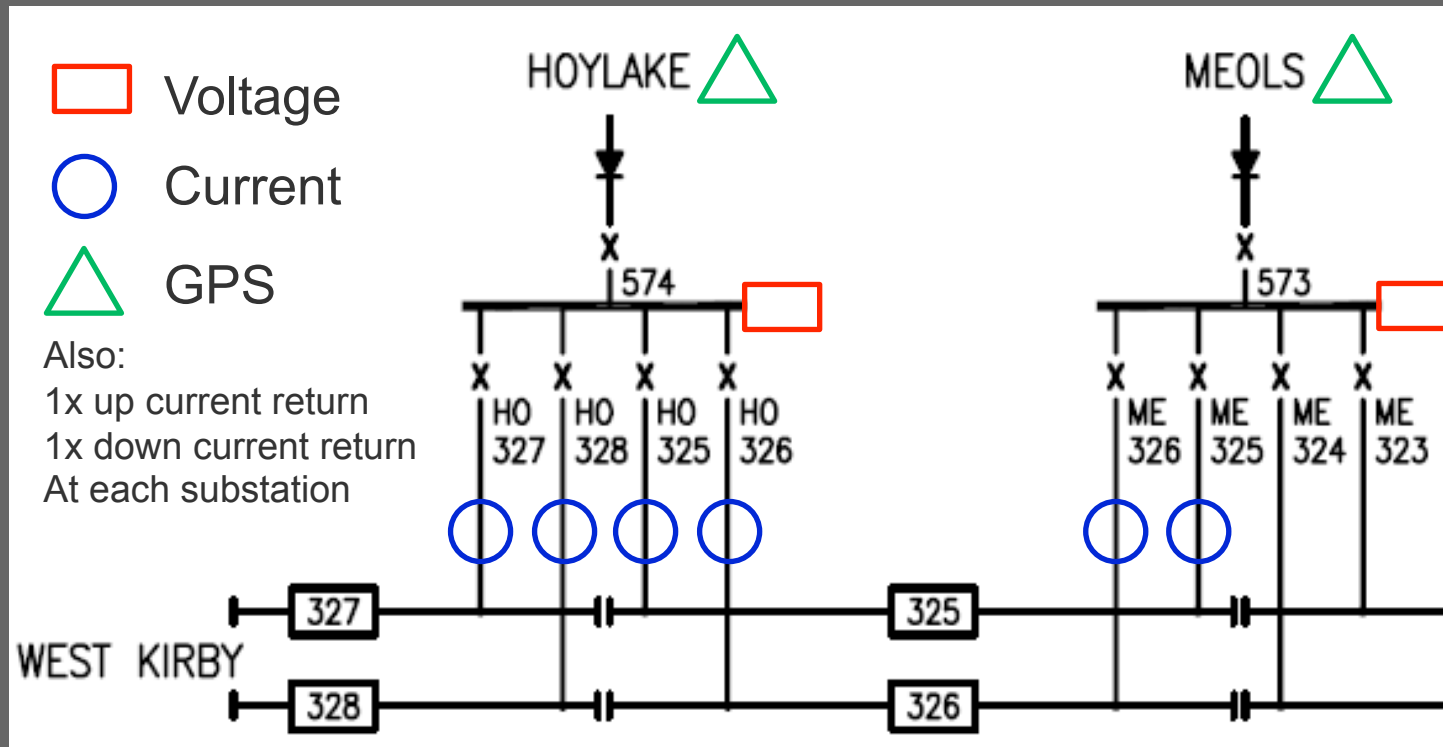
- Traction current
  - Half train
- Handle position
- CS Shift
  - Notching

# Initial Results from 1 day trial

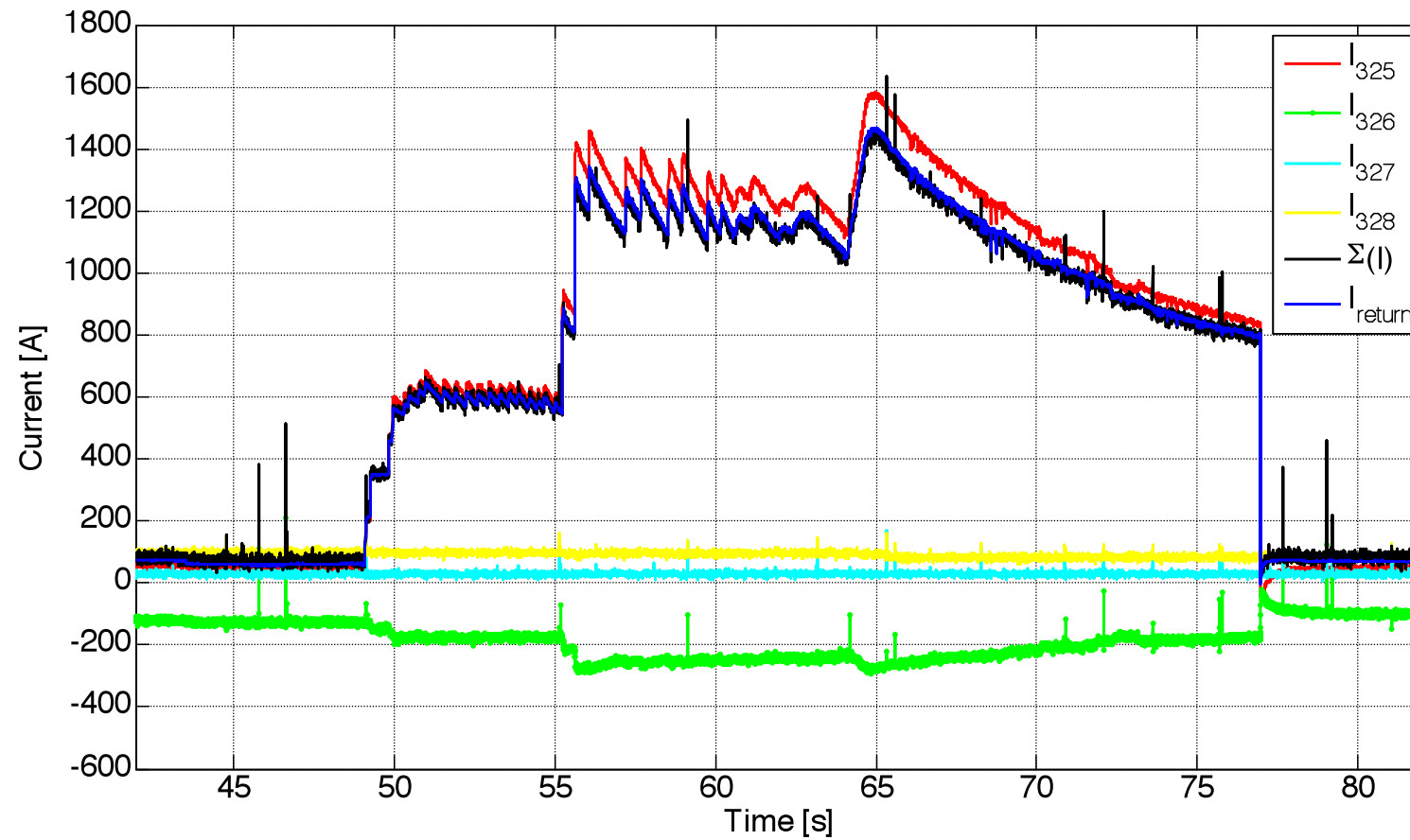


- Energy consumption
  - Half train
- Speed
- Chester to James St
- Acceleration
  - Brake test
  - Station
  - Gradient

# Substation instrumentation



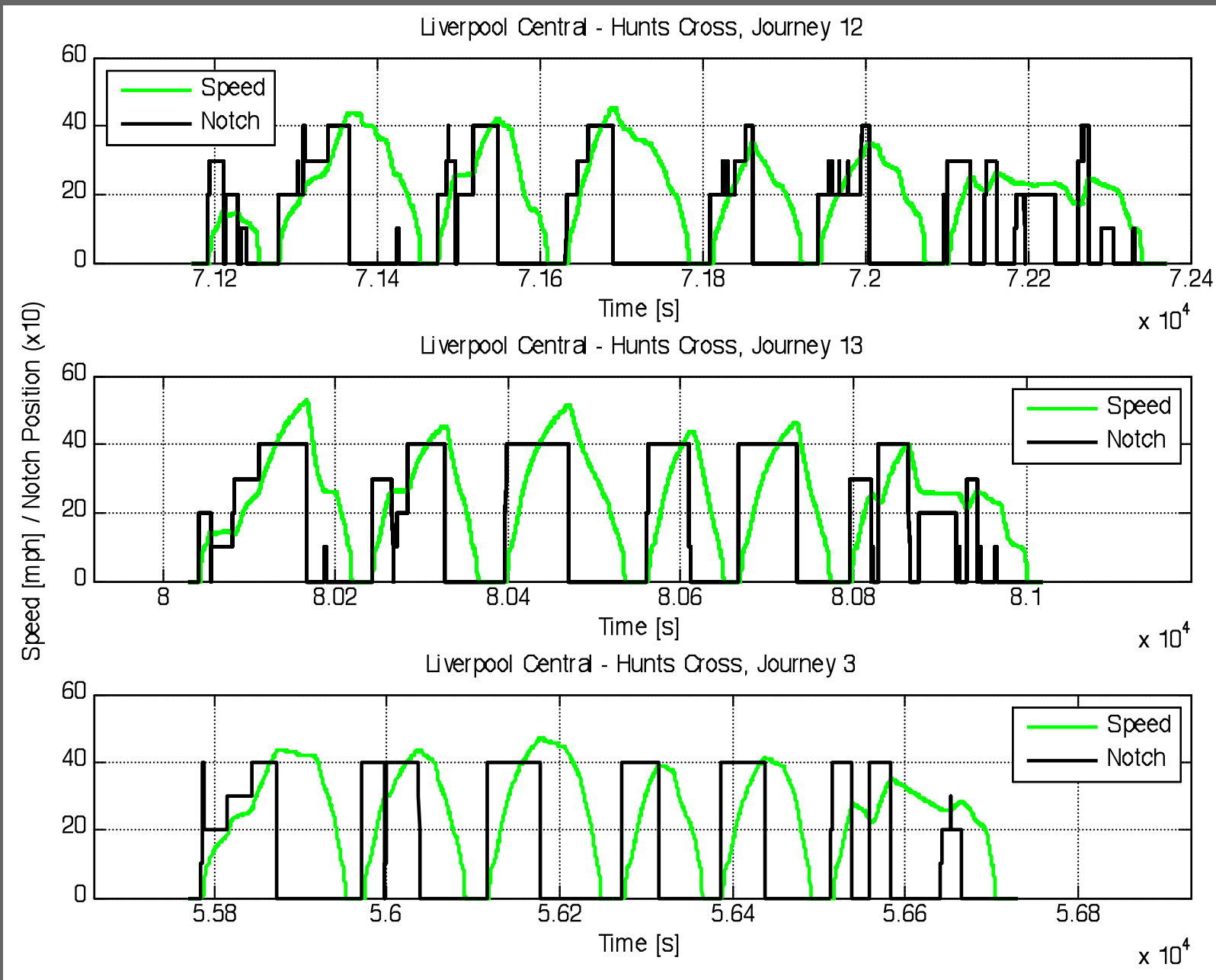
# Hoylake substation results

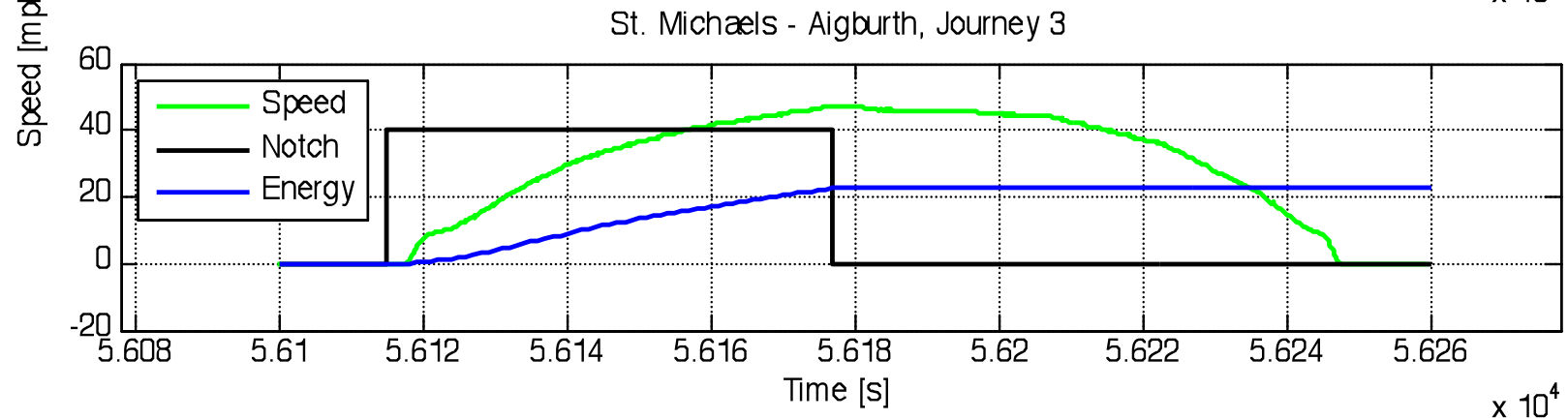
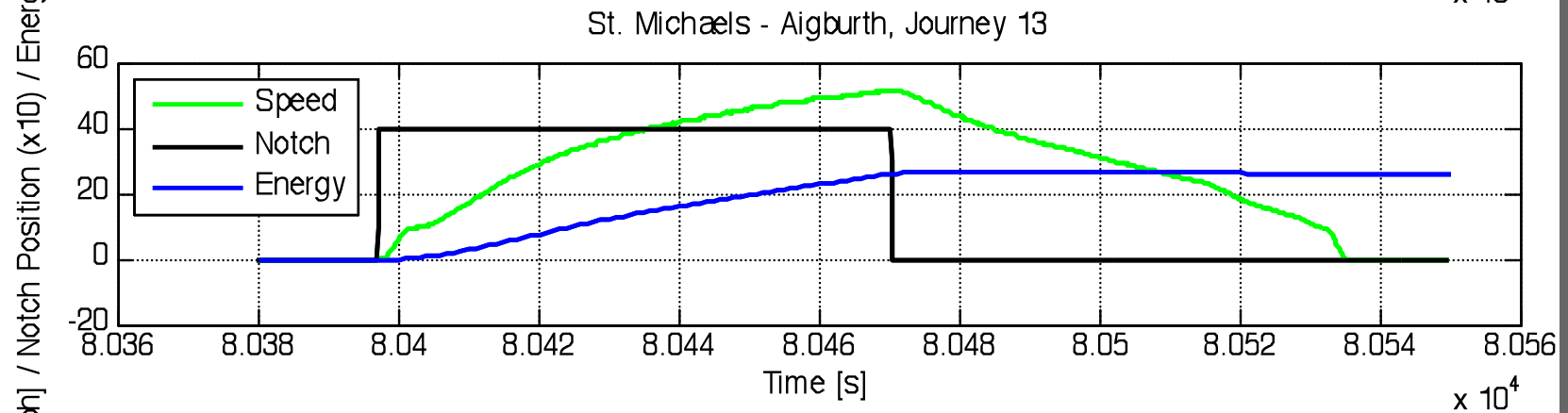
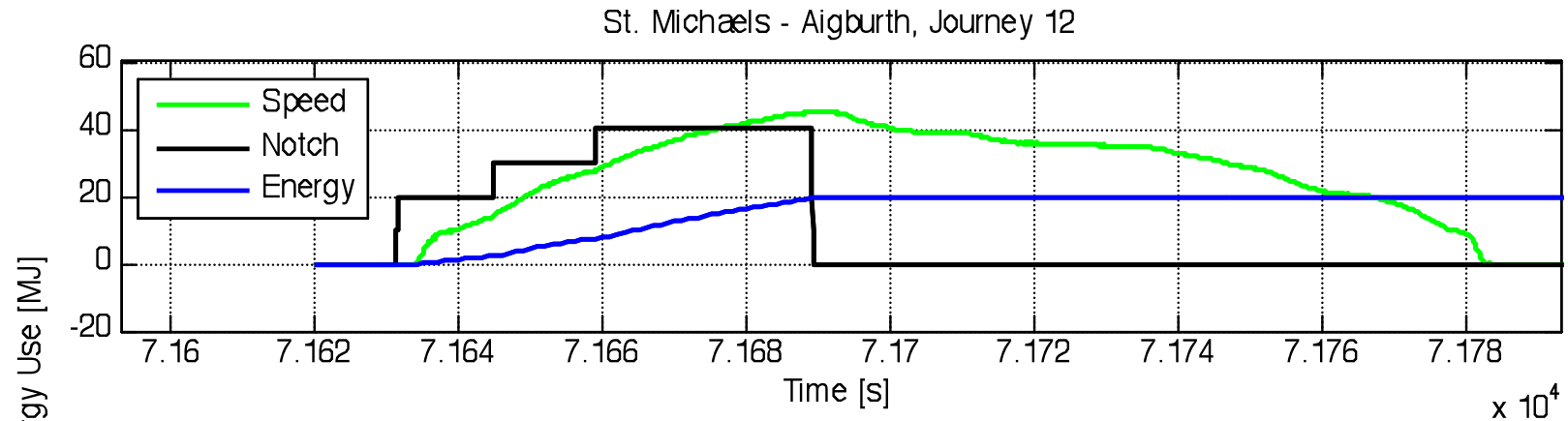


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# Results from in service operation

- Installed in service in Feb 2011
- Agreed a 12 month trial (extended from 6 weeks in original plan)
- Data collected at maintenance interval
- 4 GB per day from trains + 3 GB from substations
- Begun initial data analysis





# Conclusions/Future work

- Big variance in driver style
- Optimised driving could make use of extended operation in notch 2
  
- Alignment of substation and vehicle data
- Further analysis of train data
- Extensions to substations instrumentation to include AC side
  
- Thanks to DfT, Merseyrail, Network Rail, RSSB, Angel Trains, ATOC and RIA, ATKINS, Lloyds Register Rail

