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Buck Boost Converter for Fact Devices

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ABSTRACT: This paper presents the comparative analysis between fuzzy logic controller and neural network for DC-DC Buck converter. The major drawback in the conventional buck converter is when the input voltage or load change, the output voltage also changes which reduces the overall efficiency of the buck converter. So here we are using nonlinear controllers for buck converter which respond quickly for perturbations and maintains the fixed load voltage even when there are non-linearity's occurs compared to a linear controllers like P,PI,PID controllers which can't withstand when perturbations occur. Simplicity, low cost and adaptability to the complex systems without mathematical modelling are the best features of Fuzzy Logic controller and neural networks.

KEYWORDS: Fuzzy logic controller, DC-DC Buck converter, Network

I. INTRODUCTION

The design of dc-dc buck converter is to maintain a constant output voltage under the different load current and unregulated input voltage. The transient overshoot and recovery time of the output voltage should be minimized for stable operation in many electronic applications, which is ensured by the controller in the closed loop. Classical controllers like PWM control, proportional (P) controller, proportional integral (PI) controller, proportional integral derivative (PID). Controllers only provides results which is either true or false. These controllers don't provide adequate results when there is nonlinearities in parameters or load. Recently, several methods have been proposed in the literature to alleviate the deficiency of the classical linear controllers for power converters. So non-linear controllers like fuzzy logic controllers and neural network etc. are most widely used. Now a days we are facing situations where we are unable to determine whether the state is true or false. Term "fuzzy" describes something that is non-linear or indefinite. Fuzzy logic is based on the observation that people make decisions based on imprecise or non numerical information. Neural networks are the set of algorithms inspired by the functioning of the human brain. So we are using nonlinear controllers for controlling the non-linearity's in the load because it responds faster to a transient condition, easy to design and implementation.

II. RELATED WORK

Fuzzy logic is a mathematical logic which is based "degree of truth" unlike classical "true or false". It handles with imprecise or uncertain data. Fuzzy logic controller is easy develop and design and can operate at wider operating conditions. Fuzzy logic controller is utilized in different industrial automation & household appliances.

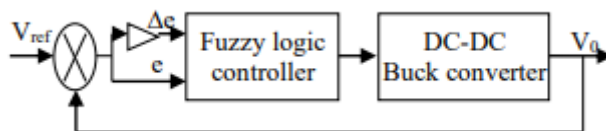


Fig 2.1: Block diagram of Fuzzy logic controller (FLC) for buck converter

III. METHODOLOGY

This chapter will cover the details explanation of methodology that is being used to make this project complete and working well. Matlab/Simulink software is used to achieve the objectives of the project that will complete. With the aim to evaluate this project, the methodology based on system development and optimization output voltage of boost converter by using H_∞ controller for closed loop compared with PID control. In order to control the DC output voltage of boost converter and to ensure good variable output voltage the H_∞ controller for closed loop

control of boost converter proposed in this project. The DC-DC buck converters are efficiently reduces the voltage levels as per our requirement. The basic circuit diagram of the Buck converter. Here the MOSFET is controlled by duty cycles which are given by the non-linear controllers.

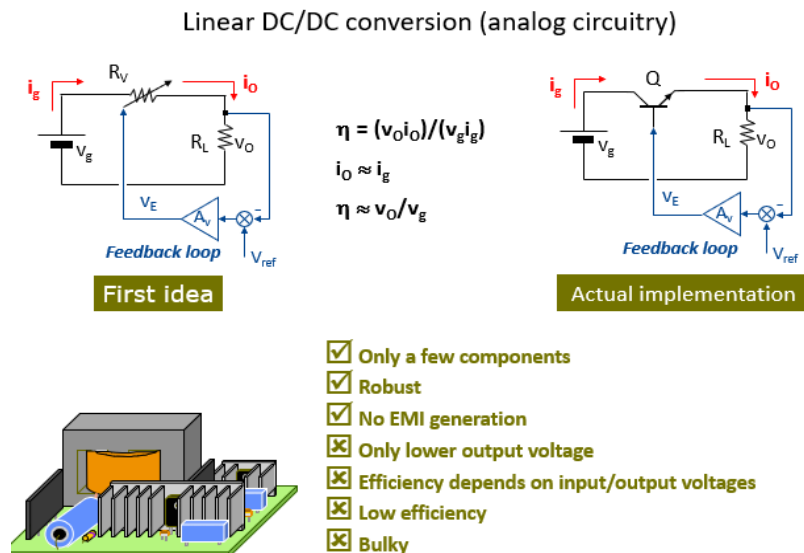


Fig 3.1: Linear DC/DC Conversion

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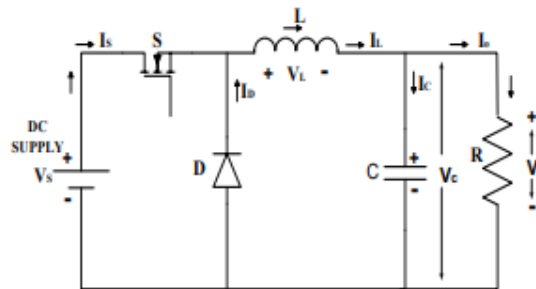


Fig 3.2: Circuit Diagram of DC-DC Buck Converter

Here, V_0 is the output voltage, V_L is the inductor current, I_C is the capacitor current, and V_C is the voltage across the capacitor. The modes of operation of buck converter are explained below.

1. When switch is closed, the current in the load and the charge of a capacitor is increase gradually because the energy also being stored in inductor. Throughout this the diode gets reverse biased because there will be a positive voltage across the cathode. So the voltage across inductor is $V_L = V_S - V_0$.

When switch is opened, the polarity of the inductor voltage changes so the diode gets forward biased but current flows in the same direction. Once the inductor returned the large part of its stored energy to the circuit, the charge stored in capacitor becomes the main source of current flowing in the circuit until the next ON period begins.

The voltage across inductor is $V_L = -V_0$

So, the output voltage is

$$V_0 = D V_S$$

Where, $D = T_{ON}/T$

IV. EXPERIMENTAL RESULTS

The main objective of a buck-boost converter is to receive an input DC voltage and output a different level of DC voltage, either lowering or boosting the voltage as required by the application. The design of a buck-boost converter is similar to a buck converter and boost converter, except that it is in a single circuit and it usually has an added control unit. The control unit senses the level of input voltage and takes appropriate action on the circuit based on that voltage.

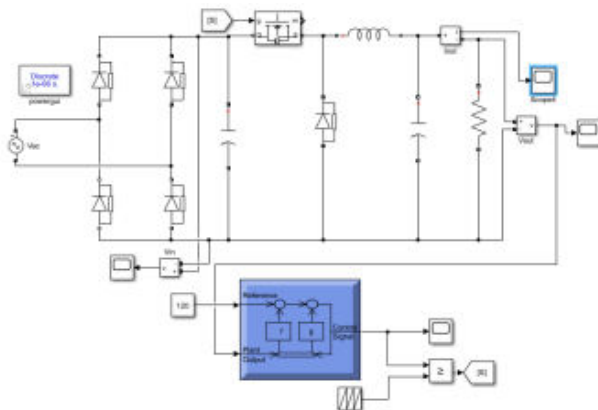


Fig 4.1: Proposed simulation diagram of fuzzy logic controller for DC-DC Buck Converter

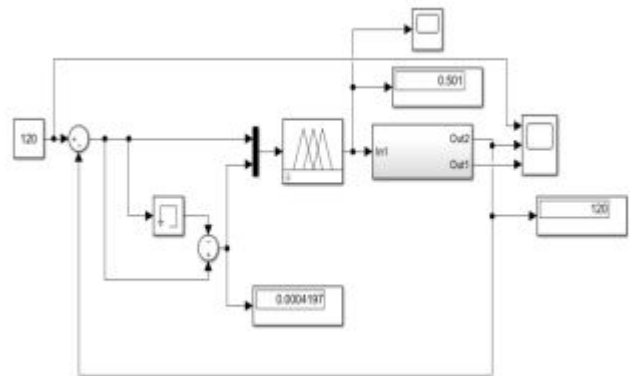


Fig 4.2: Proposed simulation diagram of NARMA L2 controller for DC-DC Buck Converter

V. CONCLUSION

In this paper, the comparative analysis of fuzzy logic controller and neural network for DC-DC buck converter is studied and implemented in MATLAB/Simulink. The main purpose of this research is to understand the different smart control methods for buck converter operation. The simulation results prove both models give the desired output but the model developed using neural network controller approach performed slightly better compared to fuzzy logic controller in terms of maximum overshoot, less steady state error and it takes less time to settle down when there are non-linearities in the system. Therefore, these controllers effectively handle the perturbations in the system thus increasing the overall performance and efficiency of the buck converter.

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