AN IMPROVED DC-LINK VOLTAGE CONTROL STRATEGY FOR GRID CONNECTED CONVERTERS BY USING FUZZY LOGIC CONTROL

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Abstract- The fuzzy logic control presents a robust control strategy to improvedc-link voltage control performances for Grid connected Converters(GcCs).The fuzzy logic control strategy is an controller and is aimed to ensure fast transient response, low dc-link voltage fluctuations, low grid current THD and after sudden changes of the active power drawn by the GcC.Several simulation and experimental results are presented to confirm and validate the effectiveness and feasibility of the proposed dc-link voltage control strategy. The fuzzy logic controller (FLC) based on fuzzy logic provides a means of converting a linguistic control strategy based on expert knowledge into an automatic control strategy. and problems that need further research are pointed out.

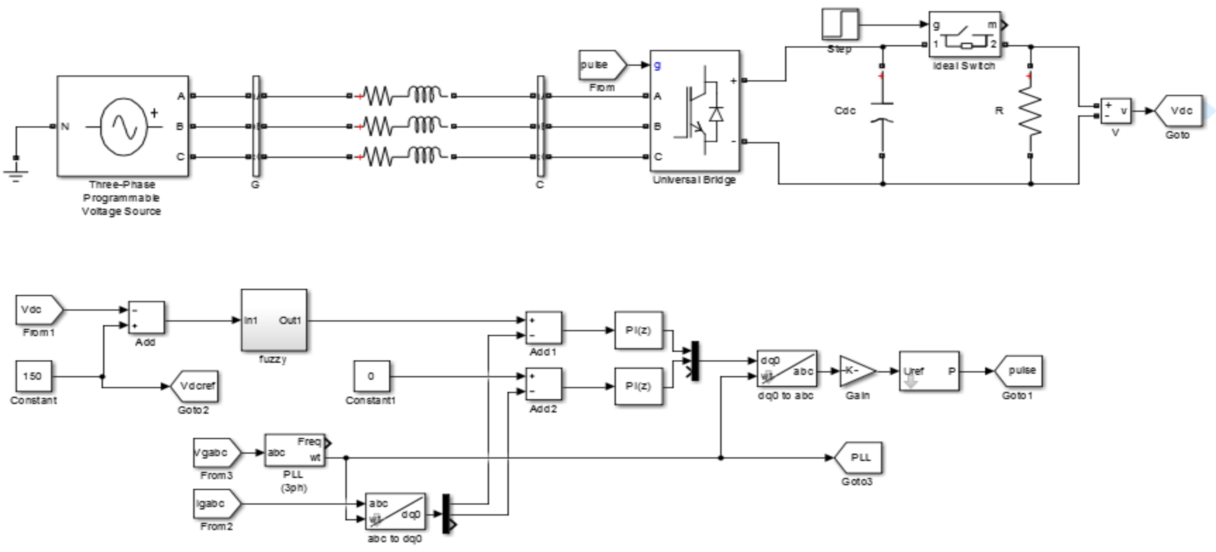
***IndexTerms*- Fuzzy Logic controller, DC-link voltage control, Grid connected Converters.**

I. INTRODUCTION

Nowadays, power converters have an important role in a large scale of industrial applications since they allow efficient power transmission between the grid (on one side) and loads or energy sources (on the other side). The commonly used power converters topologies use a dc-link as an intermediate stage for the power conversion process in addition to a Grid connected Converter (GcC) and a filter based on passive (inductive and/or capacitive) elements. For example, this is the case of adjustable speed drives [1-2], renewable energy sources [3-4], active power filters [5-6], UPS systems [7] and back-to-back systems [2],[8]. Efficient dc-link voltage control is very important for such applications to reduce voltage fluctuations in the dc-link [9], which are mainly caused by random changes (particularly sudden and sever changes) in the power drawn by the GcC. When these fluctuations cross their limits, the protection devices are activated leading to a system shut-down [3],[9]. Thus, the control objectives pertaining to the dc-link voltage can be summarized in the following key points: 1) the voltage across the dc-link capacitor must be kept at a constant value by controlling the power flow in the AC side of the GcC so that two objectives are satisfied: the first one is the upkeep of the capacitor charge, while the second one is the supply of a load connected to the dc-link (for the rectifying mode case) or the transfer of the power provided by a DC source (for the inverting mode case), 2) the dc-link voltage fluctuations must be minimized, 3) the generation of high grid current harmonics must be prevented and 4) The deviation from the unity power factor operation caused by the grid current ripples must be prevented.

The most frequently used dc-link voltage controller is the PI controller [10],[11]. Different PI controller design techniques were described in literature. Among them, we can cite the pole zero cancellation method, the pole placement method and the optimum criterion method [8],[11]. For these methods, the PI controller is usually adjusted with respect to different constraints: C_1) stability; C_2) dynamic performances; C_3) disturbance rejection; and C_4) step responses with low overshoot [12]. In order to satisfy all these constraints, some research works presented the design of adaptive PI controllers [13-17]. Other ones combine between the benefits of the PI controller and the feed forward compensation method [18-20]. For that case, despite the excellent improvement of dynamic performances, such a method increases the coupling between the controlled dc-link voltage and the grid currents. Consequently, any noise or fast oscillation in the grid currents can create ripples at the output reference of the dc-link voltage controller. Other works have presented a Direct Power Control (DPC) combined with the boundary control [26] to improve the dynamic performances of the dc-link voltage. Compared to the conventional DPC, the dc-link voltage is considered for selection of the switching states through a switching table. As a result, no outer loop is needed and the dynamic performances are highly improved. However, this method results into a variable switching frequency, which is limited to the half of the used sampling period and which depends on the system parameters, dc-link voltage and ac-side voltage [23], [27]. So, the DPC combined with boundary control cannot be used for applications that require constant switching frequency, like the case of LCL-based GcCs since it will lead to resonance problems. Moreover, this control will lead to high grid current THD values during steady state operation if low mean switching frequency is achieved [23], [26].

II. SYSTEM STRUCTURE

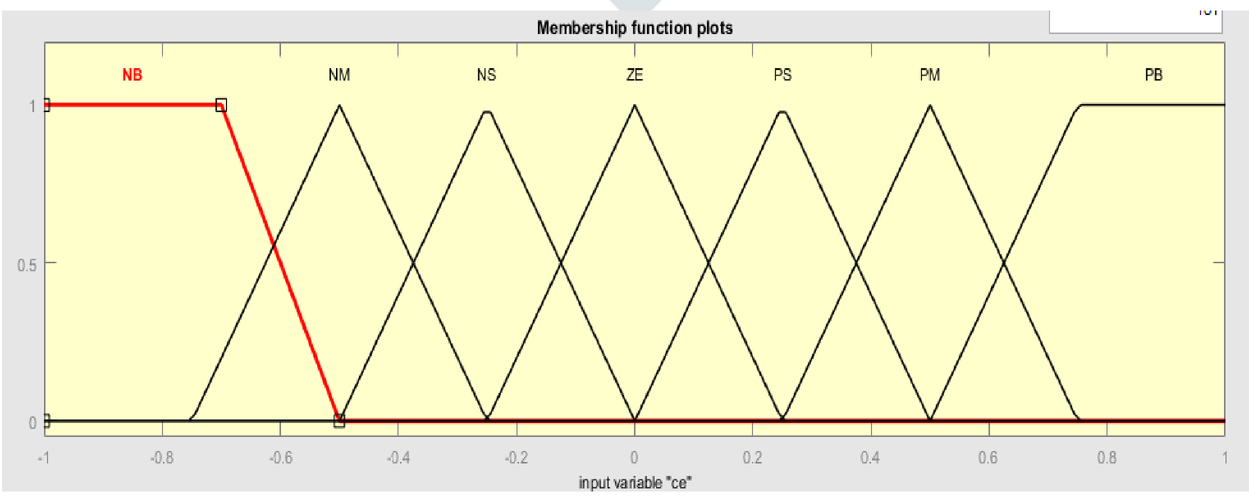


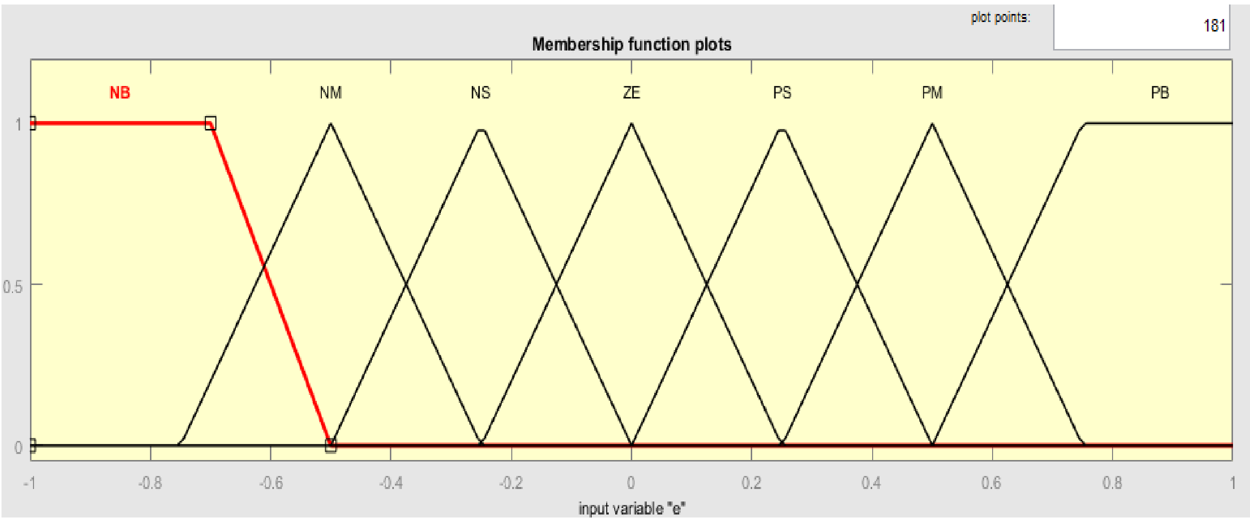
Simulation model

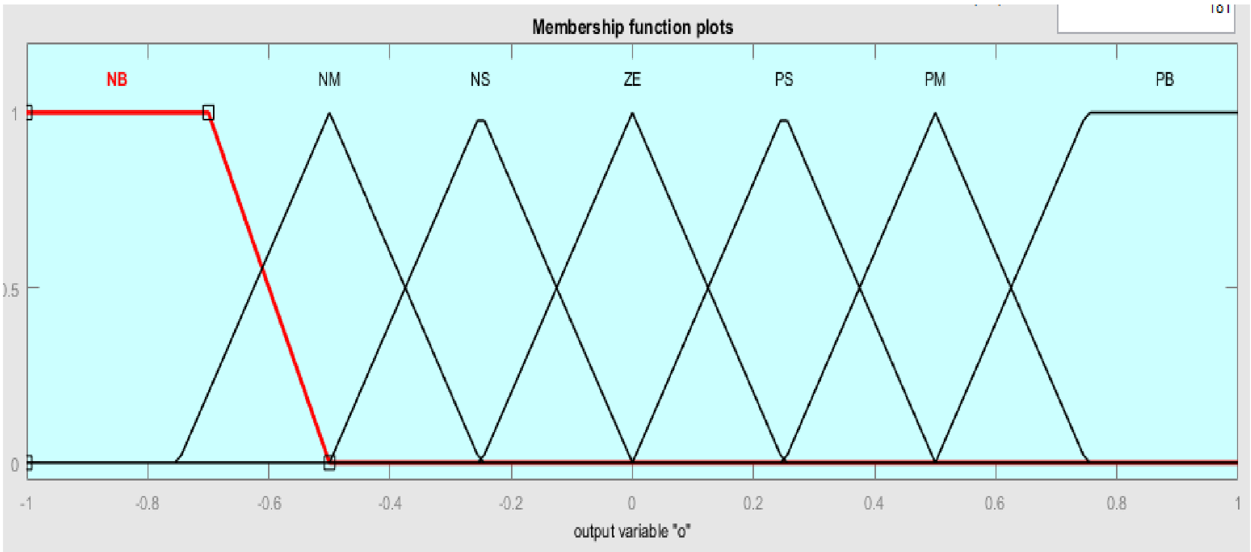
The above figure shows simulation model by using fuzzy logic control. The base paper shows in that adaptive pi control is used by reducing THD(4.391) loss and improving the efficiency of the system.
The base paper extention shows in that fuzzy logic control is used by reducing THD loss(1.316) and improving the efficiency of the system.
The fuzzy logic control is reduced more losses than pi controller it is shows the display in matlab hence practically verified the fuzzy logic control is more efficient.

When we are using fuzzy logic control than we write a membership function it is a rule of fuzzy logic control it shows the below figure (a)
In the simulation results case 1 in that figure 1 shows Dc link voltage and grid current
And the figure 2 shows the Grid voltage and current along with PLL behavior.
The case 2 in that figure 3 Shows Dc link voltage and Grid current. And the Figure 4: the Grid voltage and current along with PLL behavior
In The 1st case the total 150volts is given constant supply. And the 2nd case every 0.5 sec taking a voltage
0-150volts step signal.

a. MEMBERSHIP FUNCTIONS







III. SIMULATON RESULTS

Case1:

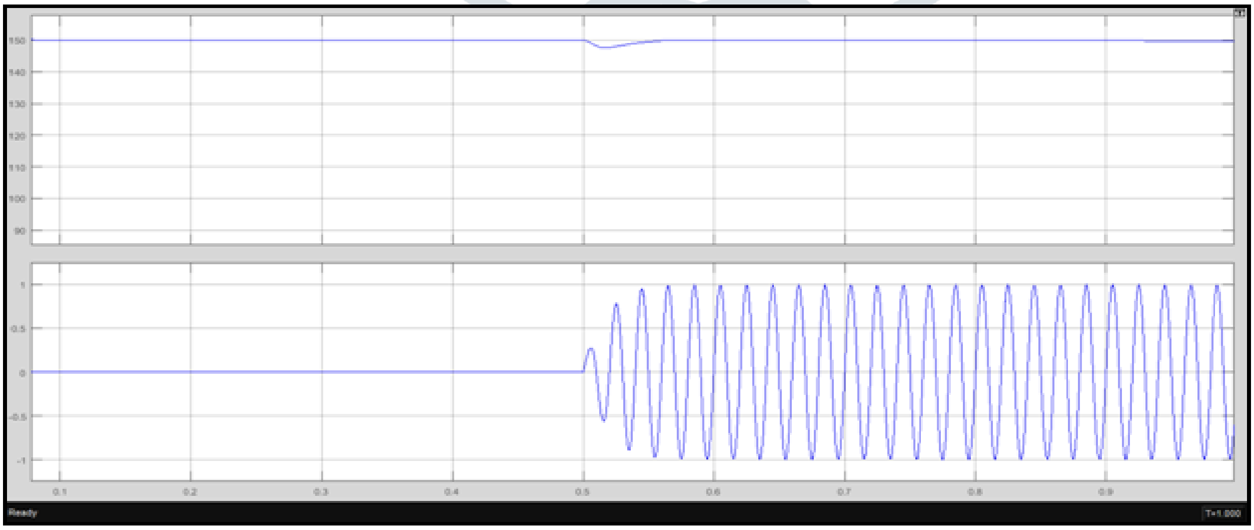


Figure 1 Dc link voltage and Grid current.

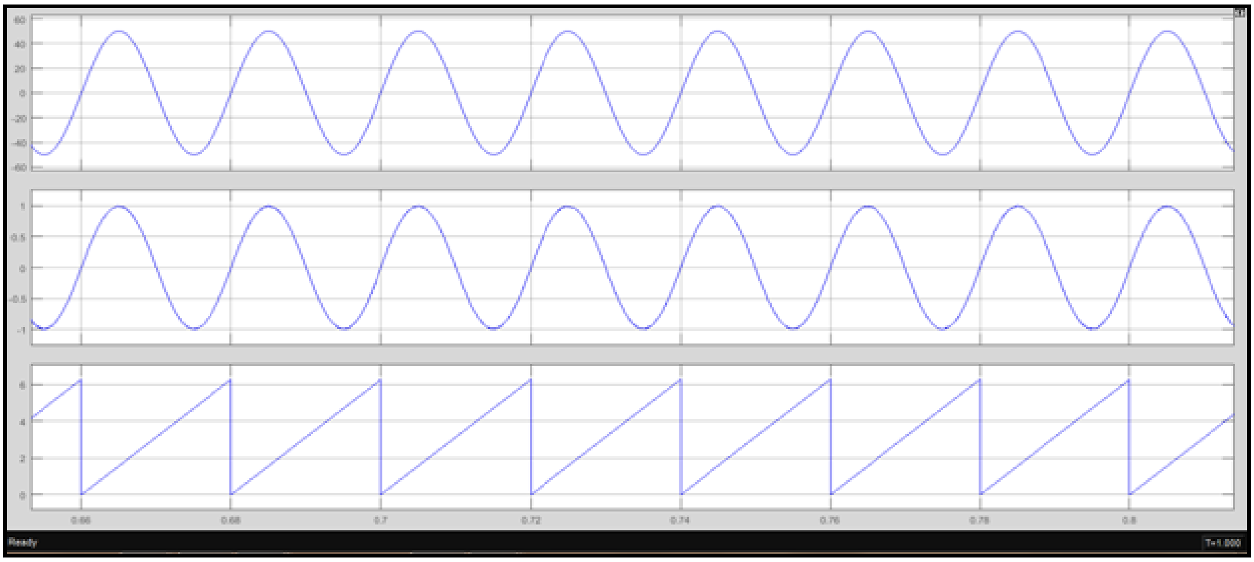


Figure2 Shows the Grid voltage and current along with PLL behavior.

Case2

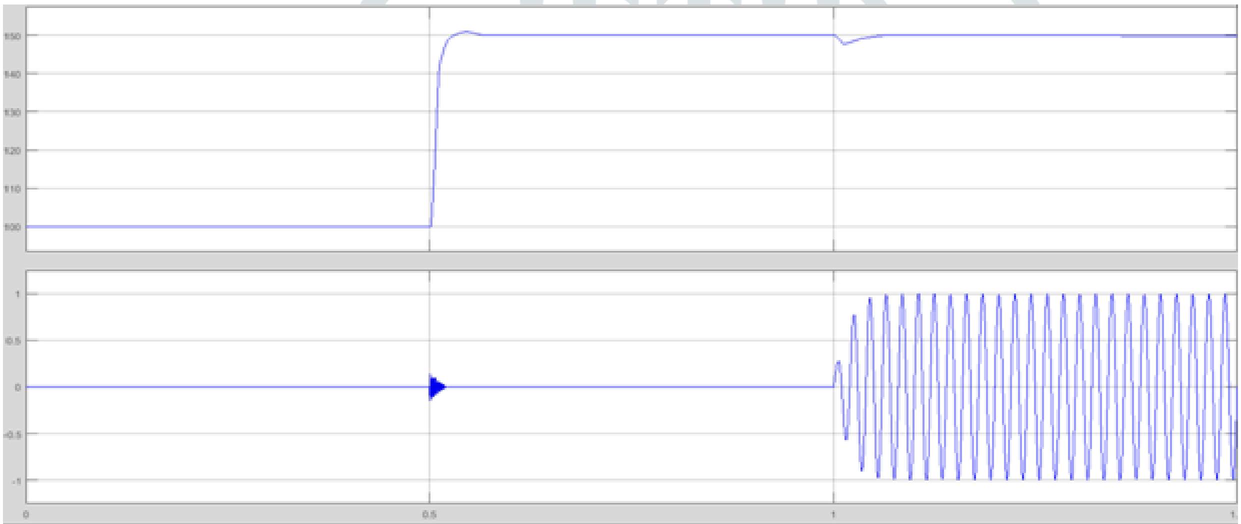


Figure3 Shows Dc link voltage and Grid current

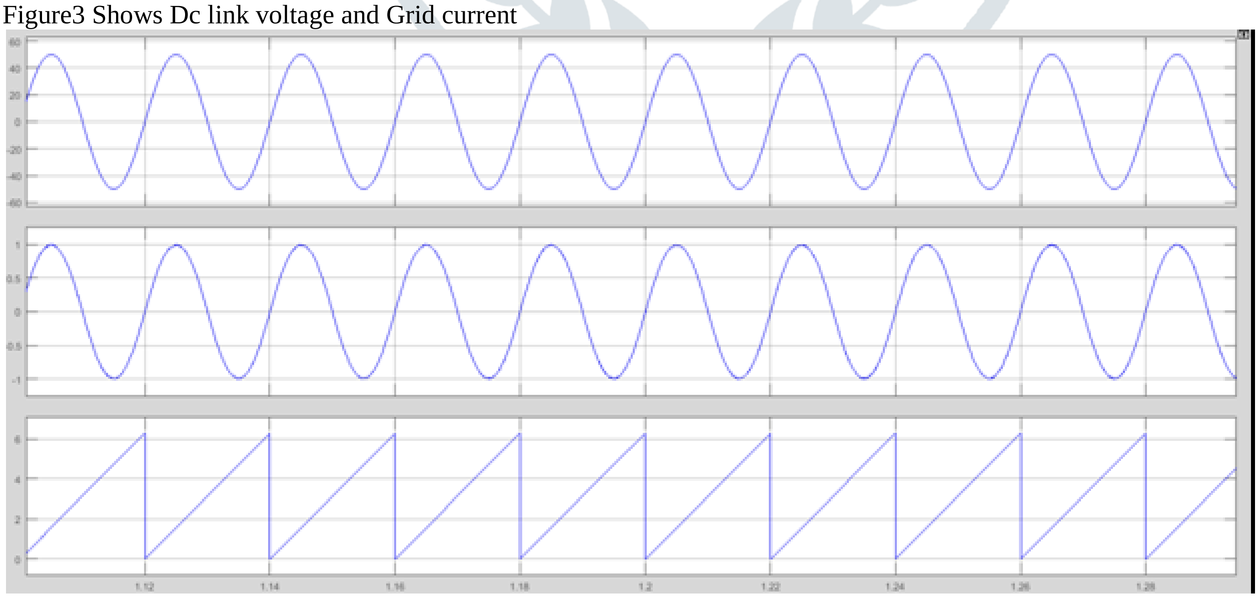


Figure 4: the Grid voltage and current along with PLL behavior

IV. CONCLUSION

This paper presented an improved dc-link voltage controller based on a fuzzy logic controller. The following constraints are satisfied no overshoot after step jumps of the dc-link voltage reference input, fast dynamic response after step jump of the input current *i*and low grid current THD value during steady state operation. A Fuzzifier which transforms the measured or the input variables in numerical forms into linguistic variables. A Controller which performs the fuzzy logic operation of assigning the outputs based on the linguistic information.The considered control was experimentally tested and verified in mat lab. The obtained experimental resultsimulation results and shows the effectiveness and reliability of the adopted controlstrategy.

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