Bi-Directional Dc-Dc converter Drive with PI and Fuzzy Logic Controller

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ABSTRACT: A Bi-Directional DC-DC converter drive with PI and Fuzzy Logic Controller is present in this paper .Speed output is used as feedback for significantly improving the dynamic performance of DC-DC Converter drive. Bidirectional DC-DC converters allow transfer of power between two dc sources, in either direction. Due to their ability to reverse the direction of flow of power, they are being increasingly used in many applications such as battery charger/dischargers, dc uninterruptible power supplies, electrical vehicle motor drives, aerospace power systems, telecom power supplies, etc. In step-up mode, the primary and secondary windings of the coupled inductor are operated in parallel charge and series discharge to achieve high step-up voltage gain. A Simulink based model is developed and the simulation results for the proposed model are obtained by using MAT LAB.

Keywords: Bidirectional DC-DC Converter, Proposed Converter, coupled inductor, Pulse Width Modulation, Drive.

I. INTRODUCTION

 Bi-Directional DC-DC converters are used to transfer the power between two DC sources in either direction [1]. Bidirectional dc-dc converters for use in battery charger and discharger are not only to control the battery charging and discharging current, but also to regulate the output voltage of discharger to a predetermined value when again using the stored energy in the battery. Conventionally, PI, PD and PID controller are most popular controllers and widely used in most power electronic closed loop appliances however recently there are many researchers reported successfully adopted Fuzzy Logic Controller (FLC) to become one of intelligent controllers to their appliances.

The fuzzy logic approach has been proposed to converters. Its major advantage is that expert knowledge can regulate the output voltage of the switching DC–DC Buck boost converter be incorporated into the fuzzy controller using simple linguistic rules to achieve the control objective without involving the converter's mathematical models. The Fuzzy logic controller are designed based on dimensional rule table using voltage error and change in voltage error as input variables and change in duty cycle as control output.

II. FUNCTIONS OF DC-DC CONVERTER

The DC-DC converter has some functions. These are:

i. Convert a DC input voltage Vs into a DC output voltage Vo.

ii. Regulate the DC output voltage against load and line variations.

iii. Reduce the AC voltage ripple on the DC output voltage below the required level.

iv. Provide isolation between the input source and the load (if required).

v. Protect the supplied system and the input source from electromagnetic interference

III. TYPES OD DC-DC CONVERTERS

There are many different types of DC-DC converters, each of which tends to be more suitable for some type of applications than for others. For convenience they can be classified into various groups, owever. For example some converters are only suitable for stepping down the voltage, while others are only suitable for stepping it up a third group can be used for either. In this we are going to main types of DC-DC converters.
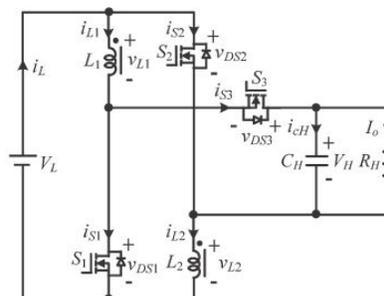Currently DC-DC converters can be divided into three types
• Buck Converter
• Boost Converter
• Buck-Boost Converter

IV. ANALYSIS OF PROPOSED MODEL

STEP UP MODE OF OPERATION

The circuit diagram for the bidirectional dc-dc coverter is show below:

Proposed Bidirectional DC-DC Converter

Operation: The operation analaysis done basing on the switches closing and reopening intervals which decides the energy sotring elements is operation.In the first mode the switches S1 & S2 are closed while the switch S3 is opened , then the coupled inductor is in parallel charging mode.In the second mode the switches S1 I& S2 are opened while the switch S3 is closesd , then the coupled inductor is in series discharging mode.

$$G_{\text{CCM STEP-UP}} = \frac{1+D}{1-D}$$
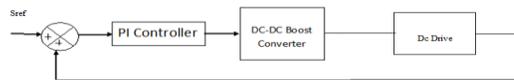
VI. INTRODUCTION TO PI CONTROLLER

PI Controller (proportional-integral controller) is a special case of the PID controller in which the derivative (D) of the error is not used. The PI control is the most popular control system; it is versatile and can be tuned adjusting three constants. PI is a well proved and successfully applied in many control systems [2].
General approach to PI tuning:
1. Initially set integral gain equal to zero,
2. Increase KP until satisfactory response has been obtained,
3. Add integral gain and adjust KI until the steady state error is removed.

VII. INTRODUCTION TO FUZZY CONTROLLER

The fuzzification module converts the crisp values of the control inputs into fuzzy values. A fuzzy variable has values which are defined by linguistic variables (fuzzy sets or subsets) such as low, Medium, high, big, slow… where each one is defined by a gradually varying membership function. In fuzzy set terminology, all the possible values that a variable can assume are named universe of discourse, and the fuzzy sets (characterized by membership functions) cover the whole universe of discourse. The shape of fuzzy sets can be triangular, trapezoidal, etc
Structure of a fuzzy logic controller consists of: input, fuzzification, Rule base, Defuzzification, output. There are specific components characteristic of a fuzzy controller to support a design procedure [4].
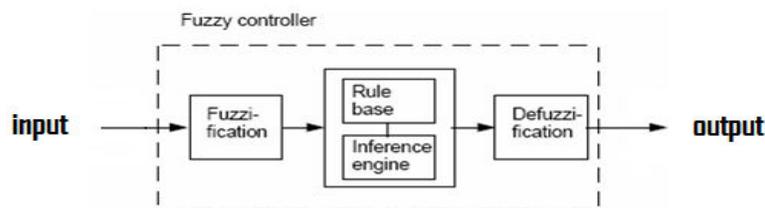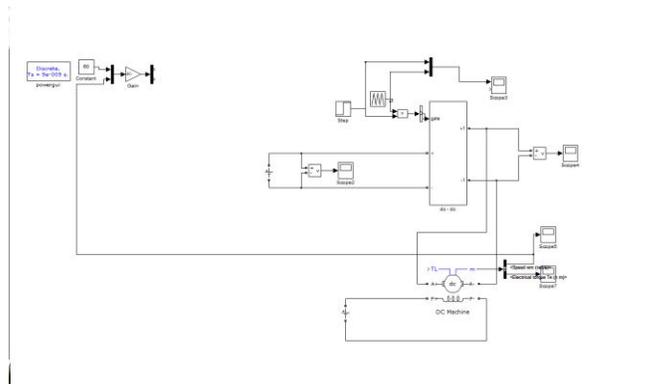
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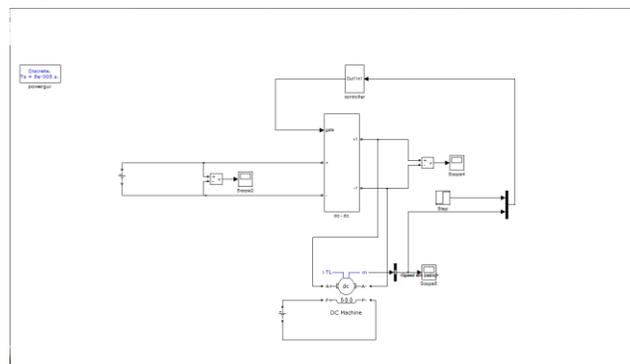
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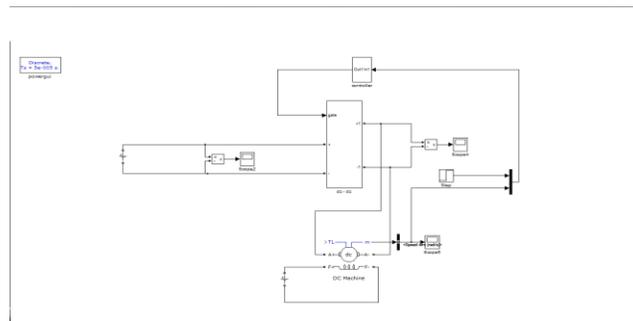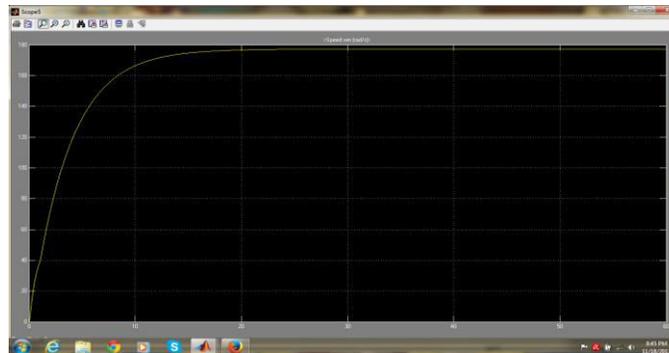## Vol. 2, Issue 11, November 2013

VIII. MODELLING THE PROPOSED CIRCUIT AND MATLAB/SIMULINK RESULTS

DC-DC Boost Converter

DC-DC Boost Converter with PI Controller

DC-DC Boost Converter with Fuzzy Controller

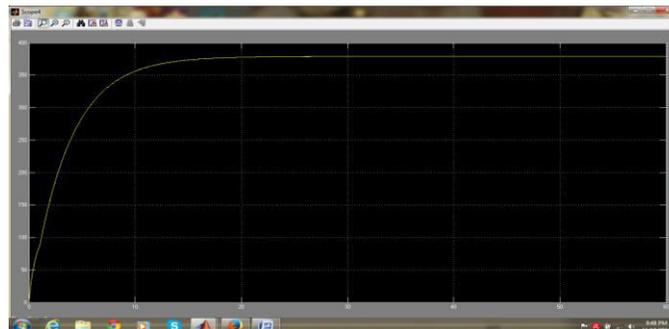Fig. 1 Speed output of proposed DC-DC Bi-Directional converter

Fig. 2 Voltage output of proposed Bi-Directional DC-DC Converter

Fig. 3 Speed output of proposed Bi-Directional DC-DC converter with PI controller

Fig. 4 Voltage output of proposed Bi-Directional DC-DC converter with PI controller
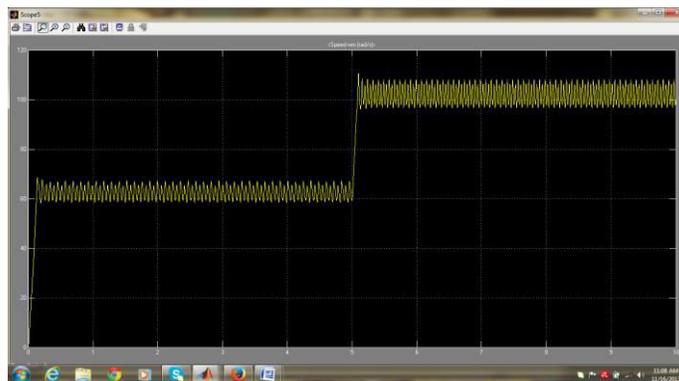

Fig. 5 Speed output of proposed Bi-Directional DC-DC converter with Fuzzy logic controller
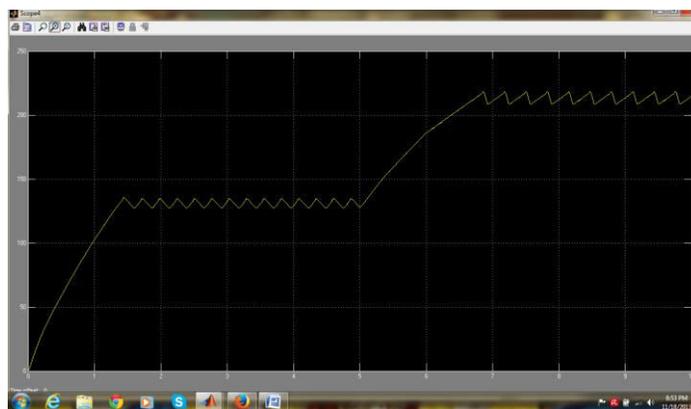

Fig. 6 Voltage output of proposed Bi-Directional DC-DC converter with Fuzzy logic controller

IX. CONCLUSION

In this paper the proposed dc-dc converter topology has been used to drive the dc shunt motor. The proposed converter is controlled by using both pi and fuzzy logic controllers to obtain the reference speeds. The simulation is done by using MATLAB SIMULINK. As the dc machine are easy to control the output speed response for both the controllers are obtained using voltage control method. For above rated speeds the output of the converter can be fed to the field circuit to get the desired output speeds.

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