

Vehicle Speed Optimization According to Energy and Time Minimization

Problem Definition & Significance:

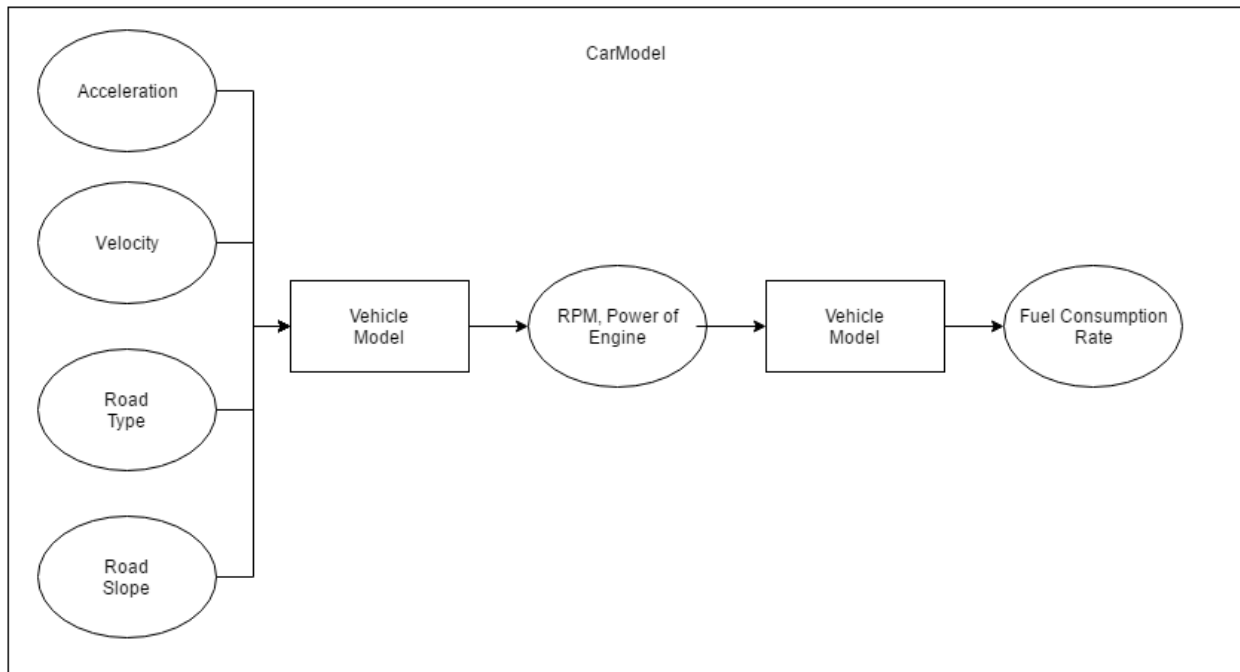
- Vehicles are one of the major sources of energy consumption, and are used by almost everyone, hence improving/reducing the energy consumption of vehicles is important.
- Some energy can often be saved by adopting certain operating strategies (energy friendly driving practices).
- Our problem statement entails selecting a particular road journey and by optimizing speed profile for minimum energy consumption and time, obtaining an optimum speed profile.
- The optimization will consider various constraints like signals, turns, traffic conditions etc, which will be added to the model.
- These recommended then can be potentially followed by the drivers, reducing the energy consumption.
- This profile might be especially useful for the driverless cars, which can follow such a given speed profile better.

Modelling Platform

Software used will be majorly MATLAB (or some other programming platform, if deemed more useful) for modelling as well as optimization. If a more suitable optimization package is available for MATLAB, we might use it.

Methodology:

We will use a car model constructed with the help of certain standard models (examples of some such possible sources can be found in references). This model will take inputs like velocity of car, acceleration of car etc, and many other small parameters: which will be obtained preferably from manufacturer's website, but if the data is absolutely not available, assumptions of model can be suitably used as a substitute.



Variables: Acceleration, Velocity, Road Type (Road Grade), Road Slope etc.

This fuel consumption model thus reconstructed (replicated) will be then used for finding optimum velocity profile, minimizing total fuel consumption (which is consequently minimum energy consumption) and minimizing total time of travel (a mixture of two objectives).

Constraints: Traffic, Turns, Speed limit, Signals etc.

For input data we have considered several standard models which have been taken from research papers for determining road profile and fuel consumption. They are mentioned in 'References'.

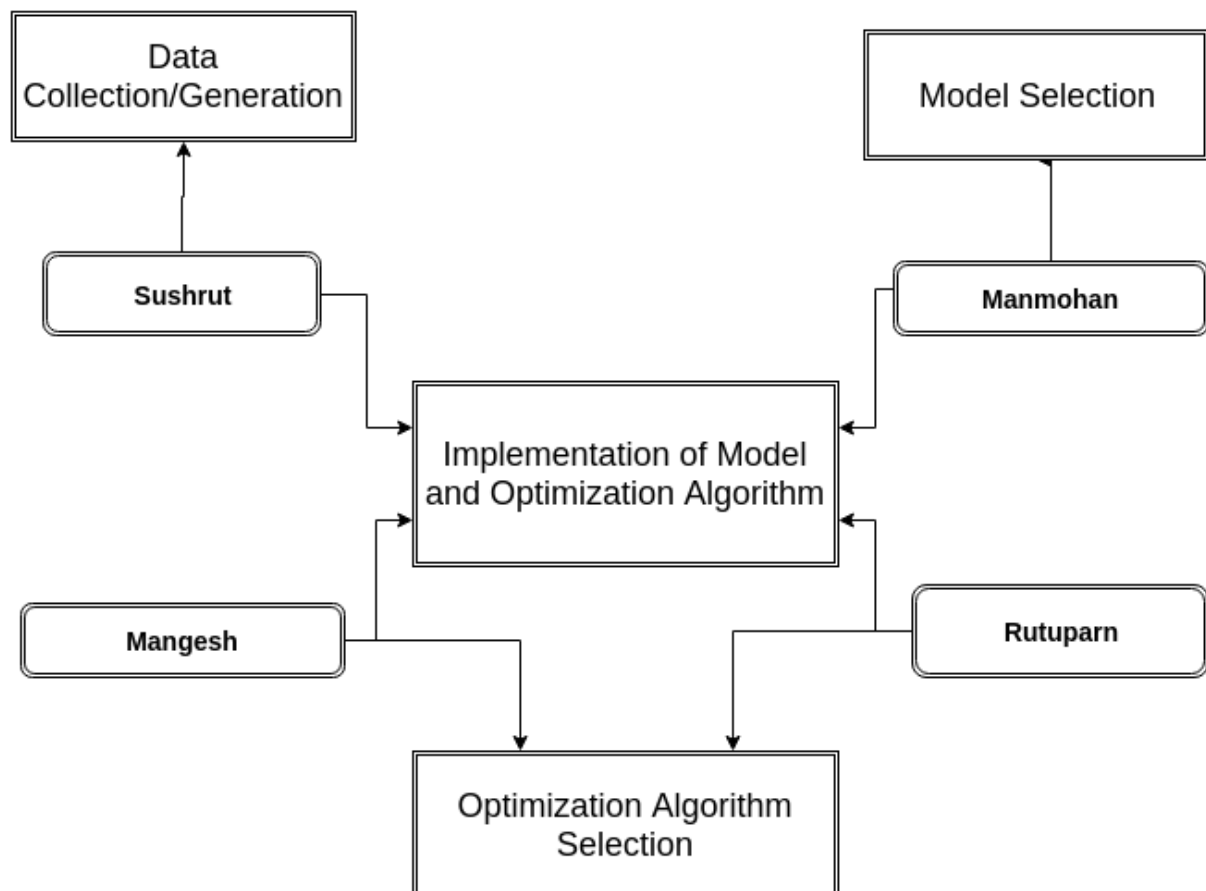
Validation:

In the end we are generating optimum velocity profile so that it minimizes either (a) travelling time or (b) fuel consumption. For validation we will generate multiple random velocity profiles, then for each velocity profile travel time and fuel consumption will be calculated. Travel time and fuel consumption obtained from our model has to be less than travel times and fuel consumption for all random velocity profiles.

Expected End-user (client) and usefulness:

1. Customers already using that particular vehicle can use our model to get a general idea about how their driving habits could potentially be improved.
2. Car companies which can use it to enhance future versions of the model for particular road types.
3. Self-driving car companies/projects e.g. Tesla, Google can use this model to add another factor to their self driving mechanism.
4. Car Navigator Companies/services/software, which can integrate this with their existing service(s) as an add-on feature.

Individual Contribution:



Timeline:

Aug 9-23	Topic selection and project write-up
Aug 24-Sept 4	Model selection, Data collection and generation
Sept 5-Sept 30	Model implementation
Oct 1 – Oct 15	Optimization algorithm selection, Implementation of optimization algorithm
Oct 15 – Oct 31	Further Implementation of optimization algorithm, Validation
Nov – 1	Final submission of course project
Nov – 4	Final presentation

Expected Insights/Value addition

-We will understand what factors affect vehicle fuel consumption, and what is the general nature of such relationships.

-We will understand about optimization algorithms.

-Such kind of analysis can potentially be extended to multiple roads/cars.

Work done till now

Topic selection and project write-up, Division of work

References:

1. Random road profile :
<http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.474.1875&rep=rep1&type=pdf>
2. Fuel Consumption Modeling of Conventional and Advanced Technology Vehicles in the Physical Emission Rate Estimator (PERE):
<https://www3.epa.gov/otaq/models/ngm/420p05001.pdf>
3. Heavy-Duty Diesel Vehicle Fuel Consumption Modeling Based on Road Load and Power Train Parameters:
http://collaboratory.ucr.edu/files/Diesel_Vehicle_Fuel_Consumption.pdf
4. Analytic Modeling of Vehicle Fuel Consumption:
<https://www.mdpi.com/1996-1073/6/1/117/pdf>

