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Performance Analysis of Drive Train Configurations using ADVISOR

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Abstract --The use of fuel has become more widen these days and the world us now shifting to those means of consumption of energy, which are the most efficient and ensures less emission to the universe. The HT is also one of those technologies by using which the fuel consumption becomes fewer and there is less threat to atmosphere too. This paper is also one step towards the understanding of hybrid technology. This technology is more energy efficient but an expensive technology. So, there should be something by using which one can escape from the experimental cost of his project. So, NREL of US in late 1990s took a vital step in this regard and made an analyzing tool which could run in MATLAB's library named ADVISOR it is also well refined GUI. The important part of this software is get information's regarding HEV's By using this one can analyze that what selection of drive train component is most efficient at provided Drive Cycle. This is the main theme on which we are working in our project. We are analyzing one small car with different specifications, at same drive cycle and constant road grade to optimize that which selection is most efficient and consistent.

Keywords: (NREL) National Renewable Energy Laboratory, (ADVISOR) Advance Vehicle Simulator, (HT) Hybrid Technology, (GUI) Graphical User Interface, (HEV's) Hybrid Electric Vehicles.

1: INTRODUCTION

The Advanced Vehicle Simulator (ADVISOR) developed by the National Renewable Energy Laboratory is the most recent of the HEV simulation tools. The code operates in the MATLAB/SIMULINK visual block diagram programming. It contains the wide range of features and broad flexibility necessary to model any type of HEV or ICE vehicle, with a minimum of change. As with many of the simulating software, ADVISOR can utilize a variety of custom and standard driving cycles. It can predict the fuel economy, emissions, acceleration, and grade sustainability of a given vehicle and plot or data log any number of intermediate and final values.

Another particularly convenient feature unique to ADVISOR is the well-refined graphical user interface (GUI) which allows the user to easily select from a list of custom or predefined base vehicles, interchangeable components, driving cycles, and outputs. Finally ,the components and control strategy can be run through the standard MATLAB optimization routines to determine the ideal operating conditions for a particular configuration.

1.1: Advisor Structure

Advisor has a three window graphical user interface (GUI).With the GUIs, the user can iteratively evaluate the impacts of vehicle parameters and drive cycle requirements on the vehicle performance, fuel economy, and emissions. The GUIs facilitate interaction with the raw input and output data that is present in the MATLAB workspace.

The vehicle model is depicted graphically using Simulink block diagrams to define the connections between components. The model then reads the input data from the MATLAB work space during the simulation and outputs the results to the workspace to be viewed in the results window.

2: LITERATURE

The software ADVISOR is used for Advance Vehicles Simulator consisting different models with built in specifications, It was ist developed by NREL's in November 1994.The purpose of this designed is to analysis and to get help in order to understand hybrid electric vehicles (HEVs) behaviors and interactions with their components [1].

Advisor is a type of modern Vehicles Simulator having forward facing approach including driver model. It also consists of built in drive train with the entire components list available to perform tests for the emissions, fuel economy etc [2].

The simulator ADVISOR has an ideal structure with having capability of interchanging various components different modern controlling strategies. This software has been tested by considering different commercials and student based projects of HEV's

from top ranked engineering institutions of the world such types of software's ensures their importance in the field of mechanical and auto mobile engineering fields [3].

In this thesis the author consider distinct hybrid vehicles models and studied, a fuel economy, battery hybrid and combustion engine internal part in order to check their drive and power train performance. Many models are already built in to perform the tests .By improving modeling accuracy and adding more modern tools the importance of this software can be increased in auto mobiles and especially in hybrid vehicles industry [4].

In this paper author discuss different methods of modeling by using distinct tools like Power train System Analyses Tool kit (PSAT) and Advanced Vehicle Simulator (ADVISOR).Few other examples of such systems are also explained through applications like PSIM, Virtual Test Bed [5].

Hybrid electric vehicles (HEVs) having higher economy of fuel and low emissions of hazardous gasses and pollution injurious to health and environment, which is one of the main reason for the HEV's to be more successful as compared to conventional vehicles. Other important factors are also admire able like control handling , driving performance, battery bank for backup in case of running out of fuel and much more. In this paper work few necessary tests are conducted for both conventional and hybrid electric vehicles to compare and judge their performances [6].

3: PROBLEM STATEMENT

In this project we are going to analyze performance of conventional vehicle with hybrid electric vehicle. In this regard we select different input parameters and conduct multiple tests like Acceleration test, Grad ability test, Energy Storage test and simulate their responses to analyze the output parameters which determine the overall Vehicle performance.

4: Conventional Vehicle Hybrid Vehicle models and Components

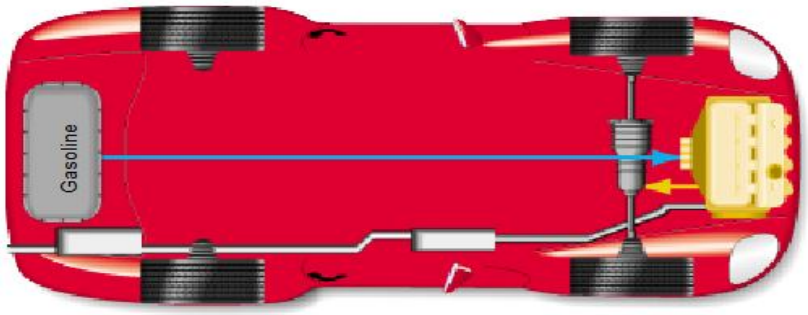

Fig: No 1: Conventional Vehicle model

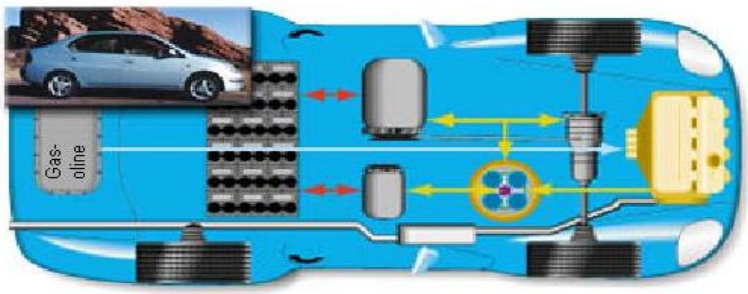

Fig: No 2: Hybrid Vehicle model

	CONVENTIONAL	HYBRID		CON	HYB	CON	HYB	CON	HYB
LOAD FILE	CONVENTIONAL_DEFAULTS_IN	PRIUS_JPN_DEFAULTS_IN							
DRIVE TRAIN CONFIGURATION	CONVENTIONAL	PRIUS_JPN							
VEHICLE	VEH_SMCAR	VEH_PRIUS_JPN	SMALL CAR					918	918
FUEL CONVERTER	FC_ SI141_EMIS	FC_ PRIUS_JPN	FUEL CONVERTOR SPARK IGNITION 41KW	41	43	0.34	39	131	137
EXHAUST AFTER TREAT	EX_SI	EX_SI						11	11
ENERGY STORAGE	NA	ESS_NMH6	NA	NA		NA		NA	275
MOTOR CONTROLLER	NA	MC_ PRIUS_JPN	NA	NA	31	NA	91	NA	57
GENERATOR	NA	GC_ PRIUS_JPN	NA	NA	15	NA	84	NA	33
TRANSMISSION	TX_5SPD	TX_ PRIUS_CVT_JPN				1		114	
WHEEL/ AXEL	WH_SMCAR	WH_ PRIUS_JPN							
ACCESSORY	ACC_CONV	ACC_ PRIUS_JPN							
POWER TRAIN CONTROL	PTC_CONV	PTC_ PRIUS_JPN	POWER TRAIN CONTROL						
CALCULATED MASS		PRIUS_JPN_DEFAULTS_IN						984	1332

TABLE :NO 1: COMPONENTS DETAILS AND DESCRIPTIONS OF CONVENTIONAL AND HYBRID VEHICLES

Most of the components present in both but few often only available in hybrid vehicle. We will perform frequent tests on each vehicle separately to check out their parameters and response. The same drive train of Indian high way is considered.

5: DRIVE CYCLE SELECTION

Indian Highway

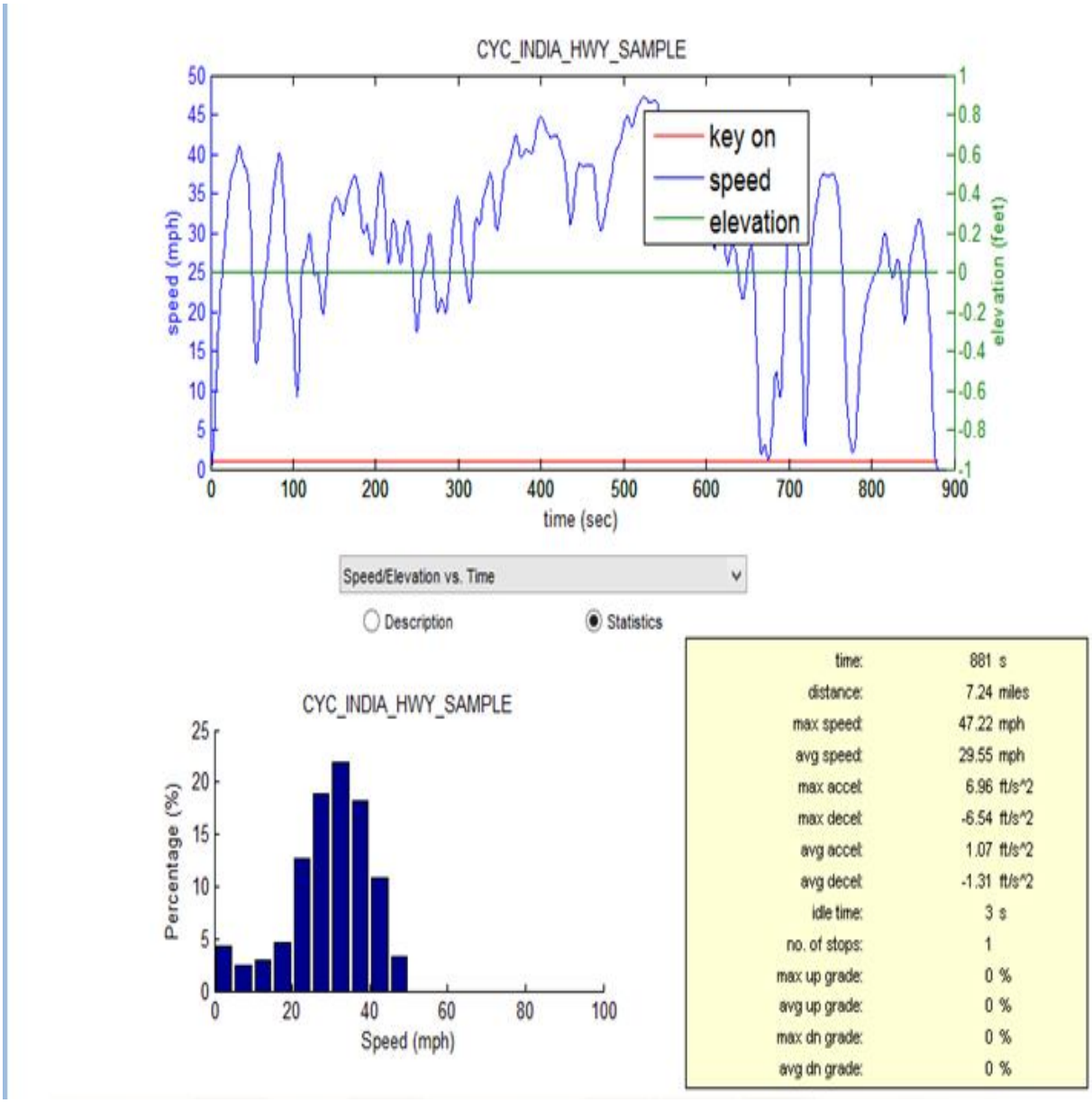

Fig: No 3: Drive cycle description

6: PARAMETRIC STUDY

By applying this test we can study relationship between two or three parameters of any vehicle configuration. The standard values of some vehicle parameters are given below.

Sr. no	Variable	Description	Conventional	Hybrid
1.	acc_elec_pwr	AC Electric Power	0	700
2.	acc_elec_eff	Electrical efficiency	1	1
3.	Acc_mech_eff	Mechanical efficiency	1	1
4.	Ess_max_volts	Energy storage system maximum voltage	NA	9 V
5.	Ess_min_volt	Energy storage system minimum voltage	NA	6 V
6.	Mc_mass	Motor controller mass	NA	56.75 kg
7.	Mc_max_crrnt	Motor controller maximum current	NA	120 A
8.	Mc_min_volt	Motor controller minimum voltage	NA	60 V
9.	Veh_mass	Vehicle mass	984 Kg	1368 Kg
10.	Wh_radius	Wheel radius	0.282 m	0.287 m
Table :No 2: parametric study of conventional and hybrid vehicles				

7: CONVENTIONAL OUTPUT

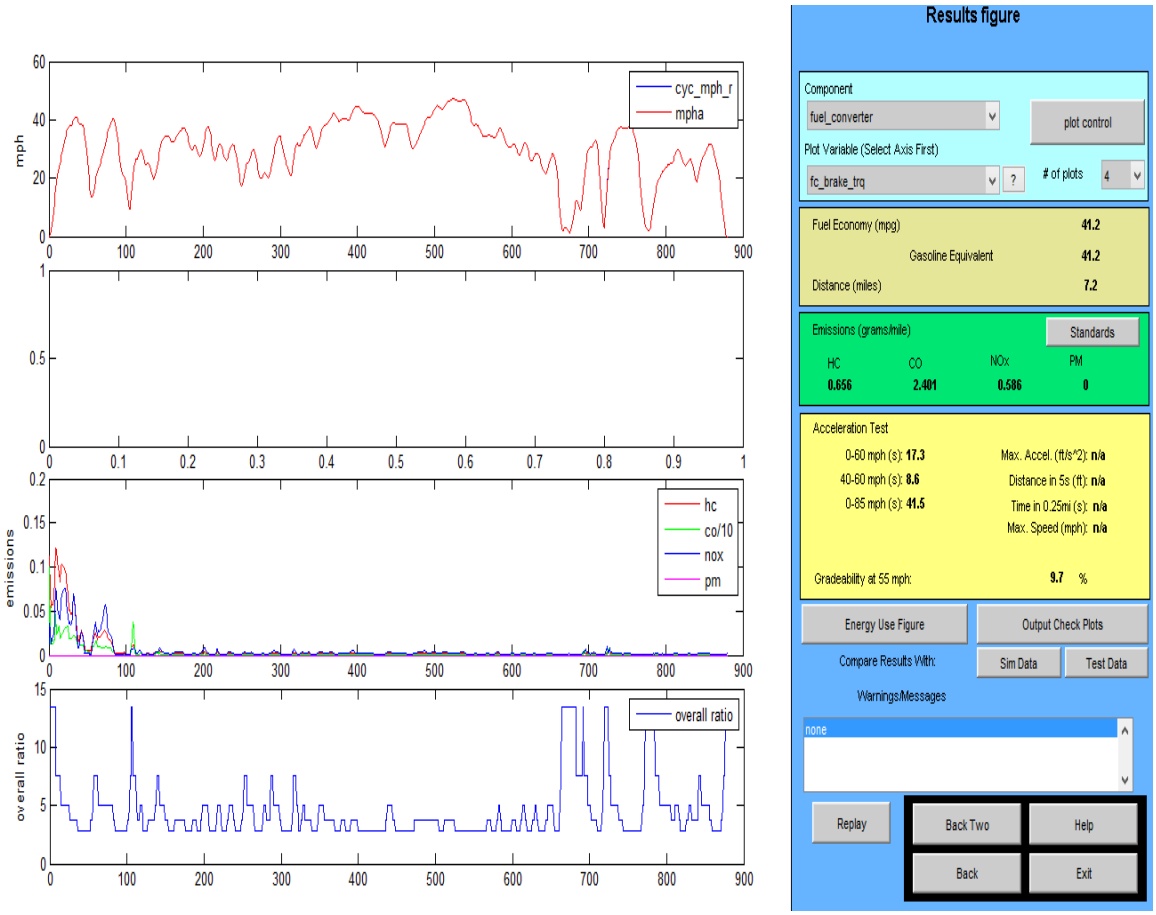

Fig: No 4: Complete output for conventional Vehicles

8: HYBRID OUTPUT

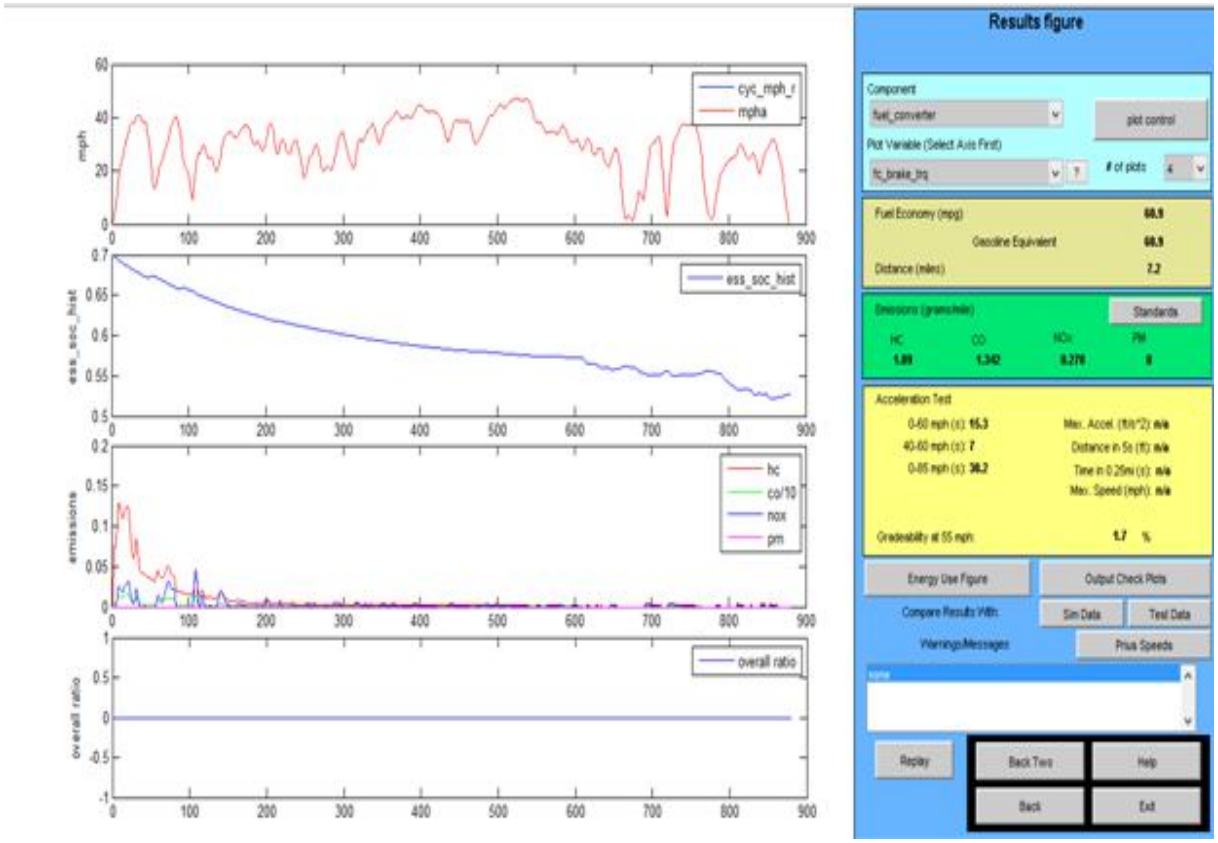

Fig : No 4: Complete output for Hybrid Vehicle

Outputs

Mph

According to drive cycle the maximum attained speed is approximately 47.2 mph.

Emissions

In the emissions graphs of both vehicle we can see that the emission rate of hybrid vehicle is much less as compare to conventional vehicle. Test shows

Acceleration

Outputs shows acceleration of hybrid vehicle is much faster and quick as compared with conventional non hybrid vehicle as u can see in result chart that in all cases acceleration time of hybrid is less as compared with Conventional. .

9: COMPARISON

Drive Train	Fuel Emissions			Fuel Economy			Acceleration Time		
	HO	CO	NO	MPG	Gas Equivalent	Distance (Miles)	0-60 MPH	40-60 MPH	0-85 MPH
Conventional	0.605	2.282	0.478	49.7	49.7	7.2	17.3 (s)	8.6 (s)	41.5 (s)
Hybrid	1.09	1.342	0.278	60.9	60.9	7.2	15.3(s)	7(s)	30.2(s)

10: RESULTS & CONCLUSIONS

By summarizing all the domino effects came by our all working on ADVISOR we can say that rating of Drive train components used in Car 2 are better than that of Drive train components used in Car 1.Hybrid Vehicles are more safer and reliable regarding fuel economy and dangerous emissions of gasses to environment which led many issues and diseases.

References

[1]"ADVISOR 2.0: A Second-Generation Advanced Vehicle Simulator for Systems Analysis" Keith Wipke, National Renewable Energy Laboratory (NREL) 1617 Cole Blvd. Golden, CO http://www.ctts.nrel.gov/analysis.
[2]" ADVISOR 2.1: A User-Friendly Advanced Power train Simulation Using a Combined Backward/Forward Approach" by Matthew R. Cuddy, and Steven D. Burch in 1999.
[3]" Validation of ADVISOR as a Simulation Tool for a Series Hybrid Electric Vehicle Using the Virginia Tech Future Car Lumina" by Randall Donn Senger in September 18, 1997 Blacksburg, Virginia. Revised March 11, 1998..
[4]" Modeling and Simulation of Hybrid Electric Vehicles" By Yuliang Leon Zhou, University of Science & Tech. Beijing, 2005.
[5]'Modeling and Simulation of Electric and Hybrid Vehicles" by Gao, D.W. Dept. of Electr. & Comput. Eng., Tennessee Technol. Univ., Cookeville, TN , Volume:95 Issue:4 IEEE explore.
[6]"Design and Optimization of Hybrid Electric Vehicle Drivetrain and Control Strategy Parameters Using Evolutionary Algorithms" Desai, Chirag (2010*)* Design and Optimization of Hybrid Electric Vehicle Drivetrain and Control Strategy Parameters Using Evolutionary Algorithms. *Masters thesis, Concordia University.*

