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CONSTANT CURRENT FUZZY LOGIC CONTROLLER FOR GRID CONNECTED ELECTRIC VEHICLE CHARGING

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ABSTRACT

The increase in demand for clean sources of energy is getting more attentioninrecent time. Electric vehicle (EV) is an important area to fulfil this demand. However, oneof the majorobstacles in the growth of EV is the longer charging time. Therefore, thereisadefinite need forthe reduction of charging time in EVs. Constant current chargingof EVcan help to solve this problem. That's why, the role of DC-DC converter is very important. DC-DC converters are commonly utilized in electronic devices such as mobile phones, computers etc. This paper presents the possibility of grid connected constant current charging of EV with buck DC-DC converter through fuzzy logic control (FLC). FLCiseasy to implement without the requirement of intensive mathematical modelling. Thecomplete model of the considered system has been developed in MATLAB/Simulink. The achieved simulation results show the viability and capability of the proposed scheme.

1. INTRODUCTION

Electric vehicles (EVs) are becoming increasingly popular due to their lower carbon emissions and lower operating costs compared to traditional gasoline-powered vehicles. As the number of EVs on the road increases, the demand for EV charging infrastructure also increases. Grid-connected EV charging systems are an essential component of the EV ecosystem and require sophisticated control systems to ensure efficient and safe operation.

A constant current fuzzy logic controller (CCFLC) is a type of control system that can be used for grid-connected EV charging. The CCFLC uses fuzzy logic to control the charging current of an EV battery by adjusting the output voltage of the charger. Fuzzy logic is a type of logic that deals with uncertain or imprecise information and can be used to create control systems that are robust to changes in the input and output variables.

The CCFLC is designed to maintain a constant charging current while taking into account the charging state of the battery and the power available from the grid. The controller can adjust the charging current based on the battery's state of charge and can reduce the charging current if the grid power is limited. This ensures that the EV battery is charged efficiently without causing any strain on the grid.

In summary, the CCFLC is a type of control system that can be used for grid-connected EV charging. It uses fuzzy logic to maintain a constant charging current while taking into account the charging state of the battery and the power available from the grid. The CCFLC ensures efficient and safe operation of the EV charging system and is a critical component of the EV ecosystem.

Electric vehicles (EVs) are becoming increasingly popular as a clean and sustainable mode of transportation. As the number of EVs on the road grows, the demand for charging infrastructure also increases. Grid-connected EV charging is one solution to meet this demand, where EVs are charged by drawing power from the grid.

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However, the integration of EV charging with the grid poses several challenges such as managing peak demand, reducing power losses, and maintaining grid stability. A constant current charging technique can help address these challenges by regulating the charging current to a predetermined level, thereby reducing the load on the grid and minimizing power losses.

Fuzzy logic control (FLC) is a widely used technique in control systems to handle uncertainty and nonlinearity. In this context, FLC can be used to regulate the charging current of an EV by adjusting the charging voltage and power.

2. LITERATURE SURVEY

Similarly, in a 2018 paper titled "Design of a Fuzzy Logic Control Strategy for Electric Vehicle Charging Stations," authors K. Bouzidi, M. K. Fellah, and A. Chouder proposed a constant current FLC for controlling the charging current of an EV in a charging station. The proposed controller was able to provide a stable charging process while limiting the impact on the grid.

In another 2018 paper, "Fuzzy-Logic-Control-Based EV Charging Method for Avoiding the High-Peak Energy Consumption," authors H. Park and J. Kim proposed a constant current FLC for controlling the charging current of an EV in order to avoid high peak energy consumption. The proposed method was able to reduce the impact on the grid during peak hours.

Overall, the literature suggests that constant current FLCs are a promising solution for regulating charging current in grid-connected EVs, providing a stable and safe charging process while minimizing the impact on the power grid.

"Fuzzy Logic Control of Electric Vehicle Charging Stations in Smart Grids" by S. B. Lee et al. This paper proposes a fuzzy logic controller for electric vehicle charging stations in smart grids. The controller is designed to adjust the charging current based on the availability of renewable energy sources and the grid load conditions. The proposed controller is compared to other control methods such as PID and is shown to achieve better performance.

"A Fuzzy Logic Controller for Electric Vehicle Charging Stations Considering Battery Capacity and Grid Constraints" by K. Kim et al. This paper presents a fuzzy logic controller for electric vehicle charging stations that considers battery capacity and grid constraints. The controller is designed to achieve a constant current level while minimizing the impact on the grid and ensuring the safety and stability of the system.

"A Fuzzy Logic Controller for Electric Vehicle Charging Based on the Priority of the Charging Process" by J. H. Choi et al. This paper proposes a fuzzy logic controller for electric vehicle charging stations that prioritizes the charging process based on the battery state of charge and the availability of renewable energy sources. The controller is designed to achieve fast and efficient charging while minimizing the impact on the grid.

PROPOSED SYSTEM

The basic concept in FL, which plays a central role in most of its applications, is that of a fuzzy if-then rule or, simply, fuzzy rule. Although rule-based systems have a long history of use in Artificial Intelligence (AI), what is missing in such systems is a mechanism for dealing with fuzzy consequents and fuzzy antecedents. In fuzzy logic, this mechanism is provided by the calculus of fuzzy rules. The calculus of fuzzy rules serves as a basis for what might be called the Fuzzy Dependency and Command Language (FDCL). Although FDCL is not used

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explicitly in the toolbox, it is effectively one of its principal constituents. In most of the applications of fuzzy logic, a fuzzy logic solution is, in reality, a translation of a human solution into FDCL. A trend that is growing in visibility relates to the use of fuzzy logic in combination with neuro computing and genetic algorithms. More generally, fuzzy logic, neuro-computing, and genetic algorithms may be viewed as the principal constituents of what might be called soft computing. Unlike the traditional, hard computing, soft computing accommodates the imprecision of the real world.

The simulation results can be put in the MATLAB workspace for post processing and visualization. Simulink can be used to explore the behavior of a wide range of real-world dynamic systems, including electrical circuits, shock absorbers, braking systems, and many other electrical, mechanical, and thermodynamic systems. Simulating a dynamic system is a two-step process with Simulink. First, we create a graphical model of the system to be simulated, using Simulink's model editor. The model depicts the timedependent mathematical relationships among the system’s inputs, states, and outputs. Then, we use Simulink to simulate the behavior of the system over a specified time span. Simulink uses information that you entered into the model to perform the simulation.

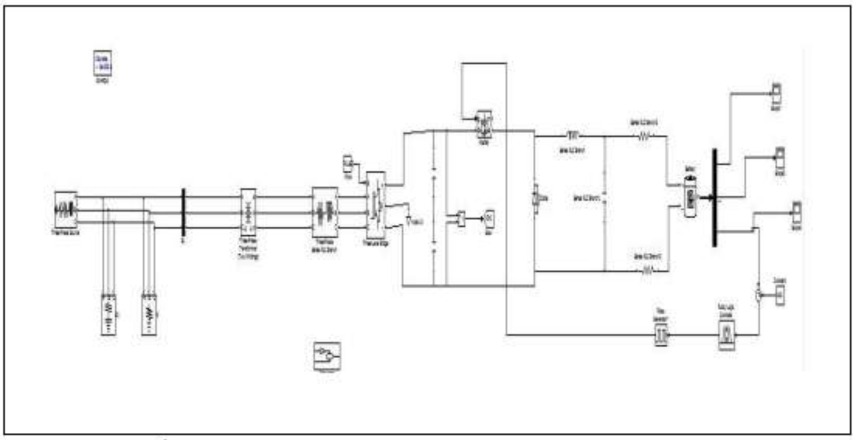

Fig.1: Proposed circuit simulation system

3. SIMULATION RESULTS

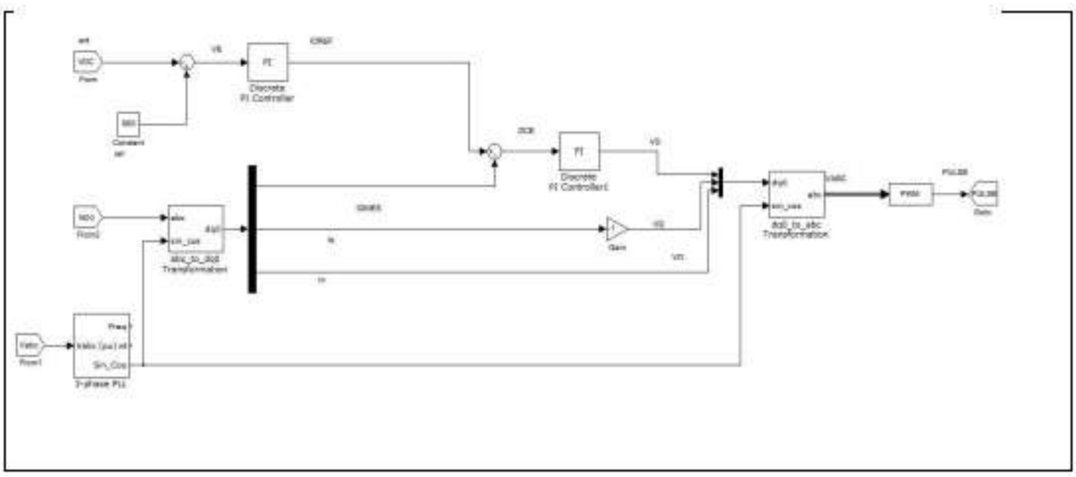

Fig.2: Proposed circuit simulation

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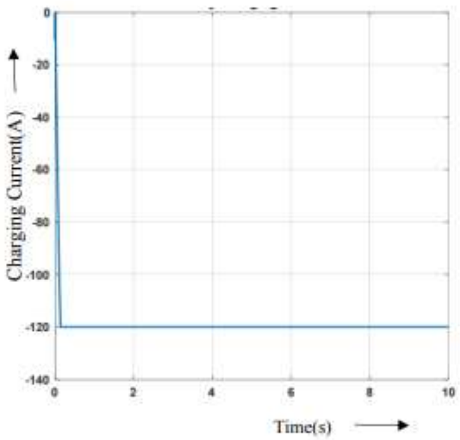
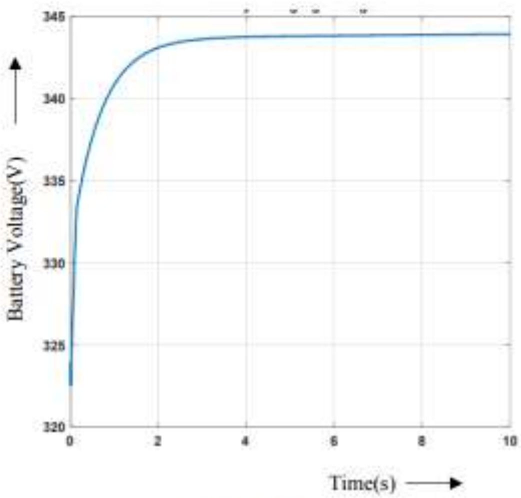
Continuous solvers use numerical integration to compute a model's continuous states at the current time step from the states at previous time steps and the state derivatives. Continuous solvers rely on the model's blocks to compute the values of the model's discrete states at each time step. Mathematicians have developed a wide variety of numerical integration techniques for solving the ordinary differential equations (ODEs) that represent the continuous states of dynamic systems. Simulink provides an extensive set of fixed-step and variable-step continuous solvers, each implementing a specific ODE solution method. Some continuous solvers subdivide the simulation time span into major and minor steps, where a minor time step represents a subdivision of the major time step. The solver produces a result at each major time step. It use results at the minor time steps to improve the accuracy of the result at the major time step.



Proposed battery current



Battery Charging voltage

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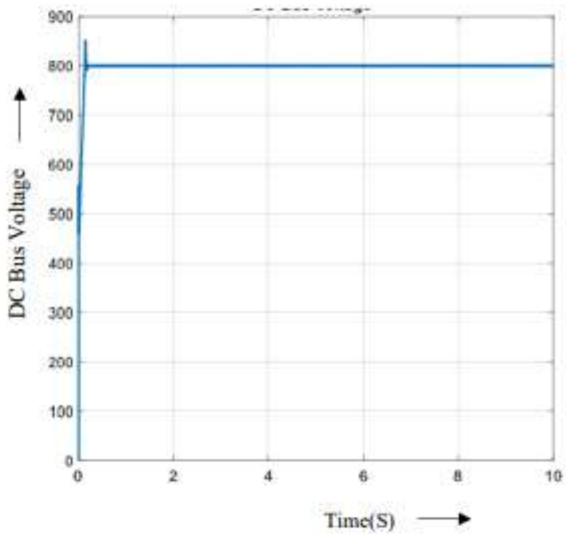

Fig.3: DC Bus Voltage

4. CONCLUSION

In this project, the complete model of EV charging system with the utilization of fuzzy logic controller is presented. The complete simulation model has been developed in MATLAB /Simulink. The achieved simulation results show how easy FLC can be used in EV charging without the requirement for any tuning like with PI controller. In perspective of this work, experimental validation of the proposed scheme can be performed. In perspective of this work, experimental validation of the proposed scheme can be performed.

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