Auxiliary Energy Source Connected With A Boost-Buck Converter To Regulate Mixed Energy

KODAVATI SRIMANNA RAYANA  
M.Tech Student, Dept of EEE  
Vidya Jyothi Institute of Engineering & Technology  
Ongole, A.P, India

S. AVINASH KUMAR  
Associate Professor, Dept of EEE  
Vidya Jyothi Institute of Engineering & Technology  
Ongole, A.P, India

Abstract: The storage system includes a fuel cell (FC), becoming the primary source of energy, along with a super capacitor (SC), becoming an auxiliary source of energy. Additionally, it includes a power block for energy conversion composed of the boost ripper tools associated with the primary source along with a boost-buck ripper tools associated with the auxiliary source. This paper handles the issue of controlling a hybrid energy storage system (HESS) for electric vehicles. The converters share exactly the same electricity bus that is attached to the traction motor with an inverter. These power converters should be controlled to satisfy the next needs: Tight electricity bus current regulation, perfect tracking from the SC current to the reference, and asymptotic stability from the closed-loop system. It's shown using both a proper analysis and simulations the developed controller meets all preferred objectives. A nonlinear controller is developed, based on the machine nonlinear model, using Lyapunov stability design techniques. The second makes up about the ability converters’ large-signal dynamics but for the FC nonlinear characteristics.

Keywords: DC–DC Power Converters; Electric Vehicle; Fuel Cell (FC); Nonlinear Control; Super Capacitor (SC);

I. INTRODUCTION

Nowadays, further scientific studies are now being conducted on technologies for vehicles for the future. Of these technologies, the hybrid electric vehicle (HEV) is an excellent and promising perspective. Presently, most HEVs involve two energy storage devices: one rich in energy storage capacity, known as the “main energy system” (MES), and yet another rich in power capacity and reversibility, known as the “auxiliary energy system” (AES). The MES offers an extended driving range, and also the AES provides good acceleration and regenerative braking [1]. Accordingly, fuel cell (FC) HEVs can considerably improve gas mileage and could be more effective than traditional car engines. The expansion and infrastructure of FC technologies happen to be quickly progressing toward the advance from the overall system efficiency under realistic automotive loads while meeting the requirements for any dynamic response under transient loads or cold-start conditions. A stand-alone FC system built-into an automotive power train isn’t necessarily sufficient to supply the burden demands of the vehicle. To supply the first power peak during transients for example start-up, acceleration, or sudden load changes but additionally to benefit from the regenerative power an electrical vehicle at braking, a super capacitor (SC) bank is required, additionally towards the FC. To guarantee the dynamic exchange of one's between your FC unit, the burden, and also the SC modules, various power electronics ripper tools topologies and connected controls may be used. Within this paper, the goal would be to investigate modeling and also the charge of HESSs, considering the nonlinear nature of those systems. It will likely be proven that the quite rigorous nonlinear model can be discovered and based on to build up a nonlinear controller while using Lyapunov stability approach [2]. The control objectives are threefold: 1) tight electricity bus current regulation, 2) perfect tracking from the SC current to the reference, and three) asymptotic stability from the closed-loop system. It's formally demonstrated the developed controller does meet its performances. This outcome is confirmed by statistical simulations.

II. PROPOSED STRUCTURE

The part from the FC would be to supply mean capacity to the burden, whereas the SC can be used like a source of energy that supplies transient power demand and peak current needed during acceleration and deceleration stages. HESS for electric vehicles, includes a 400-V electricity link provided with a 48-kW PEMFC utilized as the primary source, via a current nonreversible electricity-electricity boost ripper tools, an SC bank utilized as an auxiliary source, that is attached to the electricity link via a current reversible electricity-electricity boost-buck ripper tools, and also the load constituted of the inverter driving the motor unit. FC Ripper tools (Boost :) Because the primary FC source isn't current reversible, the boost power ripper tools can be used to evolve the...
reduced electricity current delivered through the FC in the rated power the electricity bus [3]. The power converter consists of a higher-frequency inductor L1, an output filtering capacitor CDC, a diode D1, along with a primary insulatedgate bipolar transistor (IGBT) switch S1 controlled with a binary input signal u1. SC Ripper tools (Boost-Buck): The SC is attached to the electricity bus using a two quadrant electricity-electricity ripper tools, also known as a lift-buck ripper tools. The SC current flowing over the hard drive could be negative or positive, allowing energy to become transferred both in directions. Energy Management Technique of a Hybrid Source of Energy: The condition of control of the SC bank needs to be controlled to prevent overcharge or undercharge conditions. During low power demand periods, the FC system generates as much as its load limit, and also the excess power can be used to charge the SC [4]. The charging or discharging from the SC bank occurs based on the terminal current from the overall load needs. Short-time power interruptions within the FC system are only able to be provided through the SC bank. The sensible implementation from the aforementioned energy management strategy entails an effective charge of the electricity-electricity power converters.

![Fig.1.V –I characteristic of an elementary single cell](image)

### III. METHODOLOGY

The purpose of this would be to create a large-signal type of the ability circuit from the energy storage system considering their nonlinearities. The developed model is going to be used later within the control design. An average static V –I polarization curve for any single-cell FC is proven, in which the drop from the FC current with load current density could be observed. This current reduction is because three major losses, namely, activation, ohmic, and transport losses. The SC could be symbolized by its classical equivalent circuit composed of the capacitance Csc, a similar series resistance (ESR) Rsc representing the charging and discharging resistances, as well as an equivalent parallel resistance (EPR) representing the self-discharging losses. It’s possible to have the power stage bilinear equations, thinking about some no idealities. Boost-Buck Ripper tools modeling ripper tools operate like a boost ripper tools or perhaps a buck ripper tools. Indeed, in discharging mode (isc > 0), the ripper tools operates like a boost ripper tools, as well as in charging mode (isc < 0), it operates as a buck converter. Notice that the nonlinear model is a multi-input-multioutput (MIMO) system, which increases the complexity of the control problem. Nonlinear Control Design: Once the control objectives are defined, as thermion system is highly nonlinear, a Lyapunov-based nonlinear control is proposed. The first control objective is to enforce the dc bus voltage vdc to track a given constant reference signal Vdcref. In this respect, recall that the boost converter has a no minimum phase feature. More specifically, the objective is to enforce the input inductor current ifc to track a reference signal. Achieving the dc bus voltage regulation objective entails the regulation of the error e1 at zero. The next step is to elaborate a control law for the boost-buck converter input signal µ23, bearing in mind the second control objective. The achievement of the tracking objective regarding the SC current isc amounts to enforcing the error e2 to decrease, if possible, exponentially. The third control objective, i.e., closed-loop stability, will now be analyzed. The key idea is to select so that the time derivative ?V is made negative definite [5]. The simulations are performed considering a vehicle with the following specifications: acceleration of 0-100 km/h in 12.5 s on ground level, vehicle mass , rolling resistance coefficient of 0.01, aerodynamic drag coefficient of 0.3, front area of 2.5 m2, and maximum speed of 120 km/h. The traction induction motor has the following characteristics: nominal power of 45 kW and a peak of 75 kW, maximum speed of 3500 r/min, and maximum torque of 255 N · m. The simulation bench of the HESS control is described and is simulated using the MATLAB software, and the corresponding parameters have the numerical values shown.

### IV. CONCLUSION

The power conversion between your sources and also the load is managed using two electricity-electricity power converters. A controller is developed that generates the binary power converters input signals to satisfy the next needs: Tight electricity current regulation, perfect tracking from the SC current to the reference, and asymptotic stability from the closed-loop system. Interestingly, the only real used info on the motor part may be the measurement from the load current. The issue of controlling an HESS utilized in electric vehicles continues to be addressed. The machine includes a PEMFC because the primary source as well as an SC because the auxiliary source. The controller was created based on the nonlinear averaged type of the machine while using Lyapunov stability theory. It’s formally proven by using this theory the developed control strategy really meets the control objectives, whatever the vehicle and also the motor type.
V. REFERENCES


