A DSTATCOM for Diesel Generation System with Load Compensation Based on Fuzzy Logic

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Abstract: *The distributed static compensator concept is put out in this work to compensate for reactive powers, harmonics, and imbalances. This diesel electrical generator's primary function is to produce electricity and deliver it to the distribution point. Variability, interruptions, and voltage distributions—also referred to as power quality issues—are the primary issues that arise in these distribution systems. The various types of FACTS controllers are categorized according to how well they improve power quality. These devices are categorized as series and shunt converters, depending on how they are built and connected to the line. In order to improve performance over earlier conventional controllers, this work also focuses on the idea of fuzzy logic controllers. In essence, the fuzzy controller's benefits include minimal steady state error and a reduction in the outcomes are confirmed for both PI and fuzzy controllers, and these experimental diagrams are validated in MATLAB/Simulink.*

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I. Introduction

The aim of the electric producing system is to send power to customers with an acceptable voltage. When power quality is disturbed, something changes about the power (such as voltage, current or frequency) and causes electrical equipment to function abnormally. There are four major groups in which various power quality improvement techniques such as FACTS controllers, are placed. A DVR is a device in series that supplies a voltage with a specific amount and phase difference at a common location. Then, another device that supports in lowering harmonic currents is called DSTATCOM.

II. Function of DSTATCOM

The system includes two-level VSCs that turn the DC power in the battery storage into AC power that feeds into the distribution network, plus a shunt coupling transformer. Control over transfer of active and reactive power between the ac system and the D-STATCOM is provided by ratings on the device. Figure 1 demonstrates that the voltage sag is fixed by the current Ish which modifies the voltage drop across Z_{th}. To increase or decrease Ish, simply set another output voltage on the converter.
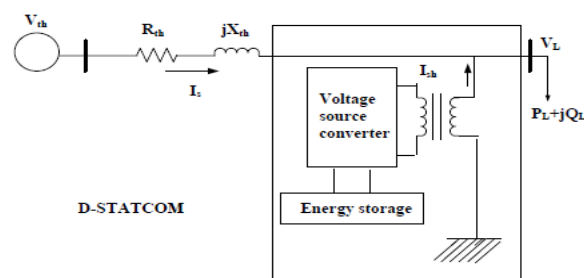

Fig 1: DSTATCOM block diagram

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The DSTATCOM system combines a coupling transformer and a three-phase voltage source converter. The device is able to generate three related sinusoidal voltages at the original frequency, allowing the voltage amplitude and phase to be modified. Generally, a DSTATCOM allows you to maintain levels across the load, correct power factors, resolve harmonic issues and maintain appropriate voltages.
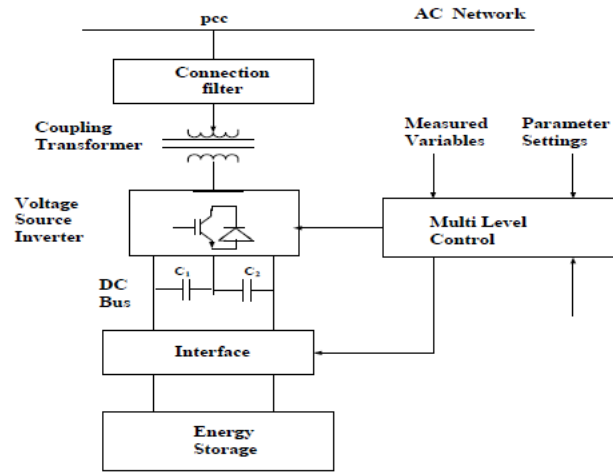

Fig 2: DSTATCOM configuration

The system for distributed static compensators uses a battery energy storage system, a VS converter control diagram, a coupling transformer and interface system and a filter circuit at the AC bus system.
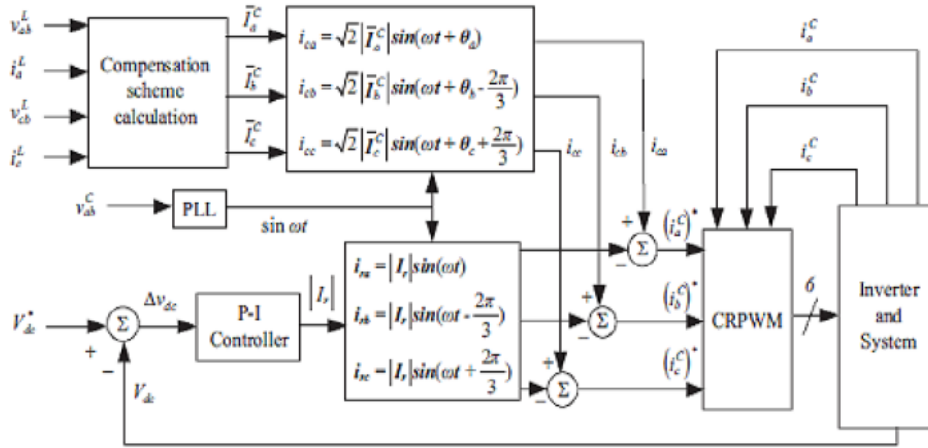

Fig 3: DSTATCOM closed loop diagram

The block diagram for the suggested DSTATCOM controller is displayed in Figure 3. The compensation current commands are computed by the DSTATCOM controller using the formulae.

III. DSTATCOM Diesel Generator Set

In remote locations, the electrical energy generated by a diesel engine-based device is useful for delivering power to certain essential pieces of equipment. Non-linear and unbalanced loads are common in these distribution energy storage systems. As a result, changes in load lead to changes in power system parameters. The diesel energy system's schematic diagram for serving various loads, including linear and non-linear loads, is displayed in Figure 4.
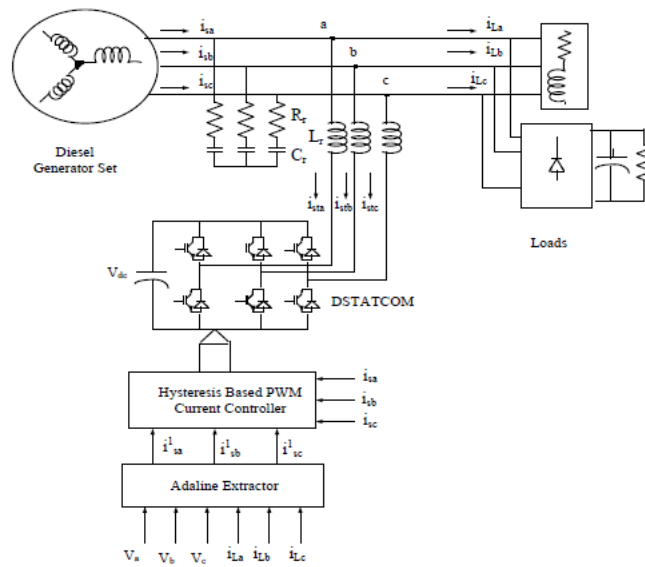
Fig 4: Diesel Energy System Based STATCOM Controller

IV. Simulated Waveforms and Diagrams

Figure 6 depicts the STATCOM controller and diesel generating system experimental setup. The primary power circuit control diagram is modeled using Simulink and the Power System Block set. The grid source is represented by a three-phase AC source that is connected at the load end. DSTATCOM combines a distributed energy source or a voltage source converter that feeds a capacitive reactor.
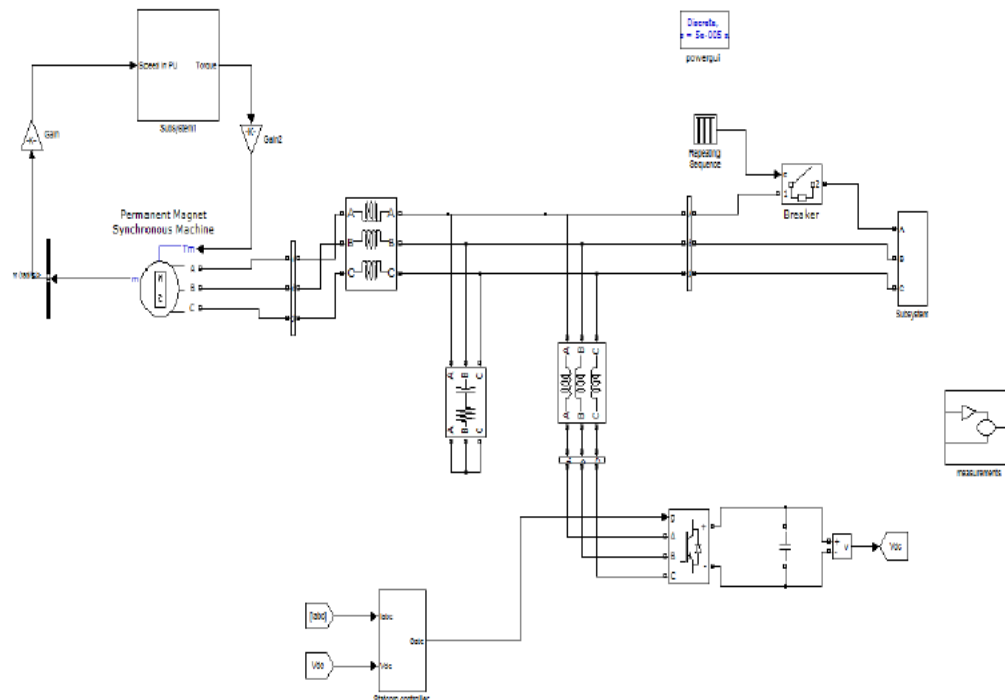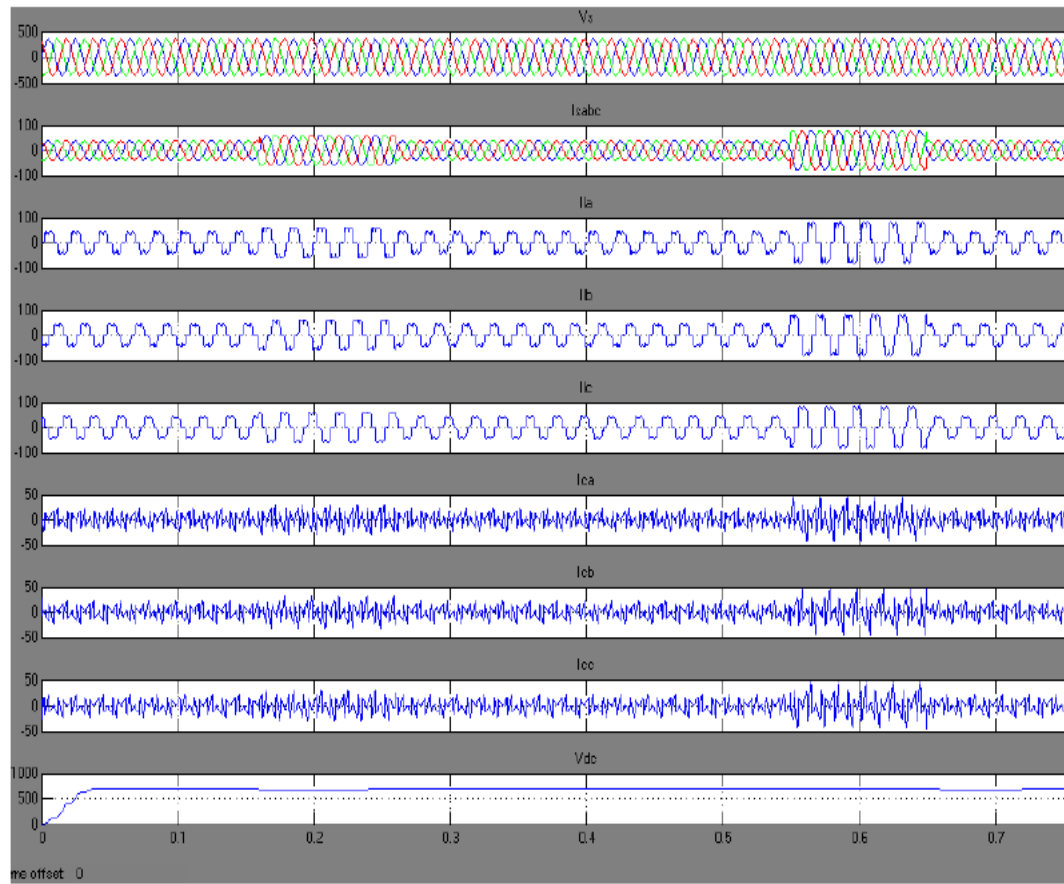

Fig 5: Proposed System in MATLAB/Simulink

Fig 6: Simulation Results for Non- Linear R-Load

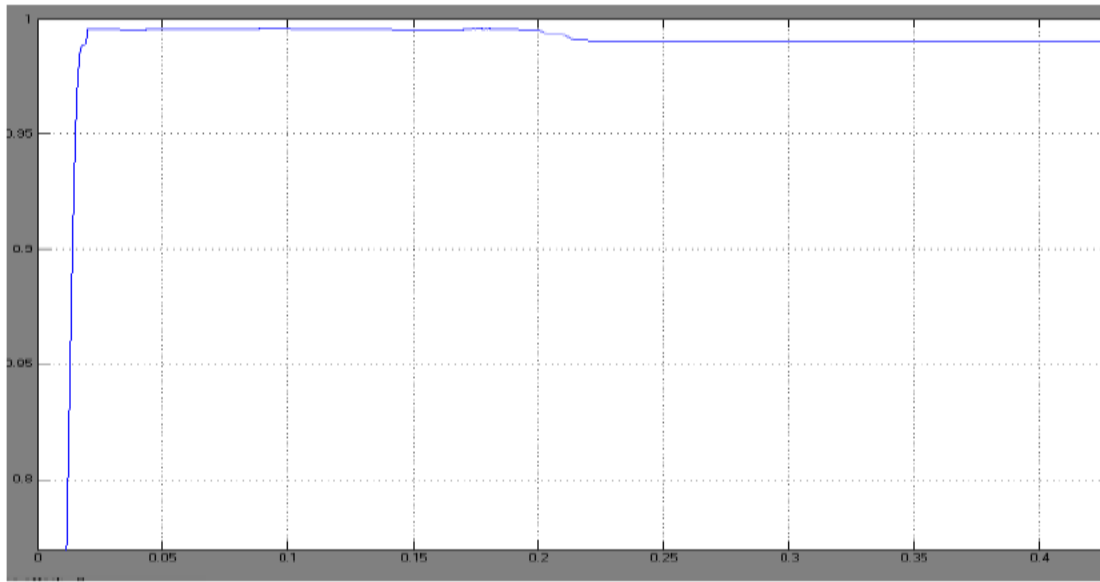Fig 7: PCC Voltage without DSTATCOM during LG Fault

Fig 8: Voltage with STATCOM during LG Fault

V. Conclusion

This study suggested a static compensator based on fuzzy logic to address power quality issues in distribution networks. One of the most adaptable types of devices is the distribution static compensator, which may be operated in either voltage or current controlled modes. Voltage control modes are utilized for voltage stabilizers, while current control modes are used to compensate for voltage changes and imbalances. It has the capacity to regulate input current imbalances and fluctuations. It has been noted that the factor of the overall harmonic distributor is decreased with the aid of these compensators. The fuzzy logic controller is used to extend this paper. This fuzzy controller's primary function is to improve control action and decrease settling time.

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