MD & HD VEHICLE RANGE ESTIMATION

Group Members
Anthony Rudasics[1],
Chia Agrawal[2],
Peter Ma[3],
Ruize Zhao[4]

MECHANICAL ENGINEERING[1]
UNIVERSITY of WASHINGTON

In Association With[1] PACCAR

BACKGROUND

- **Range Anxiety:** The worry that your electric vehicle (EV) will run out of battery before reaching your destination
- Range anxiety creates hesitancy in adopting medium duty and heavy duty EV's
  - E.g. Garbage trucks, semi trucks
- Maximizing range capabilities of EV's may reduce public range anxiety

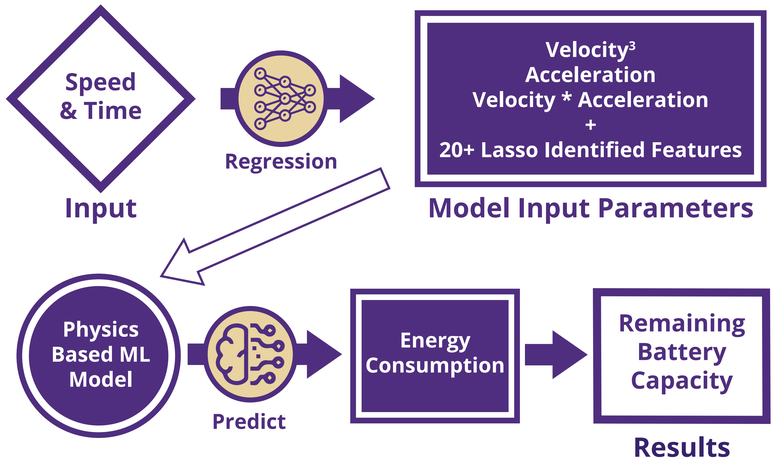
PROBLEM STATEMENT

PACCAR engineers need a more accurate way of estimating how much the components they choose for electric vehicles will effect the range capabilities of the final assembly.

DESIGN REQUIREMENTS

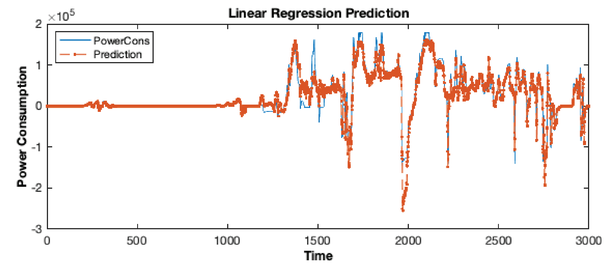
- Mathematical model based on collected sensor data
  - Data from real EV's
- Model applicable for a variety of trucks and use cases
  - E.g. pickup & delivery, city driving, highway driving
- Components or parameters of EV's are interchangeable for different results

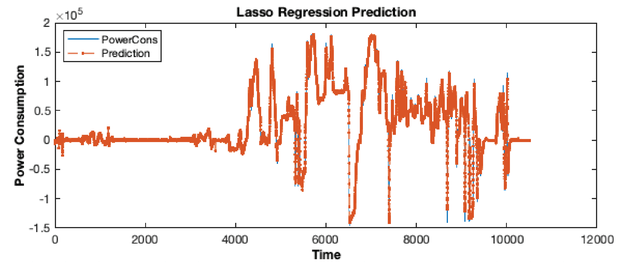
METHODS

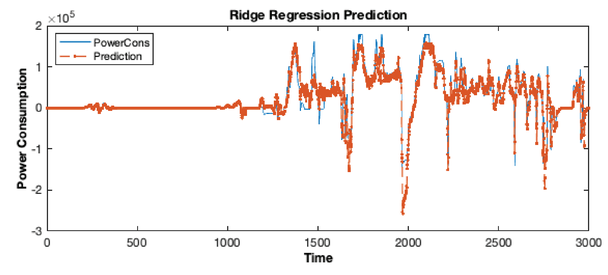


RESULTS – PREDICTION

The following plots use city route data for various regression methods.







FINDINGS

RMSE	City	Highway	P&D
Linear	22,354	30,979	17,538
Lasso	3,754	9,815	3,960
Ridge	22,436	31,131	17,566

★ Root-mean-square error (RSME) is a measure of error between the measured data and the prediction.

- Lasso identifies additional drive cycle variables for higher prediction accuracy
  - E.g. Pedal position, cruise control
- City vs Highway vs P&D predictability affected by nonlinear regenerative braking
- Regression coefficients validated by physics-based model

CONCLUSION

- The three regression models are all useful models for predicting range capabilities of EV's, with lasso producing least error

PATH FORWARD

- Develop a battery model based on battery characteristics to calculate state of charge
- Integrate current models with global positioning (GPS), topographic, and meteorological data for increased accuracy along predicted routes

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