Michigan Tech
MEEM/EE 4295: Introduction to Propulsion Systems for Hybrid Electric Drive Vehicles

HW-8, Vehicle Parameters
Posted: November 28nd, 2012
Due Date: December 5th, 2012

HW-8: In all the pervious homework assignments and quizzes, the vehicle parameters such as weight, drag coefficient, rolling resistance, cross sectional area, center of gravity, etc. were provided either as specific values or ranges of values. The bulk of the coefficients were used in the Linear Vehicle Dynamics model without actual validation of the numerical values of the variables.

The weight, tire radius, gear ratios, center of gravity may be determined from basic measurements, however, the rolling resistance (f_r) and drag coefficient (C_d) are difficult to measure and have a significant impact on the energy required during motoring.

For this homework, you will utilize the method developed by White and Korst (published in 1972) and presented in Lecture 32 to determine the rolling resistance and drag coefficient from coast down data (velocity versus time) and to gain an understanding of the influence of various parameters on the overall fuel economy. HW-8 is similar to HW-7 since a complete HEV model is not needed.

Initial Conditions:

V_o=26.822 meters/sec (same as 60 mph)

ρ= 1.24 kg/m^3

Table 1: General Vehicle Parameters.

Your last name starts with	Weight,, Newtons	Area,, meters^2	Tire Radius,, meters	Wheelbase,Meters L=variable	Front/Rear Weight Ratio	L/H Ratio, H=height to cg.	Coast –down file name
A-J	18,680	2.40	0.318	2.89	52.0	3.71	Velocity_AJ
K-P	16,100	2.45	0.318	2.89	52.0	3.71	Velocity_KP
Q-Z	13,400	2.10	0.303	2.61	51.5	3.93	Velocity_QZ

Using the velocity profile, approximate the rolling resistance and the drag coefficient. The value of β is determined by a "best fit" curve of normalized curves and is one source of error, another is the model reduction method.

General Output Requirements:

1) A complete write-up of the White and Korst method to determine rolling resistance and drag coefficient.
2) The values of rolling resistance, drag coefficient and the value of β.
3) Using the coefficients determined, provide at the minimum:
    a) plot velocity versus time for both the actual LVD model and the White and Korst reduced model.
    b) plot distance versus time for both the actual LVD model and the White and Korst reduced model.
    c) plot acceleration versus time for both the actual LVD model and the White and Korst reduced model.

Comment on the results.

Since both models are non-linear ODE's, you may want to use a Simulink model for the solution of the ODE and use Matlab for the plotting. If you use just Matlab to solve the ODE, use a Runge-Kutta or equivalent solution method.

Reference Material

The Determinations of Vehicle Drag Coefficients for Coast-Down Test, R.A. White, H.H. Korst, SAE Paper 720099.

SAE J1263: Road Lad Measurements and Dynamometer Simulation Using Coastdown Techniques. Issued 1979-06, Reaffirmed 1996-02

The Analytical Basis of Automotive Coastdown Testing, Thomas P. Yasin, Product Engineering, General Motors, SAE Paper 780334