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Design and Simulation of Electric Vehicle

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Abstract: ***This paper is all about Design of Electric Vehicle. The growing development in the field of Electric vehicle in the need of the hour. In effort to save the environment and reduce our dependence on foreign oil, we planned of designing an Electric vehicle which can be used in conversion of any basic IC engine vehicle. Rapid climatic change, advances in renewable energy, rapid urbanization, battery chemistry and energy security are the result of developing an electric vehicle. In this paper we have consider most of the design aspect of electric vehicle and checked the results using a simulation software named modelica. This software enables us to have various drive trains, load dynamics and torque analysis. The Electric vehicles are environmental friendly, less expensive low maintenance, tend to be quiet, potential for tax credits and benefits to the utilities. IC engines automobiles emit harmful gases which are dangerous to health on other hand the electric vehicles emit hardly any harmful gases.***

NOMENCLATURE

Keywords : Electric vehicle, optimization , Design Calculations, Modelica.

I. INTRODUCTION

THE Electric Vehicle are more environmentally friendly as there is practically no emissions, the energy emitted by EVs is 97 percent cleaner in terms of noxious pollutants, It has an advantage of providing powered at any engine speed. While the Internal Combustion Engines will have hundreds of moving arts, the EVs has motor which is the main reason why they are more efficient.The Electric motors are reliable because of its simplicity all the mots have only two basic components a rotor and a stator. The only maintenance is to check each cell electrolyte level and periodically refilling them with water. The Electric Vehicles are safe to environment because of zero emission. The Eclectic vehicle follows

1. Use of electricity to power.
2. Are zero emission vehicle.
3. Generate little toxic waste.
4. Require nontoxic inputs such as water and wash fluids.
5. Are highly efficient and benefits electric utilities.

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II. DESIGN OF ELECTRIC VEHICLE

A. *Weight Analysis*

1. Weight and accelerations

$F_a = C_i \times W_a$
$C_i = I + 0.04 + 0.0025(N_c)^2$

2. Weight and Climbing

When ou go uphill, you add another force
$F_h = W \sin Ø$
Degree of incline = 1%= Rise/Run
Angle of incline, Ø =Arctan(Rise/Run)=Artan0.01= abount 0 degrees and 34minutes.

Degree of Incline %	Angle of Incline Ø	SINØ	F_h (in pounds)
1	0 degrees 34 min	0.00989	9.9
2	1 degrees 9 min	0.02007	20.1
3	1 degrees 43 min	0.02996	29.6
4	2 degrees 17 min	0.04013	40.1
5	3 degrees 26 min	0.05989	59.9
6	4 degrees 34 min	0.07062	79.6
8	5 degrees 43 min	009961	99.6

Table to show various degrees of incline and Fh

3. Weight and Speed.

Although the speed involves other factors, it’s definitely related to weight. Horsepower and torque are related to speed
Hp=FV/550
Newton’s Second Law rearranged
a= (1/M) x F
and because M=W/g and F=550 x hp/V, the can be substituted to yield
a=550(g/V) x (hp/W)
Finally, a and v acan be integrated to give
V=550 x (g/a) x (hp/W)

4. Weight affects Range

Distance is simply sped multiplied by time.
D=Vt ; therefore D= 550 x (g/a) x (hp/W)t
So weight again enters the picture.

B. *Aerodynamic Drag Force*

The aerodynamic drag fore is expressed as
$F_d = (C_d A V^2)/391$
$F_{td} = F_d + C_w F_d$
Average values of 75 mph for average wind speed for 3 different C_{rw} values are

C_{rw} at average	C_w Factor at V=	C_w Factor at V=	C_w Factor at V=	C_w Factor at V=	C_w Factor at V=	C_w Factor at V=	C_w Factor at V=
Wind 7.5 mph	5 mph	10 mph	20 mph	30 mph	45 mph	60 mph	75 mph
1.2	3.180	0.929	0.299	0.163	0.159	0.063	0.047
1.4`	3.810	1.133	0.374	0.206	0.185	0.082	0.062
1.6	4.440	1.338	0.449	0.250	0.212	0.101	0.072

Tires

C. *Electric Motors*

Electric motors are inherently powerful, by selecting a design that deliver peak torque at or near stall; nearly all motor deliver near peak torque at zero rpm. Few other motors comes to this mechanical efficiency.

D. *Calculation Overview*

Design center operating point, beat 100mph speedster, a 20mph economy fler or 50 mph utility truck

Available engine Power = Tractive resistance demand

Plugging in the force equation you get

Force = $F_a + F_h + F_r + F_d + F_w$

Force = $C_1 W_{a+W}$ Sin Ø $+ C_r$ W Cos Ø $+ C_d A_v^2 + C_w F_c$

Force = C_r W Cos Ø + C_d $AV^2 + C_w F_d$

Horse power (hp)= (Torque x RPM)/ 5252

Wheel RPM = (mph x Revolutions/miles)/60

Hp_{wheel} = ($Torque_{wheel}$ x maph x Revolutions/ mile)/(5252x60)

Therefore

Hp_{motor}=($Torque_{wheel}$ x mph x Revolution (miles))/ (315120 x n)

Now you have to determine the Gear Ratio

Overall gear Ratio = RPM_{motor}/ Rpm_{wheel}

$Torque_{wheel}$ = $Torque_{motor}$ / (Overall gear Ratio x N)

$Speed_{vehicle\ (in\ mph)}$ = (RPMmotor x 60) /(overall gear ratio x Revolution / miles)

E. *Formulas*

- Hp = FV/550
- 88feet/s = 60mph
- Horse power (hp) = FV/375
- Horse power(hp) = (Torque x Rpm)/ 5252
- Wheel RPM = (mph x Revolutions/ miles)/ 60
- Power (kw) = 0.7457 x hp
- Stndard Gravitational constant (g) = 32.16 ft/sec^2
- Weight (w) = Mass (M) x g/32.16
- Torque = F(5280/2pei)/ (revolution/miles)
- $Torque_{wheel}$ = torque x (Overall gear ratio x overalldrivetrain efficiency)
- $Speed_{vehicle\ (in\ mph)}$ = (RPM x 60)/ (overallgear ratio x revolution/mile)

F. *Modelica Simulation Results*

This model considers, battery model and behavior, power train losses, braking can occur with either power train and mechanical brakes, power train have limits in the torque and power they can deliver or absorb

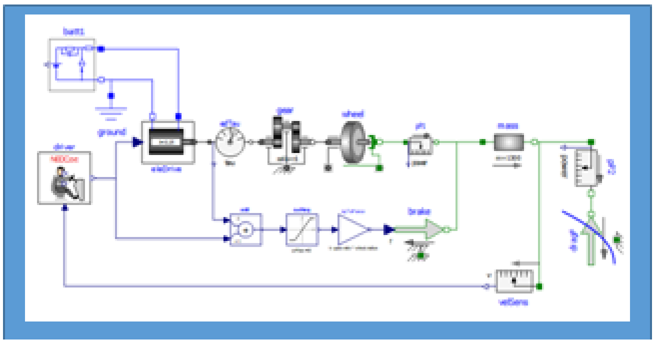

Figure : Electric vehicle Model

Modelling of Battery

Our battery will have the given model structure. The model consist of an electromagnetic force E, R-C network, a parasitic current Ip- The charge stored in the battery is the integral of current flowing through E, while integral of IP is charge is lost. We take E is proportional to the stored charge. Therefore E itself can be substituted b a capacitor, having a very large capacitance, and a voltage equal to the so called open circuit voltage (OCV) ie the voltage that can be measured when the battery is disconnected from the outside circuit, and has stayed disconnected for a while, therefore that capacitor will still partially charged even when the battery is discharged. Ip is taken as being a fixed fraction of the absolute value of the current lowing through the terminal drive train.

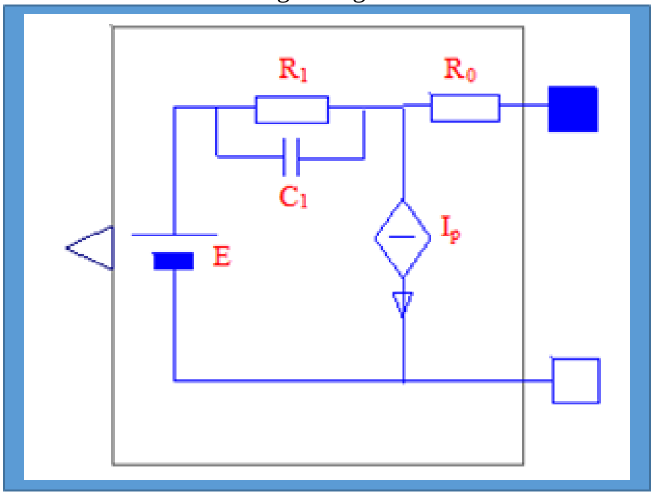

Figure : Battery model.

It is to be noted that the sum of torque is automatically made by modelica software, since toque is a flow variable an flow variables are automatically summed up when several connectors are connected to each other. Here, the required braking force is non – zero only when electric braking from elecdrive is insufficient.

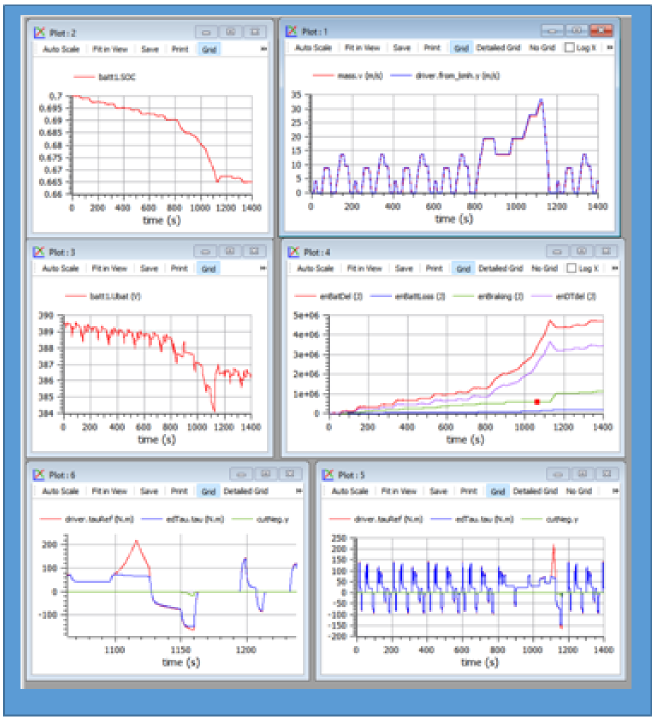

Figure : Simulation results

- Plot top left contains the battery state of charge (50C).
- Plot top right compares actual (red)and desired speed, and shows that they are very near to each other.
- Plot middle left contains the battery voltage.
- Bottom plots show torque (red), torque delivered by the electric drive (green) torque corresponding to mechanical braking force (blue).

Note : positive torque above 100Nm are requested but not delivered. This is common in vehicle; whenever drives request torque that are larger than maximum available and it this case has no practical effect on the desired speed.

Negative torque are nearly always obtained with electric braking; mechanical braking here occur only at the final deceleration of the extra urban part.

Plot in the middle right shows energies. In this case energies are obtained using direct equations.

Applications and extensions.

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REFERENCES

1. M. Ceraolo: New Dynamical Models of Lead-Acid Batteries , IEEE Transactions on Power Systems, November 2000, Vol. 15, N. 4, pp. 1184-1190.
2. M. Ceraolo, A. Caleo, P. Capozzella, M. Marcacci, L. Carmignani, A. Pallottini: A Parallel-Hybrid Drive-Train for Propulsion of a Small Scooter , IEEE Transactions on Power Electronics, ISSN: 0885-8993, Vol. 21, N. 3, May 2006, pp768-778.
3. M. Ehsani, Y. Gao, A. Emadi: Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design , CRC Press, 2009, ISBN 9781420053982
4. Toyota documentation http://www.evworld.com /library /toyotahs2.pdf, May 2003, file available for download on June 2017
5. M. Ceraolo, T. Huria, G. Lutzemberger: Experimentally determined models for high-power lithium batteries , Book Advanced battery technology, ISBN: 978-0-7680-4749-3 doi:10.4271/2011-01-1365. Also presented at the SAE 2011 World Congress. Cobo Center Detroit, Michigan (USA), 12-14/4/2011.

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