\documentclass[journal]{IEEEtran}

\usepackage{graphicx}

% correct bad hyphenation here

\hyphenation{op-tical net-works semi-conduc-tor}

\begin{document}

\title{Power Split Energy Management}

\author{Mohemmad~Inam,Thirumurugan~Dinesh,and~Vivek~K.}% <-this % stops a space

% The paper headers

\markboth{SEMINAR ELECTROMOBILITY SS 2015}%

{Shell \MakeLowercase{\textit{et al.}}: Bare Demo of IEEEtran.cls for IEEE Journals}

% make the title area

\maketitle

\begin{abstract}

The depleting fuel resources and stringent pollution norms requires new technological developments. A Hybrid Vehicle uses two energy medium for propelling, usually a conventional engine and coupled with battery powered electric motor. The optimization can be obtained by controlling the power flow between the engine, motor and battery. A mild Hybrid vehicle is considered here for which an energy management system is developed using the rule based strategy, where it is used to minimize the fuel conception and sustain state of charge of battery for the considered two driving cycles (NEDC in Europe and FTP-75 as in US) by providing conditional constraints respectively. The tool considered is MATLAB with simulink. The results of simulation are interpreted and reported.

\end{abstract}

\begin{IEEEkeywords}

IEEE, IEEEtran, journal, \LaTeX, paper, template.

\end{IEEEkeywords}

\IEEEpeerreviewmaketitle

\section{Introduction}

\IEEEPARstart{S}{ince} 90’s the discussion over the degrading environment factor of pollution, global warming and usage of non – renewable resources lead to the technology of electric driven vehicles, which solves the above problems since its economic friendly, the power extraction can be renewable and no greenhouse gas emissions[1][2]. But the electric driven vehicles had the limitations such as, Short Driving Range and Speed, limited battery life cycle , higher weight and high production , maintenance cost.[2]\\

\subsection{Parallel Hybrid Electric Vehicle}

The Hybrid Vehicle uses two energy source for propelling , i.e, Electric motor combined with an internal combustion engine. This vehicle can run on just the engine, just the batteries, or a combination of both.[3]\\

The Architecture for the Parallel Hybrid Electric Vehicle can be show as in Figure [Fig.1]\\

\begin{figure}[h]

\centering

\includegraphics[scale=.45]{Architech}

\caption{Architecture of the Parallel hybrid electric vehicle[6]}

\end{figure}

In mechanical-hybrid and parallel hybrid-electric vehicles, the mechanical power outputs from different power sources are combined using various devices that can be generically called "\textbf{torque couplers}." These include three-sprocket gears driven by belts or chains or direct coupling on the same shaft. The case of different prime movers that power different wheel axles is straightforward and not considered here.\\

Torque coupling[Fig.1] is implemented in full parallel hybrids. It consists of mounting the rotor of the electric machine on the same engine shaft, between the engine and the final drive. The stator is mounted on the outer transmission housing or on a separate intervening housing. This mounting allows the electric machine to be used as a damper to cancel oscillations at the drive train.\\

The\textbf{ Torque-Split Ratio} of $T\_{EM}$ to $T\_{MGB}$ and is characterized by the equation\\

\begin{center}

$u =\frac{{T\_{EM}}} {{T\_{MGB}}}$

\end{center}

Where $T\_{EM}$ is motor Torque, and $T\_{MGB}$ is Torque on the fly wheel.The torque-split ratio characterizes the operation modes.\\

Where various power split concept is used get a reduced fuel conception which can be achieved by optimizing the power flow between the engine, the motor and the battery. The control strategies are defined as the algorithm which is used at each sampling time to power split between engine and electric motor.\\

The power split provides different modes of flexibility to the powertrain as following :\\

Electric Vehicle Mode: The engine is off, and the battery provides electrical energy to power the motor (or the reverse when regenerative braking is engaged). Used for idling as well when the battery State of charge (SOC) is high.\\

Cruise Mode: The vehicle is cruising (i.e. not accelerating), and the engine can meet the road load demand. The power from the engine is split between the mechanical path and the generator. The battery provides electrical energy to power the motor, whose power is summed mechanically with the engine. If the battery state-of-charge is low, part of the power from the generator is directed towards charging the battery.\\

Overdrive Mode: A portion of the rotational energy is siphoned off by the main electric motor, operating as a generator, to produce electricity. This electrical energy is used to drive the sun gear in the direction opposite its usual rotation. The end result has the ring gear rotating faster than the engine, albeit at lower torque.\\

Battery Charge Mode: Also used for idling, except that in this case the battery state-of-charge is low and requires charging, which is provided by the engine and generator.\\

Power Boost Mode: Employed in situations where the engine cannot meet the road load demand. The battery is then used to power the motor to provide a boost to the engine power.\\

Regenerative Braking: during braking or deceleration, energy can be recuperated into the battery by using the electric motor as a generator.\\

This Paper presents a heuristic control strategy (Rule Based)[2][7]. This rule based control strategies are mostly based on ‘IF else’ type of control rules defined for different operations modes. Each driving mode uses different parametric functions which are dependent on the different driving conditions (Driving cycles, vehicle, state and power ratio).\\

Here the following simulation is discussed for two driving cycles 1) New European Driving Cycle (\textbf{NEDC}) for usage regulation in Europe, 2) Federal Test Procedure, commonly known as \textbf{FTP-75} defined by the US Environmental Protection Agency (EPA).\\

\subsection{Driving Cycle}

A driving cycle commonly represents a set of vehicle speed points versus time. It is used to assess fuel consumption and pollutants emissions of a vehicle in a normalized way, so that different vehicles can be compared. The driving cycle is performed on a chassis dynamometer, where tailpipes emissions of the vehicle are collected and analysed to assess the emissions rates.\\

In commercial vehicles area, the driving cycle is not performed on a vehicle dynamometer but on an engine dynamometer and is evaluated through a set of engine torque and speed points instead of vehicle speed points.\\

There are two kinds of driving cycles, the Modal Cycles as the European standard NEDC, and the Transient Cycles as the FTP-75. Main difference is that modal cycles are a compilation of straight acceleration and constant speed periods and are not representative of a real driver behaviour, whereas transient cycles involve many speed variations, typical of on-road driving conditions.[5]\\

The\textbf{ NEDC }is used as reference cycle for homologating vehicles until Euro6 norm in Europe and some other countries. It is made of an urban part called \textbf{ECE}, which is repeated four times, and an extra-urban part, the EUDC.The cycle must be performed on a cold vehicle at 20–30 °C (typically run at 25 °C).\\

\begin{figure}[h]

\centering

\includegraphics[scale=.30]{NEDC}

\caption{EU New European Driving Cycle (NEDC)[6]}

\end{figure}

Urban Driving: The cycle has been designed to represent typical driving conditions of busy European cities, and is characterized by low engine load, low exhaust gas temperature, and a maximum speed of 50 km/h.\\

The cycle ends on 195 s after a theoretical distance of 994.03 meters, then it repeats four consecutive times. Total duration is 780 s (13 minutes) over a theoretical distance of 3976.1 meters, with an average speed of 18.35 km/h.[5]\\

Extra-urban driving: This has been designed to represent more aggressive, high speed driving modes. The maximum speed of the EUDC cycle is 120 km/h; low-powered vehicles are limited to 90 km/h.\\

Total duration is 400 s (6 minutes 40 s econds) and theoretical distance is 6956 meters, with an average speed of 62.6 km/h.[5]

The combined fuel economy is calculated by a total consumption of urban and extra-urban cycles over the total distance (theoretical 11023 meters).\\

The total test time amounts to 1180 s with an average speed of 33.6 km/h. Sometimes the NEDC is also quoted at 1220 s, which includes the initial 40 s with the vehicle at standstill and combustion engine off.[6]\\

The \textbf{FTP} \textbf{Cycle} (for Federal Test Procedure) has been created by US EPA (Environmental Protection Agency) to represent a commuting cycle with a part of urban driving including frequent stops and a part of highway driving.\\

\begin{figure}[h]

\includegraphics[scale=.30]{FTP}

\caption{US EPA Federal Test Procedure (FTP-75)[6]}

\end{figure}

In 2007, EPA decided to add more cycles to the existing ones, in order to better reflect real world driving conditions.

The "city" driving program of the EPA Federal Test Procedure is identical to the UDDS Urban Dynamometer Driving Schedule plus the first 505 seconds of an additional UDDS cycle.[5]\\

Then the characteristics of the cycle are: Distance travelled: 17.77 km (11.04 miles), Duration: 1874 seconds ,Average speed: 34.1 km/h (21.2 mph), Maximum speed 91.2 km/h.[6]\\

\subsection{Vehicle Specification}

The energy management system is developed for Mercedes-Benz A 170 CDI of kerb weight 1115 kg powered by the diesel engine of 60 kW, 187 Nm, 4200 rpm, 1698 cm³.

A Permanent magnet synchronous motor with 12 kW, 60 Nm, 7639 rpm is added with the engine for hybrid configuation with Lithium-ion battery (16.38 kW, 0.468 kWh, 46.8 V, 13 mΩ, data from datasheet),A 5 speed Manual gearbox is mated with

Friction clutch for the drive.

\section{Fundementals}

The graph [Fig.4] describes the energy management system characteristic for a parallel hybrid vehicle. The abscissa represents the angular speed of flywheel and the ordinate represents the torque measured at flywheel, the product of which gives the power. At low power requirements, the vehicle is electric power driven using the battery charge (u=1). An increase in torque required beyond the threshold torque by the driver, shifts the drive into load point shift-Motor mode (u>0). Subsequently a drop in the threshold torque puts the drive in LPS generator mode (u<0). When the power required is higher, the vehicle is driven in conventional drive using the internal combustion engine (u=0).

\begin{figure}[h]

\centering

\includegraphics[scale=.25]{Ugraph}

\caption{Driving Characterstics of a Parallel Hybrid Electric Vehicle[6]}

\end{figure}

The parameters considered for the designing the controller are state of the engine and torque split ratio. $State\_{CE}$ describes the state of internal combustion engine, 0 denotes engine OFF, 1 denotes engine ON.\\

The Conditional constraints for operating modes are as follows,\\

Load Point Shifting:\\

$T\_{MGB} > 0$ and $0 <= u < 1 $ Motor Mode\\

$T\_{MGB} > 0$ and $u < 0$ Generator Mode\\

Regeneration:\\

$T\_{MGB} < 0$ and $u = 1$ Regenerative \\

$T\_{MGB} < 0$ and $0 <= u < 1$ Regeneration + Friction\\

Electric Driving:\\

$T\_{MGB} > 0$ and $u = 1$ Electric Driving Mode\\

\subsection{Rule Based Stratergy}

Rule based strategy[2][7] is based on heuristics, intuition, human expertise and even mathematical models [2]. It is very effective in real time supervisory control of power flow in power train. The advantage of this strategy is that it doesn't require previous knowledge of complete Driving cycle so it can be easily implemented practically.\\

Heuristics controls is based on Boolean Algebra or Fuzzy rules. The Rule Based stratergies operate on the If Else, switch statements. Rules can be calibrated for each driving conditions in the required driving cycles.\\

\subsection{Controller}

The EMS developed for the considered vehicle is based on the vehicle conditions i.e. static or dynamic. The start stop system is integrated into the static controller. Other operating conditions like CD and ED are implemented in controller for dynamic conditions.

The input parameters considered are as follows,\\

1. Battery charge\\

2. Vehicle speed\\

3. Gear ratio\\

4. Troque measured at flywheel\\

5. Angular accleration \\

6. Angular velocity\\

\section{Modeling and Simulation}

The system modeling is done on simulink utilizing the QSS toolbox. The EMS is designed in the control unit block.\\

In this model, there are two interpreted MATLAB functions in controller block, one is exclusively used for Engine Start/Stop and second is used for implementing all other dynamic functions.\\

The threshold torque $(T\_{MGB,th})$ for NEDC and FTP-75 cycles is optimised and were concluded to produce good results at 59.5 Nm and 33.5 Nm respectively,

The operating modes for the system modeling are,\\

\subsection{Start / Stop}

In automobiles, a start-stop system or stop-start system automatically shuts down and restarts the internal combustion engine to reduce the amount of time the engine spends idling, thereby reducing fuel consumption and emissions. This is most advantageous for vehicles which spend significant amounts of time waiting at traffic lights or frequently come to a stop in traffic jams. Start-stop technology may become more common with more stringent government fuel economy and emissions regulations.\\

In this method a separate interperted Matlab function for the start/stop isused sepeartely, for which the following constraints and input considered are as follows,\\

$|T\_{MGB}| <= T\_{EM,max}$\\

Where $T\_{MGB}$ is the torque of the flywheel, and $T\_{EM,max}$ is the torque of the electric motor. \\

$Q\_{BT} > 0.25 \* Q\_{BT,MAX}$\\

Where $Q\_{BT}$ is the Current charge of the battery and $Q\_{BT,MAX}$ is the maximum charge fo the battery. Hence for which the current charge must not fall below the 25 percent of the maximum charge of the battery.\\

If both of the given conditions are true then the state of the combustion engine is said to in OFF condition,\\

$state\_{CE} = 0 $\\

Else the state of the combustion Engine is said to be in ON condition.\\

$state\_{CE} = 1$\\

Where $state\_{CE}$ is the operating state of the combustion engine.\\

\subsection{Load Point Shifting}

Efficiency $\large\eta\_{CE}$ of the engine strongly depends on the load point ($\omega\_{CE}$,$T\_{CE}$). Efficiency $\large\eta\_{CE}$ of the engine can be improved by shifting the load point ($\omega\_{CE}$,$T\_{CE}$) with the motor. Load point can be decreased by operating the motor in motor mode and discharging the battery. Load point can be increased by operating the motor in generator mode and charging the battery. Efficiency improvement must be larger than conversion losses suggesting an optimization.\\

In this method a seperate interperted Matlab function other than that used for the start/ stop mode is defined, which consist of all the dynamic function.\\

The Load Point Shifting can be varied by operating the motor in different modes.\\

\subsubsection{Motor in Motor Mode}

In motor mode the demand torque or the power is used from the battery, which runs the motor to transfer the torque.\\

The constraints consider here are as follows,\\

$T\_{MGB} >= T\_{MGB,th} $\\

Where $T\_{MGB}$ is the torque of the flywheel, and $T\_{MGB,th}$ is the threshold torque of the flywheel. In order to maintain the \textit{SoC} and obtain a efficient system the threshold value for the flywheel is chosen to be 50Nm.\\

$Q\_{BT} > 0.25 \* Q\_{BT,MAX}$\\

Where $Q\_{BT}$ is the current charge of the battery and $Q\_{BT,MAX}$ is the maximum charge fo the battery. Hence for which the current charge must not fall below the 25 percent of the maximum charge of the battery.\\

If the above conditions are statisfied the following motor mode activated.

Torque split ratio is calculated for this mode in following manner:\\

$ u = \frac{T\_{EM}}{T\_{MGB}} = min (\frac{T\_{EM,max}(\omega\_{EM}) - |\theta\_{EM} d\omega\_{EM}| - \epsilon }{T\_{MGB}}, u\_{LPS,motor})$\\

where $T\_{EM}$ is the torque of the electric motor, $T\_{MGB}$ is the torque of the flywheel,$\omega\_{EM}$ is the angular velocity of the electricmotor,$ \theta\_{EM}$ is the motor inertia,$\epsilon$ is a design parameter chosen to circumvent the usage of motor at its maximum operating conditions and $ u\_{LPS,motor} $ is a boundary of operation mode for load point shifting in motor mode.

which corelates to the following for implementation in simulink\\

{u = min ((interpl (w\\_EM\\_max , T\\_EM\\_max, w\\_MGB) - abs(theta\\_EM\*dw\\_MGB) - epsilon)/ T\\_MGB, u\\_LPS\\_motor);

Here the matlab function 'interpl' for interpolation and 'abs' for absolute value are utilised.

\subsubsection{Motor in Generator Mode}

In the generator mode the excess torque exist in the flywheel is used to run the electric motor as a generator to generate power to charge the battery.

The constraints consider here are as follows,\\

$T\_{MGB} > 0Nm$ and $T\_{MGB} < 30Nm$ \\

Where $T\_{MGB}$ is the torque of the flywheel, for which a range is provied between the real and a optimum torque value to maintain the \textit{SoC} and to obtain lower fuel consumption.\\

$Q\_{BT} < Q\_{BT,MAX} $\\

Where $Q\_{BT}$ is the Current charge of the battery and $Q\_{BT,MAX}$ is the maximum charge fo the battery. For which the current charge should not exceed the maximum value.\\

Torque split ratio is calculated for this mode in following manner:\\

$ u = \frac{T\_{EM}}{T\_{MGB}} = min (\frac{T\_{EM,max}(\omega\_{EM}) - |\theta\_{EM} d\omega\_{EM}| - \epsilon }{T\_{MGB}}, u\_{LPS,gen})$\\

where $T\_{EM}$ is the torque of the electric motor, $T\_{MGB}$ is the torque of the flywheel,$\omega\_{EM}$ is the angular velocity of the electricmotor,$ \theta\_{EM}$ is the motor inertia,$\epsilon$ is a design parameter chosen to circumvent the usage of motor at its maximum operating conditions and $ u\_{LPS,gen} $ is a boundary of operation mode for load point shifting in generator mode.

which corelates to the following for implementation in simulink\\

{\textit{u} = max ((interpl (w\\_EM\\_max , T\\_EM\\_max, w\\_MGB) - abs(theta\\_EM\*dw\\_MGB) - epsilon)/ T\\_MGB, u\\_LPS\\_gen);\\

Here the matlab function 'interpl' for interpolation and 'abs' for absolute value are utilised.\\

\subsection{Regeneration}

Kinetic energy is dissipated to heat in friction braking and engine braking.

Kinetic energy can be stored in the battery by using the motor as generator in regenerative braking. This mode of energy generation is called Regeneration mode.

The regeneration should be maximized, which is obtained by operating the motor in the generator mode.\\

The constraints considered here are,\\

$T\_{MGB} > 0$\\

Where $T\_{MGB}$ is the torque of the flywheel, which is less than 0 having a negative torque while braking.\\

$Q\_{BT} < Q\_{BT,MAX} $

Where $Q\_{BT}$ is the Current charge of the battery and $Q\_{BT,MAX}$ is the maximum charge fo the battery. For which the current charge should not exceed the maximum value.\\

1) Compute -$T\_{EM,max}(\omega\_{EM})$ considering the initial torque of the motor, considering ($|\theta\_{EM} d\omega|$) and maximum ratio factor ($\epsilon$)\\

2) Then torque split ratio using,\\

\large

$ u = min(\frac{-T\_{EM,max}(\omega\_{EM})}{T\_{MGB}} , 1) $ \\

\subsection{Electric Drive}

In electric drive mode for which the battery charge is used completely to run the motor in the motor mode, the state of engine is read ($state\_{CE}$) if it equalls zero then this mode is executed,

Efficiency $\large\eta\_{CE}$ of the engine is low at low load ($\omega\_{CE}$,$T\_{CE}$) occurring e.g. in urban traffic. Electric driving at low load points and charging at medium load points can improve the efficiency. Electric driving can then be considered as a variant of load point shifting.\\

The constraints considered here are,\\

$T\_{MGB} > 0Nm$ and $T\_{MGB} < 23Nm$ \\

Where $T\_{MGB}$ is the torque of the flywheel, for which a range is provied between the real and a optimum torque value to maintain the \textit{SoC} and to obtain lower fuel consumption.\\

$Q\_{BT} > 0.33 \* Q\_{BT,MAX}$\\

Where $Q\_{BT}$ is the Current charge of the battery and $Q\_{BT,MAX}$ is the maximum charge fo the battery. Hence for which the current charge must not fall below the 33 percent of the maximum charge of the battery.\\

If the charge of the battery drops below 33 percent of the maximum charge, the vehicle is driven in LPS in generator mode. The condition provided assists to sustain the battery charge.

The maximum 'u' applied here is -0.35.

\subsection{Conventional Drive}

In this mode the torque for running the vehicle is completely utilized from the engine. Vehicle in this mode is acted only when nine of the condition in the above mode is satisfied.\\

The constraints considered here are,\\

$T\_{MGB} > T\_{MGB,th} $\\

Where $T\_{MGB}$ is the torque of the flywheel, and $T\_{MGB,th}$ is the threshold torque of the flywheel.\\

$Q\_{BT} < 0.25 \* Q\_{BT,MAX}$\\

Where $Q\_{BT}$ is the Current charge of the battery and $Q\_{BT,MAX}$ is the maximum charge fo the battery. Hence for which the current charge falls below the 25 percent of the maximum charge of the battery the mode is activated.\\

\section{Result}

The simulation results for both the cycles are as follows,\\

\begin{figure}[h]

\flushleft

\includegraphics[width=.55\textwidth]{graphunedc}

\caption{Simulation result of torque split ratio of NEDC}

\end{figure}

\begin{tabular}{|r|r|r|}\hline\hline

\multicolumn{1}|r|}{} &

\multicolumn{1}{|r|}{\textbf{NEDC}} &

\multicolumn{1}{|r|}{\textbf{FTP-75}}\\ \hline

$\textbf{V}\_{\textbf{CE}}$ & 3.739 & 3.373 \\ \hline

$\textbf{Q}\_{\textbf{BT}}$ & 18250 & 18320 \\ \hline

$\textbf{V}\_{\textbf{CE,equiv}} $ & 3.739 & 3.373 \\ \hline

\multicolumn{1}{|c|}{$\textbf{V}\_{\textbf{CE,eqiv}}$} &

\multicolumn{2}{|c|}{3.556}\\ \hline\hline

\end{tabular}

Subsection text here.

% needed in second column of first page if using \IEEEpubid

%\IEEEpubidadjcol

\subsection{Subsubsection Heading Here}

Subsubsection text here.

% An example of a floating figure using the graphicx package.

% Note that \label must occur AFTER (or within) \caption.

% For figures, \caption should occur after the \includegraphics.

% Note that IEEEtran v1.7 and later has special internal code that

% is designed to preserve the operation of \label within \caption

% even when the captionsoff option is in effect. However, because

% of issues like this, it may be the safest practice to put all your

% \label just after \caption rather than within \caption{}.

%

% Reminder: the "draftcls" or "draftclsnofoot", not "draft", class

% option should be used if it is desired that the figures are to be

% displayed while in draft mode.

%

%\begin{figure}[!t]

%\centering

%\includegraphics[width=2.5in]{myfigure}

% where an .eps filename suffix will be assumed under latex,

% and a .pdf suffix will be assumed for pdflatex; or what has been declared

% via \DeclareGraphicsExtensions.

%\caption{Simulation results for the network.}

%\label{fig\_sim}

%\end{figure}

% Note that the IEEE typically puts floats only at the top, even when this

% results in a large percentage of a column being occupied by floats.

% An example of a double column floating figure using two subfigures.

% (The subfig.sty package must be loaded for this to work.)

% The subfigure \label commands are set within each subfloat command,

% and the \label for the overall figure must come after \caption.

% \hfil is used as a separator to get equal spacing.

% Watch out that the combined width of all the subfigures on a

% line do not exceed the text width or a line break will occur.

%

%\begin{figure\*}[!t]

%\centering

%\subfloat[Case I]{\includegraphics[width=2.5in]{box}%

%\label{fig\_first\_case}}

%\hfil

%\subfloat[Case II]{\includegraphics[width=2.5in]{box}%

%\label{fig\_second\_case}}

%\caption{Simulation results for the network.}

%\label{fig\_sim}

%\end{figure\*}

%

% Note that often IEEE papers with subfigures do not employ subfigure

% captions (using the optional argument to \subfloat[]), but instead will

% reference/describe all of them (a), (b), etc., within the main caption.

% Be aware that for subfig.sty to generate the (a), (b), etc., subfigure

% labels, the optional argument to \subfloat must be present. If a

% subcaption is not desired, just leave its contents blank,

% e.g., \subfloat[].

% An example of a floating table. Note that, for IEEE style tables, the

% \caption command should come BEFORE the table and, given that table

% captions serve much like titles, are usually capitalized except for words

% such as a, an, and, as, at, but, by, for, in, nor, of, on, or, the, to

% and up, which are usually not capitalized unless they are the first or

% last word of the caption. Table text will default to \footnotesize as

% the IEEE normally uses this smaller font for tables.

% The \label must come after \caption as always.

%

%\begin{table}[!t]

%% increase table row spacing, adjust to taste

%\renewcommand{\arraystretch}{1.3}

% if using array.sty, it might be a good idea to tweak the value of

% \extrarowheight as needed to properly center the text within the cells

%\caption{An Example of a Table}

%\label{table\_example}

%\centering

%% Some packages, such as MDW tools, offer better commands for making tables

%% than the plain LaTeX2e tabular which is used here.

%\begin{tabular}{|c||c|}

%\hline

%One & Two\\

%\hline

%Three & Four\\

%\hline

%\end{tabular}

%\end{table}

% Note that the IEEE does not put floats in the very first column

% - or typically anywhere on the first page for that matter. Also,

% in-text middle ("here") positioning is typically not used, but it

% is allowed and encouraged for Computer Society conferences (but

% not Computer Society journals). Most IEEE journals/conferences use

% top floats exclusively.

% Note that, LaTeX2e, unlike IEEE journals/conferences, places

% footnotes above bottom floats. This can be corrected via the

% \fnbelowfloat command of the stfloats package.

\section{Conclusion}

The reference conventional vehicle with combustion engine has a equivalent fuel consumption of 4.786. The reduction in fuel consumed for a parallel hybrid vehicle with an additional motor and battery can be observed from the following,\\

For the rule based strategy considered, the simulation carried with NEDC cycle resulted in 21.87 \% improvement over the conventional vehicle.\\

The battery consumption from the initial available charge sustained over the period of cycle and had a improved by 1.28percent.\\

The simulation carried with FTP-75 cycle resulted in 29.52 percent improvement over the conventional vehicle.\\

The battery consumption from the initial available charge improved by 1.78percent.\\

\section{Future Work}

Further optimization of the EMS by incorporation of vehicle parametres like vehicle speed, gear ratio, engine coolant temperature and switching cycles of air conditioning unit.

% if have a single appendix:

%\appendix[Proof of the Zonklar Equations]

% or

%\appendix % for no appendix heading

% do not use \section anymore after \appendix, only \section\*

% is possibly needed

% use appendices with more than one appendix

% then use \section to start each appendix

% you must declare a \section before using any

% \subsection or using \label (\appendices by itself

% starts a section numbered zero.)

%

\appendices

\section{Proof of the First Zonklar Equation}

Appendix one text goes here.

% you can choose not to have a title for an appendix

% if you want by leaving the argument blank

\section{}

Appendix two text goes here.

% use section\* for acknowledgment

\section\*{Acknowledgment}

The authors would like to thank...

% Can use something like this to put references on a page

% by themselves when using endfloat and the captionsoff option.

\ifCLASSOPTIONcaptionsoff

\newpage

\fi

% trigger a \newpage just before the given reference

% number - used to balance the columns on the last page

% adjust value as needed - may need to be readjusted if

% the document is modified later

%\IEEEtriggeratref{8}

% The "triggered" command can be changed if desired:

%\IEEEtriggercmd{\enlargethispage{-5in}}

% references section

% can use a bibliography generated by BibTeX as a .bbl file

% BibTeX documentation can be easily obtained at:

% http://mirror.ctan.org/biblio/bibtex/contrib/doc/

% The IEEEtran BibTeX style support page is at:

% http://www.michaelshell.org/tex/ieeetran/bibtex/

%\bibliographystyle{IEEEtran}

% argument is your BibTeX string definitions and bibliography database(s)

%\bibliography{IEEEabrv,../bib/paper}

%

% <OR> manually copy in the resultant .bbl file

% set second argument of \begin to the number of references

% (used to reserve space for the reference number labels box)

\begin{thebibliography}{1}

\bibitem{IEEEhowto:kopka}

H.~Kopka and P.~W. Daly, \emph{A Guide to \LaTeX}, 3rd~ed.\hskip 1em plus

0.5em minus 0.4em\relax Harlow, England: Addison-Wesley, 1999.

\end{thebibliography}

% biography section

%

% If you have an EPS/PDF photo (graphicx package needed) extra braces are

% needed around the contents of the optional argument to biography to prevent

% the LaTeX parser from getting confused when it sees the complicated

% \includegraphics command within an optional argument. (You could create

% your own custom macro containing the \includegraphics command to make things

% simpler here.)

%\begin{IEEEbiography}[{\includegraphics[width=1in,height=1.25in,clip,keepaspectratio]{mshell}}]{Michael Shell}

% or if you just want to reserve a space for a photo:

\begin{IEEEbiography}{Michael Shell}

Biography text here.

\end{IEEEbiography}

% if you will not have a photo at all:

\begin{IEEEbiographynophoto}{John Doe}

Biography text here.

\end{IEEEbiographynophoto}

% insert where needed to balance the two columns on the last page with

% biographies

%\newpage

\begin{IEEEbiographynophoto}{Jane Doe}

Biography text here.

\end{IEEEbiographynophoto}

% You can push biographies down or up by placing

% a \vfill before or after them. The appropriate

% use of \vfill depends on what kind of text is

% on the last page and whether or not the columns

% are being equalized.

%\vfill

% Can be used to pull up biographies so that the bottom of the last one

% is flush with the other column.

%\enlargethispage{-5in}

% that's all folks

\end{document}