DC Droop Control Strategy for Dynamic Load Sharing in DC Microgrid

Surya Teja Padi, Sunitha Kundurthi, Srinivasa Rao Y

***Abstract:** The usage of renewable sources increasing day by day this trend faces challenges in the reliable operation and control. Parallel connected in DC micro grid dc-dc converters are the main issues related to are flowing current and load current sharing. But for load current sharing droop control method is common technique. In dc grid voltage poor current sharing and drop are main drawbacks of conventional droop method. A component of standardized current sharing distinction and misfortunes in the yield side of the converters a Fuzzy rationale control of legitimacy called droop Record (DI) is utilized to improve the execution of dc micro grid. In between the converters the current sharing and circulating current difference minimizes by using an immediate fundamental resistance R droop. Control strategy using droop index is developed and compare with conventional droop control (PID) method validate its existing FLC results by MATLAB/ Simulink model.*

***Index Terms:** Constant power loading, Distributed energy sources, Droop control, Load sharing, Voltage regulation*

I. INTRODUCTION

Practical vitality sources, and stockpiles, another structure called miniaturized scale network has been cut in the improvement of the electrical corporation close to dispersed age. To discard environmental contamination achieved by non-sustainable power sources sustainable MGs are commonly used in urban networks [1][2][3]. Due to their central focuses over air conditioning MGs the use of DC-MGs has ended up being progressively obvious. Straightforward relationship with power storages (batteries), direct bolstering of various electrical loads are consolidate with the essential points. Association with characteristically DC sustainable power source assets (photovoltaic system), absence of responsive power, and more efficiency with less demand [4]-[8]. In between the DG units and the normal transport converters that are related in parallel to the smaller scale network [9]. Miniaturized scale frameworks are the way by which to circle the payload (current) surrounded by DG system by controlling interfacing converters are another basic issue. Incorporated and non-brought together arrangements can be isolated into two methodologies [10][11]. A higher trustworthiness procedure in the decentralized or coursed (By correspondence interfaces surrounded by DG system) structure considered by the non-unified control system .

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In the DC micro grid operation regulation and below voltage guideline another best possible payload distribution are there standard objectives, Parallel associated interfacing converters are the other viewed form of the DC miniaturized scale network [12]. For instance ace slave [13], various leveled brought together controller numerous regulation strategies have on recommended being DC small scale lattice regulation [14]. All of the sources and loads are not firmly found when the pair of the particular controls desire great transmission limit correspondence. Low voltage guideline and legitimate load sharing can achieve by ace slave control. The voltage guideline disintegrates the issue along here regulation is to by virtue of all mistake among the ace regulation system. Yet the load sharing precision can't be cultivated, the voltage guideline issue can be lit up, using the discretionary controller. Droop based regulation system have on recommended, to have self-governing load distribution (without correspondence surrounded by the converters).Voltage guideline ends up low for augmentation in payload and the load distribution track corrupts among the joining about uneven line impedances are the genuine disservices of the droop control. In low voltage conveyance system, it is unavoidable.In [15], droop regulation is pre-owned tolerating such allocation line take never impedance for DC system, whatever relevant for little system giving cooking its adjacent load. Without pondering the reaction of uneven line impedances, the helper regulation was proposed [16]. Normal loading was proposed in control system subordinate [17]. This control methodology relies upon the modification of the droop increment of the system. For improving the system voltage guideline this control methodology is fit, yet suitable load sharing limit isn't provide on the nether side the prospect of uneven line impedances existent is a tradeoff among the voltage guideline and load distribution precision in far utmost of the droop regulation cases. Voltage guideline would be better anyway it debases the present sharing exactness in case the droop gain is picked to be little. Via arriving incredible voltage guideline also definite load distribution in the meantime is master displayed in this paper, another control system reliant with the P-controller whichever vary the convincing droop increment.

II. . IMPEDIMENTS OF DROOP CONTROL STRATEGY

Some inherent limitations in droop based power distribution control. First, in the converter terminal DC voltage there will be an inevitable aviation.

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Due to the voltage drop in line resistance the remotely regulated DC bus voltage further reduce. Second among the converters, deterioration in current distribution accuracy. Uneven output voltage at the converter terminals is the reason as a result of the uneven voltage drop among the line resistances. Neccessary to explain the proposed regulation method for the following analysis.

A. *Voltage Droop Characteristics:*

When By increasing the output power supplied by the source then there will be precise drop in turnout voltage which is trend for the voltage droop characteristics of DC source
Fig-1 speaks to droop qualities of two sources which can be scientifically summed up as,

$$V_1 = -m_1 P_1 + V_{NL} - - - - - 1$$

$$V_2 = -m_2 p_2 + V_{NL} - - - - - 2$$

Where , M_1, M_2 are inclines of the two sources droop line.
V_{NL} is un load voltage of the sources (voltage axis intercept of droop characteristics).

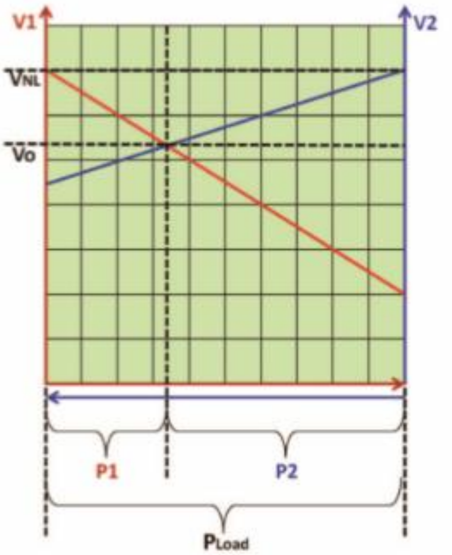

Figure 1. Droop characterstics of DC-DC converters

B. *Load Sharing*

Consider the equations mentioned above for 2 dc sources. P1 and p2 are power of the individual source where pload is total load power source,
,

$$P_1 + P_2 = P_{Load} - - - - - 3$$

Extreme voltage of two origins associated with a similar DC transport must be same with the presumption of zero interfacing line obstruction.

$$V_1 = V_2 - - - - - 4$$

From equation eqn. 1, eqn. 2 and eqn. 4,

$$-m_1 P_1 + V_{NL} = -m_2 P_2 + V_{NL} - - - - - 5$$

By combining the eqn 3 and 4

$$P_1 = P_{load} * \frac{m_2}{(m_1 + m_2)} - - - - - 6$$

$$P_2 = P_{Load} * \frac{m_2}{(m_1 + m_2)} - - - - - 7$$

From eqn.6 and eqn.7,

$$\frac{P_1}{P_2} = \frac{m_2}{m_1} - - - - - 8$$

From eqn.8, the constant power load sharing between sources is varies inversely to the slope of voltage droop characteristics
.

C . **Effect of internal resistance**:

Voltage droop occurs for centralized blocking of every dc source which imposes it inherent voltage droop characteristics. The voltage droop characteristics can be modified as

$$V_1 = -m_1 P_2 + V_{NL} - I_1 R_1 - - - - - 9$$

$$V_2 = -m_2 P_2 + V_{NL} - I_2 R_2 - - - - - 10$$

Where , I_1 and I_2 are dc source supplied load current.
R_1 and R_2 are dc source internal resistance.
The load sharing between the sources are changed as a result of to change in effectient slope of droop characterstics and centralized blockingof sources. The change in load sharing proportional to the new slopes. By changing the slopes of characterstics the internal resistance can easily compensated.

D. CONSTANT VOLTAGE CONTROL

By the total payload on the structure the study state (operating system) on the voltage droop discriminative are clear. Having higher structure payload will results in less up a certain point voltage of dc bus. In comparison avoid that trouble the droop discriminative should lift up, for that voltage support prevent of droop discriminative is varied. But it docent changes the load distribution as effective slopes which remain same

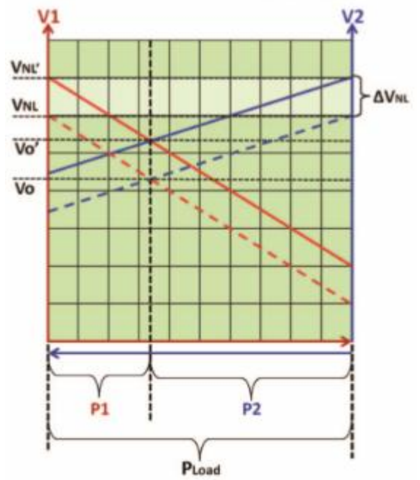

Figure 2. variation in voltage axis intercept to increase droop characterstics

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Concept of constant voltage control: voltage axis intercept (V_{NL})) is varied to lift up the droop characteristics to increase the DC Bus operating voltage (from Vo to Vo') without varying the previous load sharing. (ΔV_{NL}) is the shift in the voltage axis intercepts.constant voltage control systems. Constant voltage control system takes DC bus voltage is feedback for the voltage control system and Vnl is controlled by fuzzy controller.

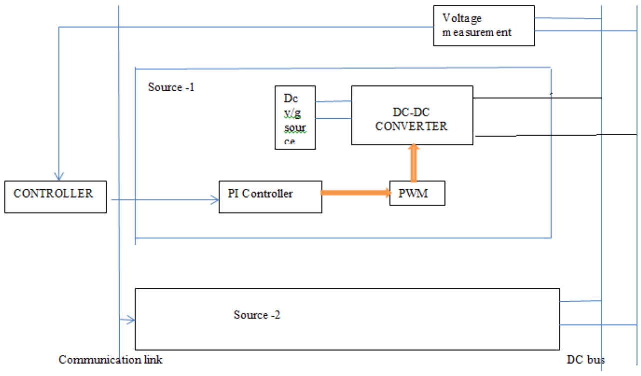


Figure 3. block diagram for proposed method

III. SIMULATION

Let Consider the dc bus with 48 volts. on one side a variable load is connected and on the other side 2 dc-dc converters are sustaining in alongside. To get the 1:2 payload distribution scale the slopes of droop characteristics are said to be in 1:2 ratio. When the droop characteristics are embedded in dc-dc converters there will be cut in duty cycle with encores in power. MATLAB Simulink is used for simulation of converters and control system. Control system response to load change is noted. Rules of fuzzy are changed to increase the feedback.

IV. RESULTS

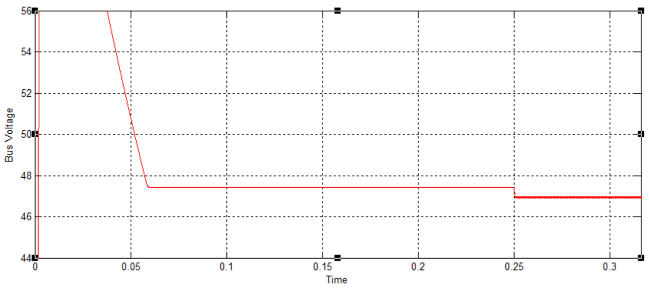
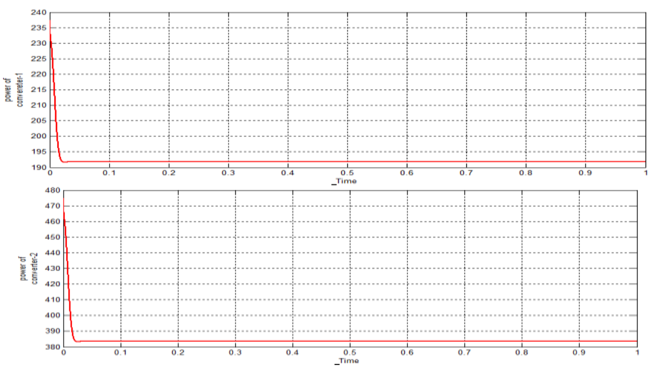


Figure 4. DC Bus voltage without constant voltage control system



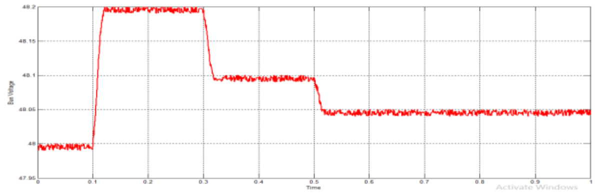


Figure 5. Load sharing between converters DC Bus voltage with PID Controller

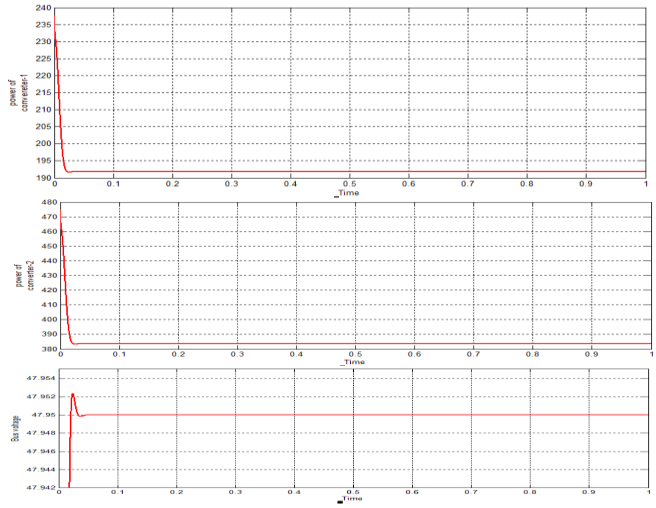


Figure 6. Load sharing between converters DC Bus voltage with Fuzzy Controller

V. CONCLUSION

A In this paper fuzzy controller strategy has been used in dc micro grid for payload distribution in between multiple dc sources. Droop characteristics the proposed method for load sharing. So by controlling droop values under any loading conditions dc bus voltages can be maintained constant. By tuning or by changing the rules of fuzzy controller. The volatile feedback of the control system could be enhanced.

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