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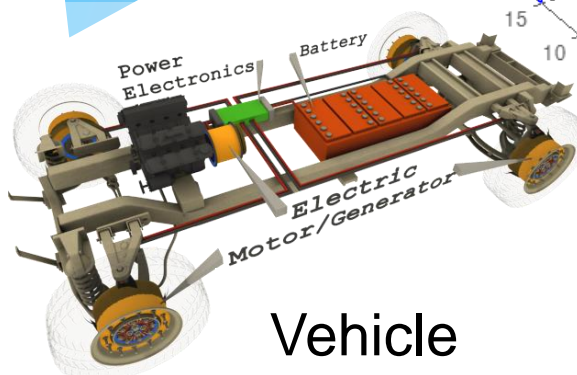
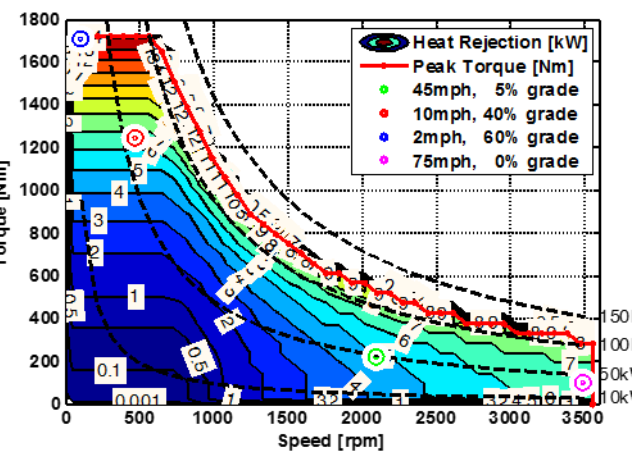
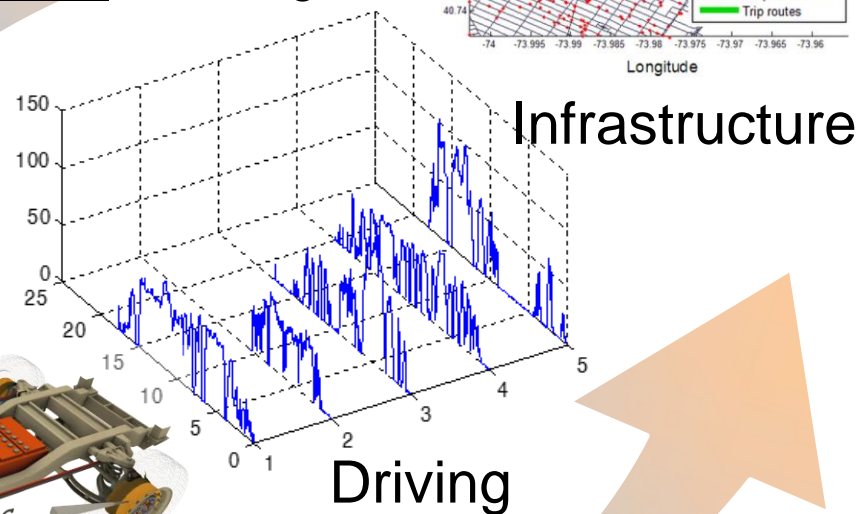
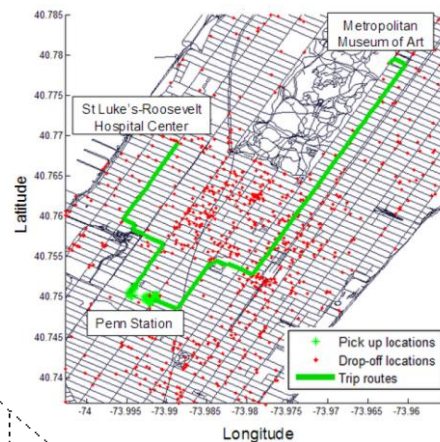
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# Andrej Ivanco

Assistant Research Professor  
Dept. of Automotive Engineering

Vehicle powertrain **SYSTEM** modeling



Component

Vehicle

Driving

Infrastructure

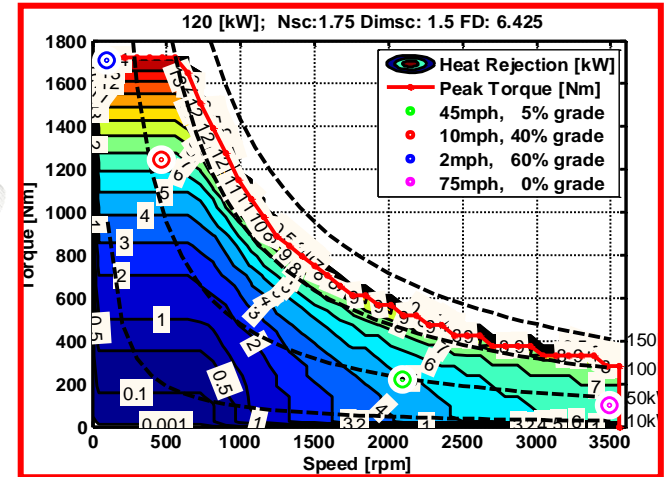
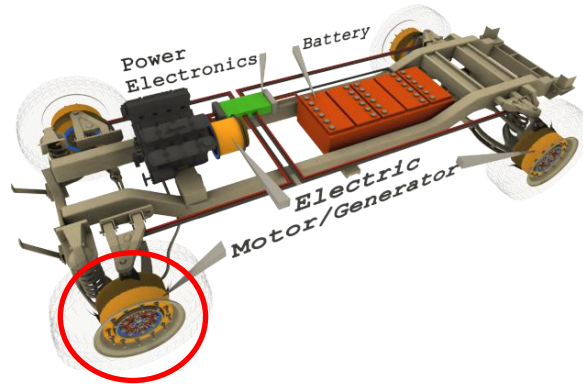
Component

Vehicle

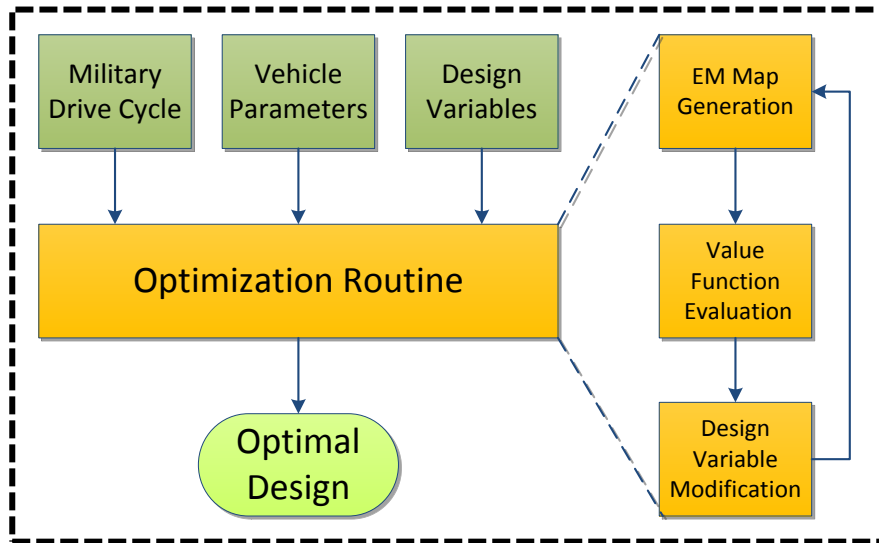
Driving

Infrastructure

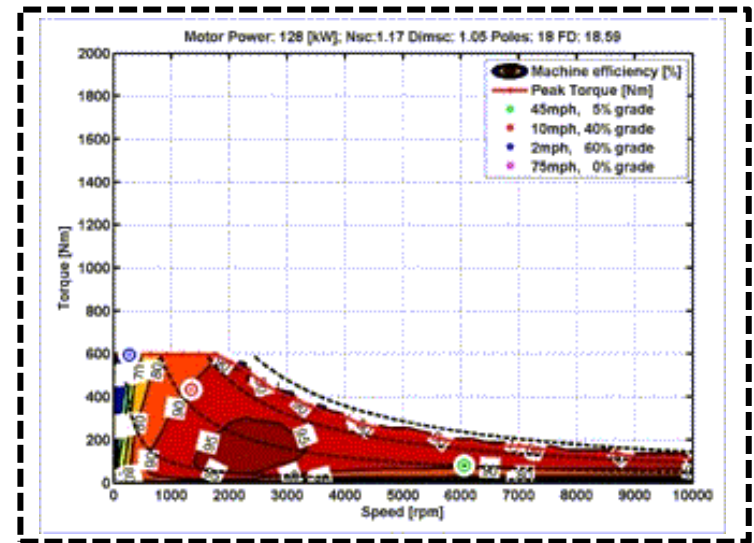
# Electric Machine Design Optimization



## Optimization Framework



## Simulation Run



**Component**

**Vehicle**

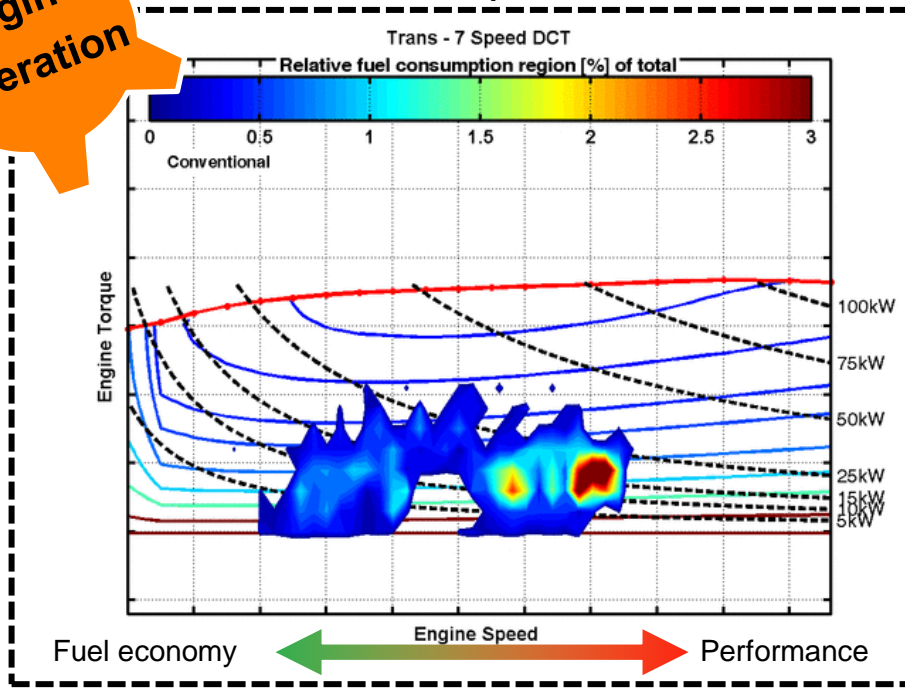
**Driving**

**Infrastructure**

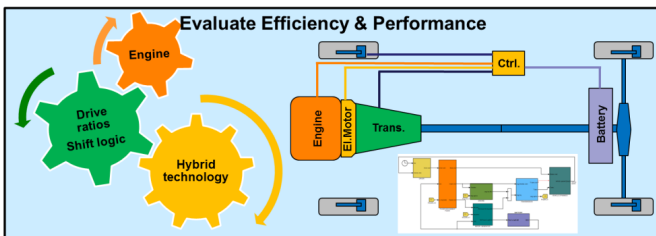
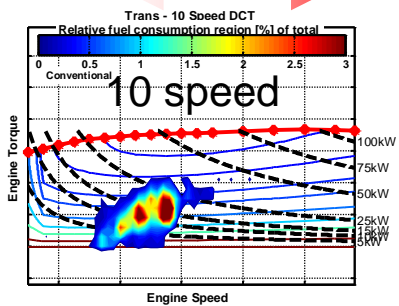
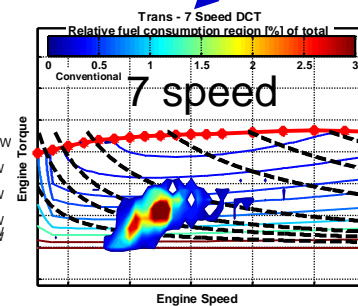
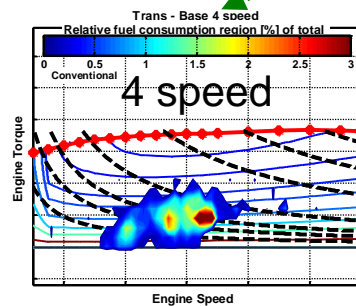
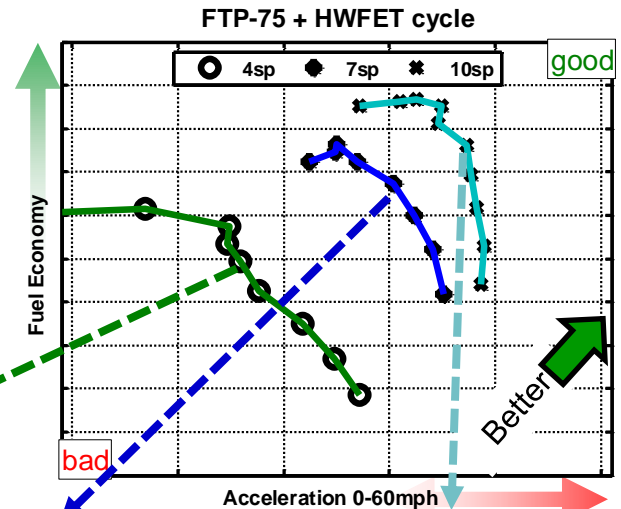
# Powertrain System: Evaluation of Advanced Transmissions

Engine Operation

## Final Drive Optimization



- 4, 7 and 10 speed transmissions coupled with engines and compared under consistent assumptions
- More gears enable gain in both, 0-60 time and fuel economy



Component

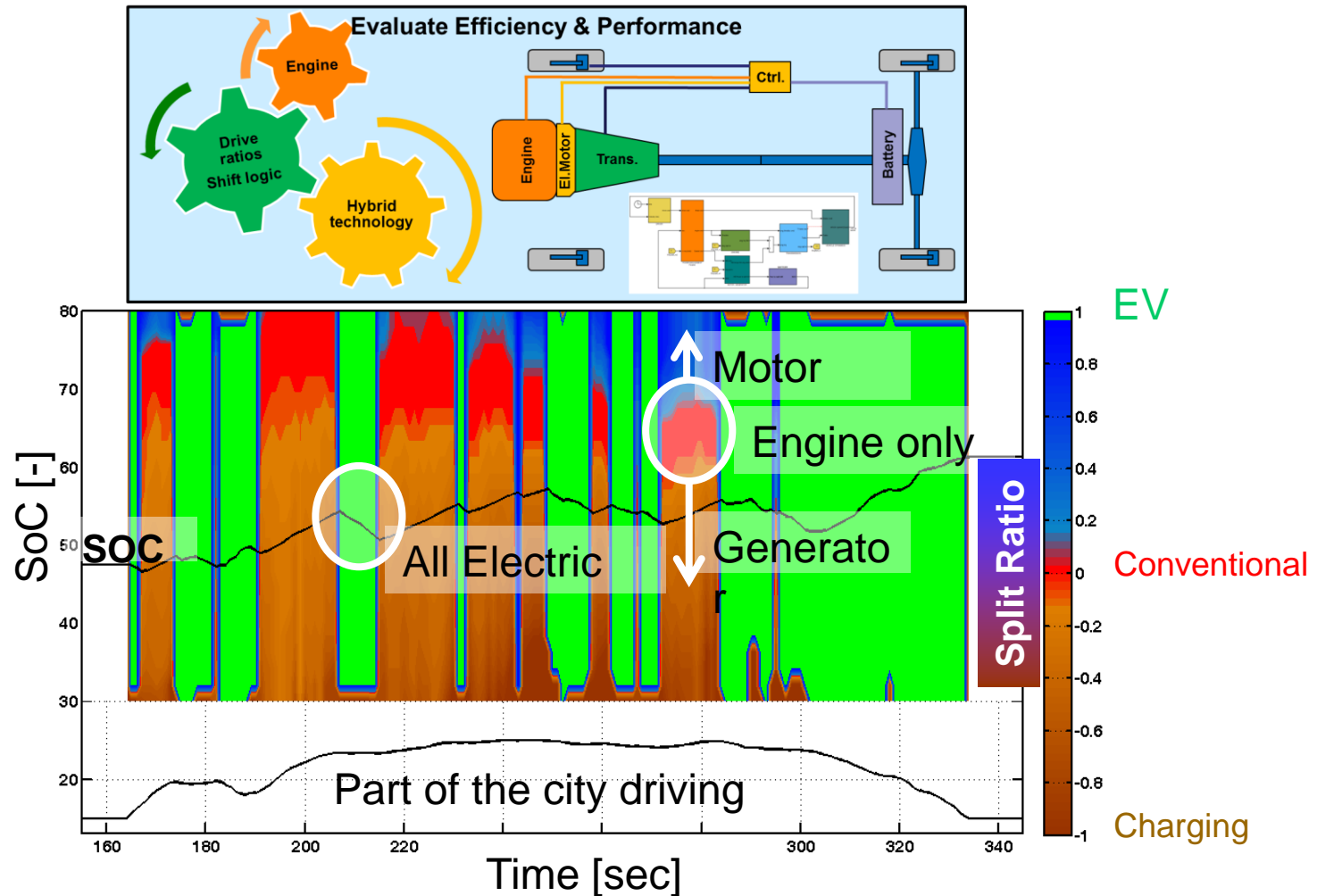
Vehicle

Driving

Infrastructure

# Energy Management Optimization Algorithm

- The main role of the supervisory control is to decide about the **power split** between the engine and electric machine for given conditions



Component

Vehicle

Driving

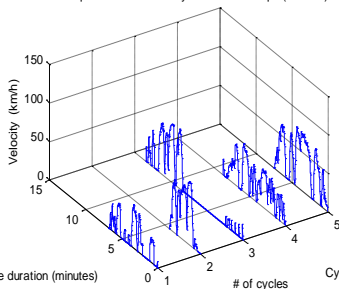
Infrastructure

# Driving patterns & Drive Cycles for EV Studies

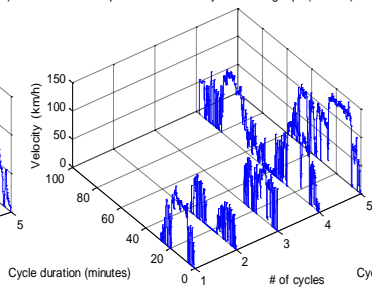
- How are people driving?
  - One trip vs. Daily distance (battery capacity)
  - Time between trips (charging opportunities)
- How is the car being used?
  - Is fast charging necessary?
  - What is the EV range – distance to empty
- Fuel economy benefits
  - Generate a representative test cycle
  - Adapt the calibration to the driver

Data → Information → Knowledge

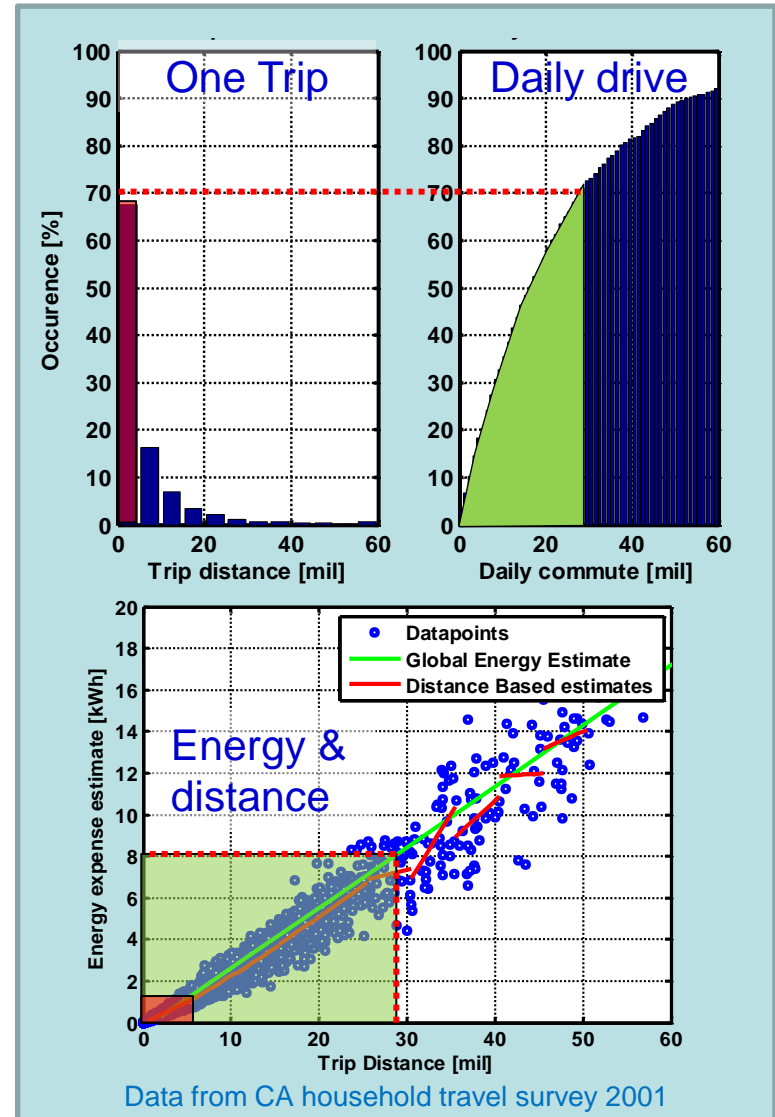
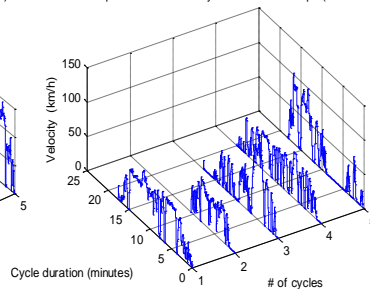
Examples of naturalistic cycles for short trips (1-5 km)



Examples of naturalistic cycles for long trips (>15 km)



Examples of naturalistic cycles for medium trips (5-15 km)



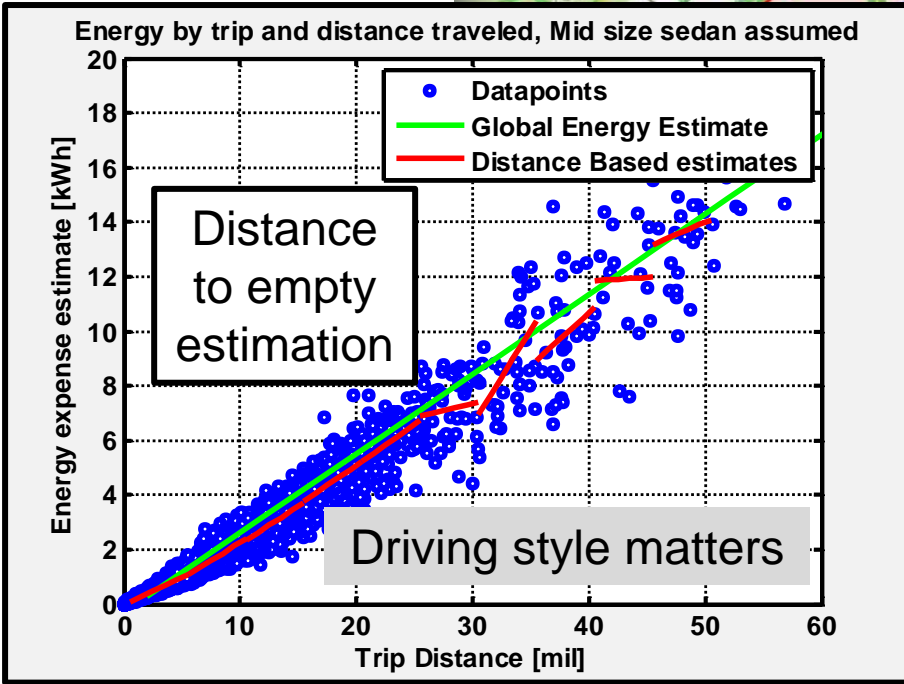
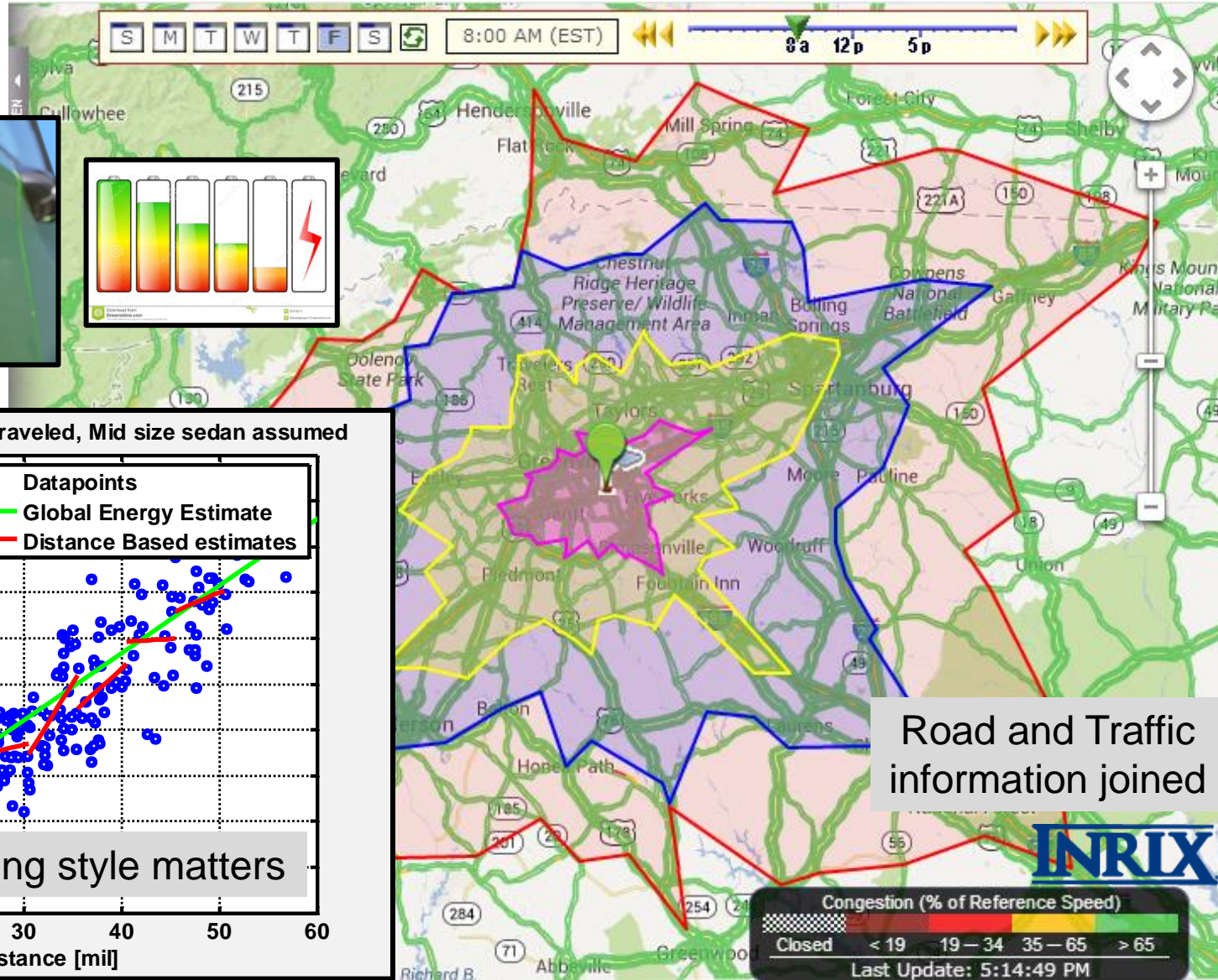
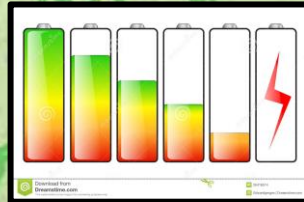
Component

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Driving

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# EV driving range estimation



Road and Traffic information joined

Component

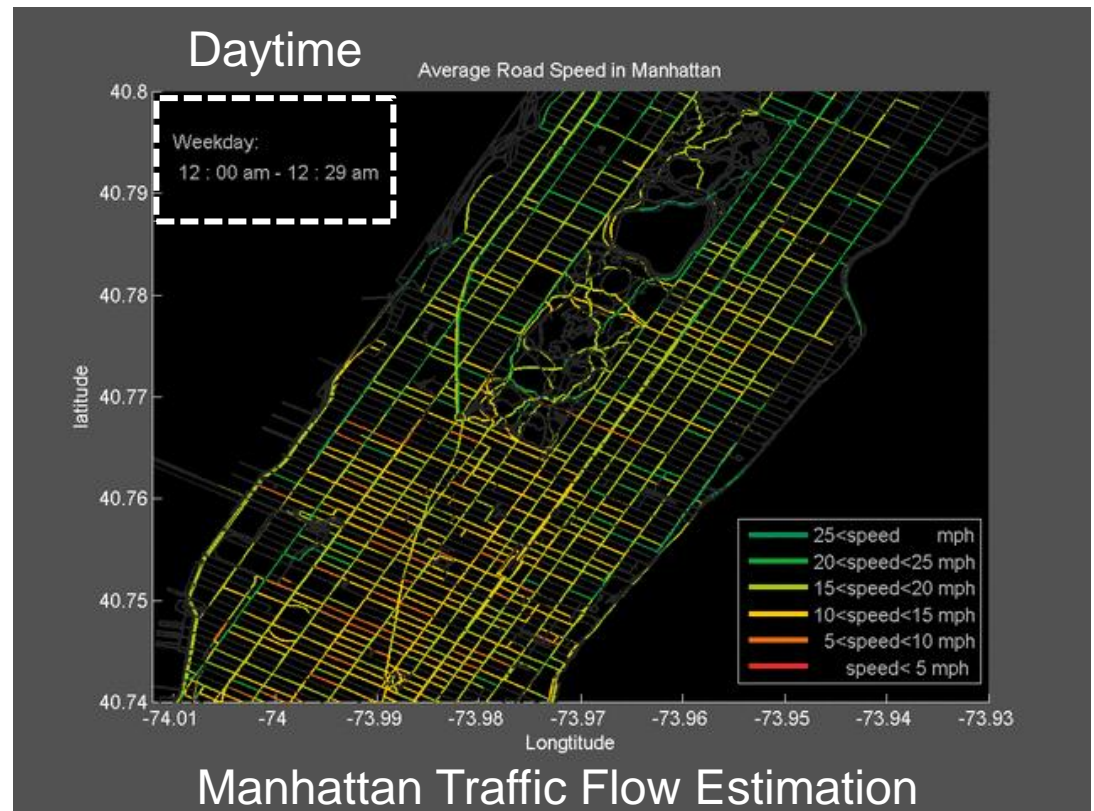
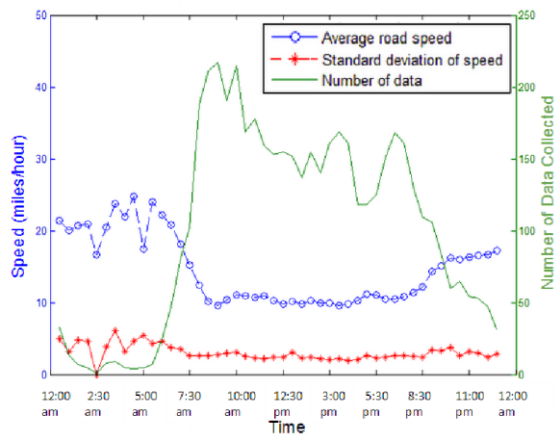
Vehicle

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# Traffic Flow Reconstruction and Routing

- Transportation Modeling
- Network Routing
- Traffic Allocation



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# System Level Perspective

Component

Vehicle

Driving

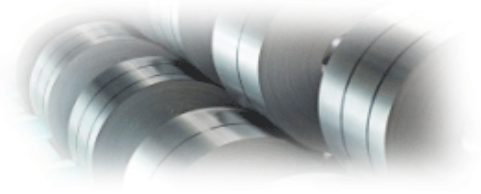
Infrastructure

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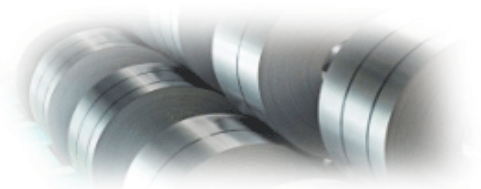




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